

Encyclopedia of Public Health

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Encyclopedia of Public Health

Edited by Lester Breslow

Volume 1
A-C

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Macmillan Reference USA
1633 Broadway
New York, NY 10019

Macmillan Reference USA
Gale Group
27500 Drake Road
Farmington Hills, MI 48331-3535

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Library of Congress Catalog in Publication Data

Encyclopedia of public health / edited by Lester Breslow.

p. cm.

Includes bibliographical references and index.

ISBN 0-02-865354-8 (set : hardcover : alk. paper) — ISBN 0-02-865350-5
(v. 1 : alk. paper) — ISBN 0-02-865351-3 (v. 2 : alk. paper) — ISBN 0-02-
865352-1 (v. 3 : alk. paper) — ISBN 0-02-865353-X (v. 4 : alk. paper)

I. Public health—Encyclopedias. I. Breslow, Lester.

RA423 .E53 2001

362.l'03—dc21

2002031501

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

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Preface

The *Encyclopedia of Public Health* was designed to offer the lay reader information about important aspects of the sciences, arts, practical skills, organization, essential functions, and historical traditions of the field. It is intended specifically for general readers with a high school or college level education, although many professional workers, trainees, and students of public health will find much here of use and interest to them.

Public health is one of the essential institutions of society. It exists to promote, protect, preserve, and restore the good health of all the people, and it achieves these ends largely through collective action. The programs, services, organizations, and institutions devoted to public health are concerned with the health needs of entire populations. Professionals engaged in the field regard it as an organized effort directed at improving the health of populations by assuring the conditions in which people can be healthy. It thus differs from the healing arts such as medicine, dentistry, nursing, and pharmacy that aim their services at the health of individuals. Public health emphasizes health promotion, the prevention and early detection of disease, disability, and premature death. Many scientific disciplines, technologies, and practical skills are involved in public health, which can be viewed as a social institution, a collective discipline (one that focuses a large group of discrete disciplines on public health), and a practice.

The component parts of public health include a wide array of intellectual disciplines, professions, trades, and practical skills: vital statistics, demogra-

phy, epidemiology, and biostatistics; basic medical sciences such as microbiology, physiology, pharmacology, and toxicology; physical sciences such as physics and chemistry; engineering; social and behavioral sciences; and clinical sciences such as those that deal with communicable diseases, cancer, and heart disease. Mature professions such as medicine, nursing, dentistry, and law, as well as newly emerged professions such as psychology, nutrition, and dietetics are all engaged in public health. All are described and discussed in this encyclopedia.

There are more than 900 entries in the *Encyclopedia of Public Health*, all arranged in alphabetical order for easy reference. The entries range in length from several thousand words on each of the most important sectors and disciplines of public health, to a hundred words or so that define basic elements of the field. All entries were written by experts, authorities in their respective fields. As much as possible, however, the authors have used language that is free of jargon and which should be easily accessible to the public at large, whether in the high school, community college, or public library environments. There are bibliographies to guide readers to sources of further information and exhaustive cross-references to help them to related topics.

The back matter features “basic documents,” a collection of some of the most essential statements of lasting historical importance about public health, as well as some of the epochal writings about public health, which are reproduced in whole or in

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part. In addition, there is an annotated bibliography of other basic texts.

An outline of contents appears at the back of Volume 4. Its purpose is to regroup articles in broad topical categories, thereby offering teachers and readers alike an informed map of the field. A comprehensive index provides yet another avenue for lay readers to access the mass of information contained in these four volumes.

The editors thank the staff at Macmillan Reference for their support throughout this project. In

particular, we thank Elly Dickason for her initial advice and encouragement; Hélène Potter for keeping us going when the going got tough; and Barbara van Orden, Deirdre Graves, and Michael McGandy for all their hard work.

Many contributors wish to acknowledge the help they received from family members and colleagues; we express our gratitude to them all.

LESTER BRESLOW

Introduction

Public health consists of the activities of a society that protect and advance the health of its people. Public health resources consist of a set of scientific disciplines, practical skills, and beliefs (values) that are directed to the maintenance and improvement of people's health through collective or social action; as well as the political will that is necessary to mobilize resources and people in support of the agencies that carry out the activities. Typically, though not in all nations, public health operates at local, state, national, and international levels—with coordination, collaboration, and interaction among these four levels. It takes many forms, including governmental, nongovernmental (voluntary), and professional.

Public health work is conducted by teams that include physicians, nurses, dentists, epidemiologists, social workers, behavioral scientists, health inspectors, sanitary engineers, statisticians, administrators, supporting clerical and secretarial staff, and others. Efficient and effective public health practice demands a high degree of harmonious collaboration among teams that vary greatly in size, complexity, levels of skill and expertise, financial support, and political commitment to the perceived importance of public health.

National leaders from Benjamin Disraeli and Otto von Bismarck to Franklin D. Roosevelt and John F. Kennedy have eloquently expressed the belief that public health is an important element, indeed is at the foundation, of national security. Protecting the health of a nation's people is as important as protecting against invasion by a foreign adversary. Yet in no nation do public health

services command more than a tiny fraction of the total national expenditure on medical and health services—typically less than 5 percent of the health budget from all public and private sources is devoted to public health. In the world's poorest nations, where the public health problems are most oppressive, the proportion is seldom as much as 1 or 2 percent of all health expenditures. Many of the poorest nations spend far more of their slender resources on armaments—sometimes to be used against their own people—than on public health services.

In focusing on the health of populations, public health differs from the healing arts such as medical, nursing, and dental practice, which respond to the health needs of individuals. From earliest times society has thrown out two arms for health; one to protect its people (e.g., migration in search of better food supply), and the other to care for the sick. Beginning with the Industrial Revolution, when people flocked from the countryside into the cities for factory work, public health concentrated on combating the communicable diseases such as tuberculosis and enteric infections that flourished in the crowded, growing urban areas. Remarkable success has attended those efforts, though much remains to be done, especially in developing countries. With the decline of communicable diseases (despite occurrence of some new ones, such as HIV/AIDS) and the generation of a new lifestyle during the twentieth century, noncommunicable diseases such as heart disease and cancer have expanded—in the developing world as well as in industrialized countries. Other

problems, such as drug addiction and domestic violence, are currently being socially redefined as public health issues.

In contrast to the major healing professions, public health personnel concentrate on the factors prevailing in a society that substantially affect the health of its people as a whole. Prominent among these are nutrition, environmental and occupational hazards, and lifestyle factors. Gross undernutrition is still a problem among segments of the population in developed nations and is an extensive problem in developing nations. Ironically, overnutrition, especially the consumption of animal fats, is increasingly and negatively affecting health throughout the globe. Water and air pollution, unsafe food, and workplace hazards pose dangers for most people in the world. Behaviors regarding tobacco, alcohol, physical exercise, and other daily habits—largely influenced by people’s living milieu—are now recognized as major factors in the development of noncommunicable diseases.

Public health incorporates scientific advances into its armamentarium, demonstrating the role of microbic agents in communicable diseases; and the role of physical inactivity, eating excessive fats, and exposure to toxic chemicals as causes of noncommunicable diseases. Epidemiology—sometimes called public health’s basic science—delineates health problems, contributes substantially to ascertaining their causes, and provides guidance toward solutions. Epidemiology and biostatistics serve as the “diagnostic” element of public health. Intervention or “therapeutic” segments consist of environmental, sociobehavioral, and personal health services, which focus on the physical and social milieu in which people live, as well as taking account of human biological nature.

After defining the mission of public health as “fulfilling society’s interest in assuring conditions in which people can be healthy,” the Institute of Medicine of the U.S. National Academy of Sciences outlined its three core functions: (1) assessment—the delineation of health problems, their nature, and the means of dealing with them; (2) policy development—the formulation and advocacy of what should be done about health problems; and (3) assurance—the implementation of policy, either by activities of others or by direct public health activities.

More specific roles of public health have evolved over time. For example, in the mid-twentieth century it was commonly accepted in public health circles that the “six basic functions” of public health were: vital statistics, communicable disease control, sanitation, laboratory services, maternal and child health services, and health education of the public.

In 1997 the World Health Organization (WHO) assembled a consensus document, based on discussions involving 145 prominent leaders of public health from sixty-seven nations, that specified nine categories of essential public functions:

1. *Monitoring the health situation.* This includes monitoring morbidity and mortality, the determinants of health (e.g., smoking), the effectiveness of public health programs and functions, and assessing population needs and risks.
2. *Protecting the environment.* Environmental protection includes ensuring access to safe water; the control of food safety and quality; provision of adequate drainage, sewerage, and solid waste disposal services; and the control of hazardous substances and wastes. Adequate vector control measures; protecting water and soil resources; and controlling atmospheric pollution and ionizing radiation are also essential, as is ensuring adequate preventive environmental services, and adequate inspection, monitoring, and control of environmental hazards.
3. *Health promotion.* The promotion of community involvement in health; the provision of information and education for health and life-skill enhancement in school, home, work, and community settings; and maintaining linkages with politicians, other sectors, and the community in support of health promotion and public health advocacy are all part of health promotion.
4. *Prevention, surveillance, and control of communicable diseases.* This function includes immunization, disease outbreak control, disease surveillance, and injury prevention.
5. *Public health legislation and regulation.* The review, formulation, and enactment of

health legislation, regulations, and administrative procedures are also essential functions of public health. Components include ensuring adequate legislation to protect environmental health; health inspection and licensing; and enforcement of health legislation, regulations, and administrative procedures.

6. *Occupational health.* Setting occupational health and safety regulations, ensuring safety in workplaces, and providing medical and health services for workers are part of this function.
7. *Specific public health services.* These include school health services, emergency disaster services, and public health laboratory services.
8. *Public health management.* Management of public health involves ensuring health policy, planning, and management; the use of scientific evidence in formulating and implementing health policies; public health and health-systems research; and international collaboration and cooperation in health.
9. *Care of vulnerable and high-risk populations.* This involves maternal health care and family planning; infant and child care; and programs to protect the health of refugees, displaced persons, and aboriginal peoples.

Clearly some of these essential public health functions have higher priority than others. In a

well-run state, nation, or community, all should be available. When they are not, or when they have previously existed and have fallen into disrepair—as has happened in the former Soviet Union—epidemic diseases such as diphtheria and poliomyelitis soon return, endangering not only the local people but people everywhere. In addition, as noted previously, noncommunicable diseases now require attention in the developing nations, where it is estimated that their mortality currently exceeds that of the communicable diseases, and in the developed nations, where neoplasms and cardiovascular diseases cause about two-thirds of all deaths. Moreover the fact that many of the essential functions require the participation of other sectors of society helps to reinforce the notion that public health not only calls for teamwork and collaboration, it also is everybody's business.

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AARP

AARP, formerly known as the American Association of Retired Persons, is the nation's leading organization for people age fifty and older. Founded in 1958 by retired educator Dr. Ethel Percy Andrus, it is a nonprofit, nonpartisan association dedicated to shaping and enriching the experience of aging for its members and all Americans. It serves its 32 million members' needs and interests through information and education, research, advocacy, and community services, all of which are provided by a network of local chapters and experienced volunteers throughout the country. Through its publications, web site, and forums, AARP informs members and the public about consumer issues, economic security, work, health, and independent living issues. AARP also engages in legislative, judicial, and consumer advocacy in these areas. It offers members a wide range of special benefits and services, including *Modern Maturity* magazine and the monthly *AARP Bulletin*.

ROBIN E. MOCKENHAUPT

(SEE ALSO: *Aging of Population; Gerontology; Life Expectancy and Life Tables; National Institute on Aging*)

ABORTION

Abortion is a generic term for pregnancies that do not end in a livebirth or a stillbirth. It is the

premature expulsion from the uterus of the products of conception, which include the placenta, bag of waters, and fetus, if present.

TYPES OF ABORTION

There are two types of abortions. Spontaneous abortion refers to a natural biological process by which some pregnancies end. Induced abortion refers to pregnancies terminated through human intervention.

Spontaneous Abortions. A large percentage of the products of the union of an egg and a sperm never become infants. If there is something seriously wrong with the fetus, the uterus often expels it. This may occur very early in the pregnancy, with the woman only experiencing a larger than usual blood flow around the time of her expected menstrual period, or it may occur later in the pregnancy. This latter event is commonly called a miscarriage, but technically it is a spontaneous abortion if it occurs before twenty weeks of pregnancy. Spontaneous abortions are often the body's way of preventing the birth of a defective child, although sometimes they are due to maternal health problems.

Induced Abortions. In contrast, induced abortions result from the planned interruption of a pregnancy. Throughout recorded history, humans have taken a variety of steps to control family size: before conception by delaying marriage or through abstinence or contraception; or after the birth by

infanticide. Induced abortion falls temporally between these two extremes by preventing a conception from becoming a live birth. In the United States in the last few decades of the twentieth century, most abortions were performed surgically using a procedure called suction curettage. The year 2000 approval in the United States of a drug, mifepristone (RU486), which in combination with another drug causes an abortion in almost all cases, may increase the percentage of abortions induced by the administration of pharmaceutical agents.

Therapeutic Abortions. This term refers to abortions thought necessary because of fetal anomalies, rape, or to protect the health of the mother when a birth might be life threatening or physically or psychologically damaging.

Elective or Voluntary Abortions. Interruption of a pregnancy before viability at the woman's request for reasons other than fetal anomalies or maternal risk is often referred to as elective or voluntary abortion. Such abortions often result from social problems, such as teenage pregnancy or non-marital births; economic difficulties, such as insufficient income to support a child; or inappropriate timing.

Legal and Illegal Abortions. Induced abortions may be legal or illegal. According to the United States Centers for Disease Control and Prevention (CDC), the federal agency that collects data on abortions, a legal abortion is "a procedure, performed by a licensed physician or someone acting under the supervision of a licensed physician, that was intended to terminate a suspected or known intrauterine pregnancy and to produce a nonviable fetus at any gestational age." An illegal abortion may be self-induced, induced by someone who is not a physician or not acting under her or his supervision, or induced by a physician under conditions that violate state laws governing abortions.

A HISTORICAL PERSPECTIVE

Almost all human societies place a high value on human life. Thus, the further along the continuum from heterosexual intercourse to a live child, the less likely is the method of fertility control to be allowed. In the modern period, most societies

allow contraception, but there is more variability around abortion. The leading institutional opposition comes from the Roman Catholic Church, but other institutions also take active positions against abortion. Survey research suggests that many Americans are ambivalent about whether abortion should be legal and, if so, under what circumstances.

Induced abortion was almost universally illegal at the beginning of the twentieth century. This changed first in the early years of the Soviet Union, which made abortion legal, widely available, and encouraged as the primary method of fertility control. In the period after World War II, abortion was legalized first in the Scandinavian countries and later in most of Western and Eastern Europe. With the broaching of the Iron Curtain in the early 1990s, abortion was legalized in more of Eastern Europe, while the more restrictive policy in West Germany was extended to the former East Germany. At the beginning of the twenty-first century, abortion was legal in most of England and Asia, but illegal in most of Africa and South America.

In the United States, abortion was universally illegal from at least the late nineteenth century until the mid-1960s, when an abortion reform movement led to legalization of abortion in some states. (The regulation of abortion, like most medical issues, is a state function.) Then, in its 1973 *Roe v. Wade* decision, the United States Supreme Court found a constitutional right to abortion before viability, at that time about twenty-eight weeks. (By the beginning of the twenty-first century, advances in the techniques of caring for very premature infants had reduced the age of viability to around twenty-three weeks.) The Court stated, however, that after viability is reached, the state's important and legitimate interest in potential life becomes compelling and it may regulate and even prohibit abortions, with the exception of those necessary to preserve the life or health of the mother.

ACCESS TO ABORTIONS

Access to legal abortions is limited by laws and regulations, financial considerations, and the availability of providers.

Laws and Regulations. Since the 1973 decision, many states have enacted measures to limit abortion, which have led to considerable litigation.

Figure 1

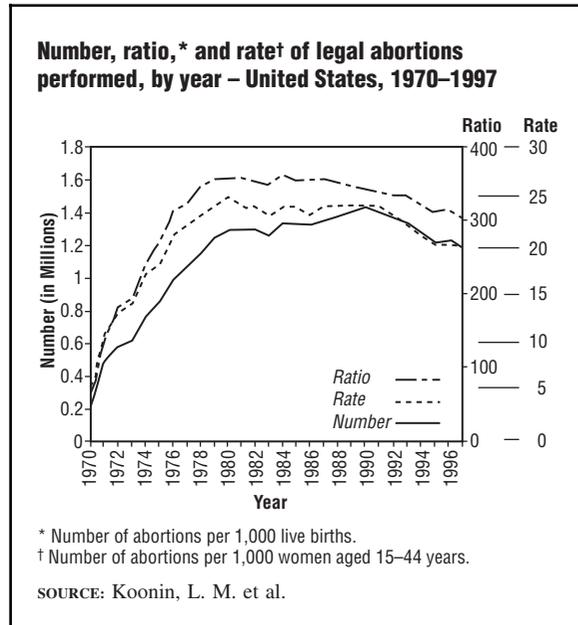
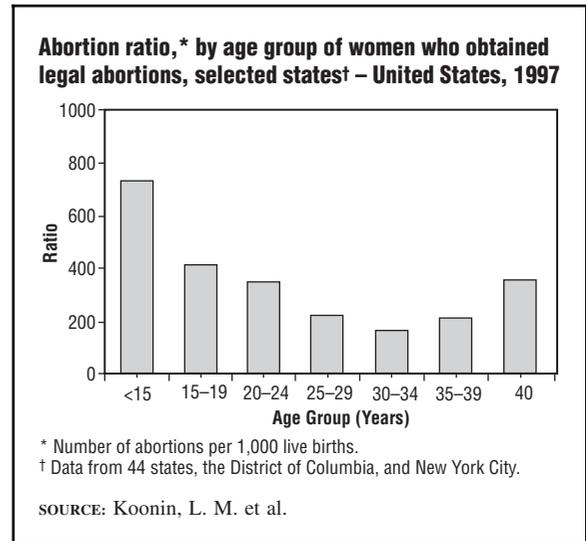


Figure 2



Some laws have been disallowed as inconsistent with *Roe*, while others have been allowed. For example, in the late 1990s, about thirty states restricted the access of minors to abortions by requiring the notification or the consent of one or both parents before an abortion could be performed, and more are considering such legislation. The Supreme Court requires that states with parental notification or consent laws must provide for a judicial bypass; that is, the minor must be allowed to obtain permission from a court for the abortion if she is unwilling or unable to seek permission from her parent(s). States may also require a waiting period between the request for an abortion and its actual performance. Or they may require the physician who is to conduct the abortion to inform the mother about the fetus’s stage of development and about alternative ways of managing an unwanted pregnancy, such as putting the baby up for adoption.

Financial Considerations. Abortion is *not* among the medical procedures covered by Medicaid, the federal-state program that provides health care to many poor women. Federal law, the so-called Hyde Amendment, passed in 1977 and amended in 1993, prohibits the use of federal Medicaid funds for abortion except in cases of rape, incest, or when the life of the pregnant

woman is in danger. Some states use their own Medicaid funds to pay for abortions that physicians consider “medically necessary,” and a few fund them in cases of fetal anomaly or grave physical health danger. Some private organizations, such as Planned Parenthood agencies, assist low-income women in states with restrictive funding policies by performing abortions for reduced fees. In 1999, less than two-fifths of women with employer-based health insurance were covered for abortion services.

Provider Availability. On the basis of a survey of abortion providers, the Alan Guttmacher Institute estimated that in 1996 there were slightly over two thousand abortion providers in the United States, a drop of 14 percent from 1992, perhaps as a result of anti-abortion publicity and disturbances. Eighty-nine of the country’s 320 metropolitan areas had no known abortion providers and an additional twelve had providers who together reported fewer than fifty abortions. Abortion providers were even less available in non-metropolitan areas.

According to the Guttmacher survey, 452 abortion clinics (defined as nonhospital facilities in which half or more of patient visits were for abortion services) performed 70 percent of the abortions in 1996. Four hundred and seventeen other clinics performed 21 percent of the abortions; 703

Figure 3

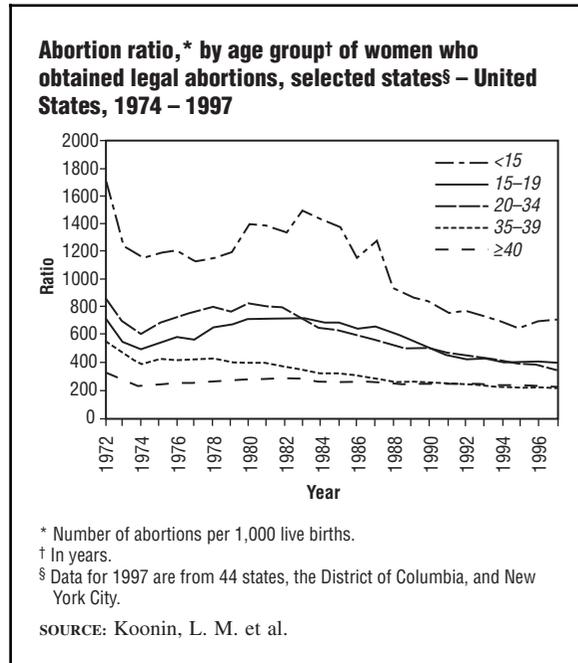
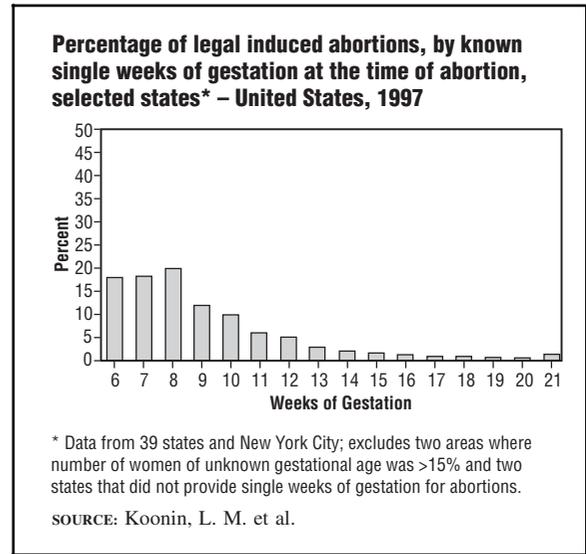


Figure 4



hospitals performed 7 percent (only 9% of those on an in-patient basis); and 470 physicians' offices performed 3 percent.

NUMBER AND RATES OF ABORTIONS

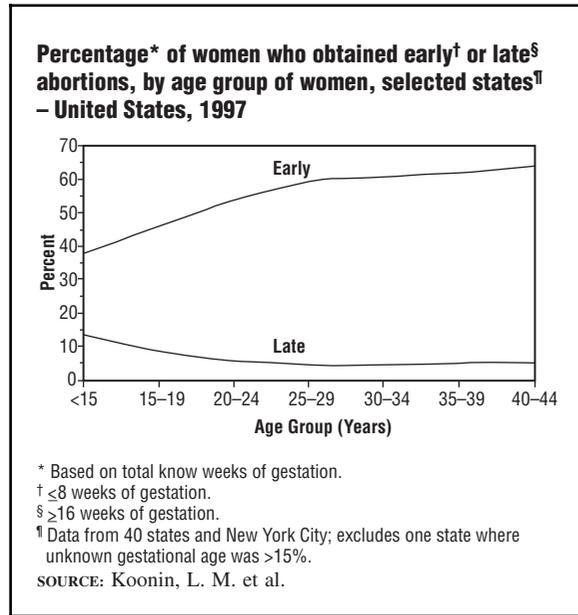
There is no definitive information about the number and rate of spontaneous abortions, although worldwide it is estimated that approximately 15 percent of women who have been pregnant for five or more weeks spontaneously abort or experience stillbirths.

The CDC has been conducting surveillance of legal induced abortions in the United States since 1969. It reported 1,186,039 legal abortions in 1997, but noted that this was probably an underestimate. The number of abortions per 1,000 women between 15 and 44 years of age (the abortion rate) was 20 and the number of abortions per 1,000 live births (the abortion ratio) was 306. Most legal abortions were performed in California, New York City, Texas, and Florida. The number of legal abortions increased from 1970 until 1990 and, with the exception of 1996, has fallen ever since.

Both the abortion rate and the abortion ratio began to decline earlier (see Figure 1).

Information on the characteristics of the women who obtain abortions and the timing of abortions is available from most, but not all, areas. Based on the information available in 1997, women between the ages of 20 and 24 obtained almost a third (31.5%) of all abortions. Abortion rates were highest for women between the ages of 20 and 24 and lowest for the youngest and oldest women. Abortion ratios, however, were highest for women under 20 and for women 40 and over, at least partially because there are fewer births in these age groups (see Figures 2-3). Slightly over half (56.3%) of women who obtained abortions were white, but the abortion rate and the abortion ratio for African Americans was slightly more than two and a half times the rate for white women. For Hispanic women in the District of Columbia, New York City, and the twenty-six states reporting ethnicity, the abortion ratio was similar to the one for non-Hispanics in the same areas, but the rate was higher. Seventy-nine percent of women who obtained abortions were unmarried, 41 percent had no previous live births, and half were obtaining abortions for the first time. Eighty-six percent of women obtaining abortions had the procedure during the first twelve weeks of pregnancy (see Figures 4-5).

Figure 5



ABORTIONS AND PUBLIC HEALTH

There is no evidence that abortions are detrimental to the health of women. The CDC reported that in 1992, the last year for which data on abortion-related deaths were available, only twenty-seven women died of abortion-related causes, ten due to induced abortions, seventeen to spontaneous abortions, and none to illegal abortions. This is a case-fatality rate for legal induced abortions of 0.7 per 100,000 legal induced abortions, a lower fatality rate than for pregnancies. (In 1992, the maternal mortality rate was 7.8 per 100,000 live births.) Injuries and illness, both physical and emotional, are also rare. Deaths and other adverse consequences are more likely to occur when women are unable to obtain abortions legally and attempt to induce abortions themselves or turn to providers outside the conventional medical care system. There were thirty-nine deaths due to illegal abortions in 1972 before the *Roe v. Wade* decision and nineteen in 1973. Since then, the number of such deaths has declined markedly: There were only two between 1988 and 1992. Studies in Czechoslovakia have shown that women who are denied abortions suffer psychological difficulties.

Most induced abortions today are the result of unwanted pregnancies. The best way to prevent this safe—but uncomfortable and usually

undesirable—procedure is to make family planning counseling and methods easily available to all women.

LORRAINE V. KLERMAN
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(SEE ALSO: *Ethics of Public Health; Pregnancy; Reproduction*)

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ABORTION LAWS

The United Nations International Conference on Population and Development, held in Cairo in

1994, recognized unsafe abortion as a major public health concern. The World Health Organization estimates that about 75,000 women die each year from unskilled abortion. Damage to women's health and the burden of care that falls on often-scarce hospital resources also add to the costly impact of poorly performed abortion on public health systems.

Abortions are usually performed without adequate skill because of laws that make safe, medically performed abortion services unlawful. Within the last two centuries, and particularly during the twentieth century, abortion has been criminalized. It was only in the closing decades of the last century that laws have recognized women's needs and rights to have access to safe abortion services.

Historically, many customary laws condemned the interruption of pregnancy, whether by herbal or invasive means, because of the harm it presented to women. Pregnancy was evidenced only at about the end of the first trimester of pregnancy (at about 13 weeks), the stage called quickening. Church courts imposed more severe sanctions than secular courts, and were more concerned with unborn human life and abortions that occurred earlier in pregnancy. The first abortion legislation enacted in the English-speaking world was an English law of 1803 that punished whoever acted "to cause and procure the miscarriage of any woman then being quick with child." Later enactments more strictly imposed liability on pregnant women themselves, and, because proof that women had been "quick with child" was often difficult to establish, the offense was redefined as occurring whether women had "quickened" or not.

Advances in medicine in time provided better understanding of human conception and gestation, directing more attention to fetal and embryonic life. For instance, the Roman Catholic Church, whose moral teachings had been reflected in laws of many European countries, had condemned abortion after the stage of development at which it believed the soul had entered the body before birth. In 1869, however, it accepted that protected life began at conception. This made abortion a crime in many legal systems at any stage of gestation. Modern developments in abortion laws can be traced from when abortion was controlled only as a crime to be punished to its later legal accommodation to protect the health and well-being of

pregnant women and their dependent born children and to its modern recognition as a woman's right to lawful choice.

THE CRIME OF ABORTION

The laws of many countries, particularly those that experienced colonization by European countries and are influenced by religious doctrines, continue to view abortion only as a criminal offense. Some countries whose criminal laws punish the willful taking of human life reinforce the prohibition of abortion by adding, sometimes in their national constitutions, that human life begins at conception. Punishments vary from a few years' custody to life imprisonment. Under Nazi occupation, France imposed a punishment of execution. Almost all laws recognize, however, that abortion procedures aimed in good faith to save a woman's life do not offend the criminal law, or are at least excusable, nonpunishable violations.

ABORTIONS FOR HEALTH AND WELFARE PURPOSES

In the mid-1960s, recognition grew that women often sought abortion for conscientious reasons, and that its medical restriction could be oppressive and unjust, causing women acting for justifiable reasons to go to unskilled illegal practitioners or to make crude interventions in their own bodies. Britain's Abortion Act of 1967, as amended in 1990, decriminalizes abortion before the twenty-fourth week of pregnancy if "the continuance of the pregnancy would involve risk, greater than if the pregnancy were terminated, of injury to the physical or mental health of the pregnant woman or any existing children of her family." Abortion also became lawful after twenty-four weeks when necessary to prevent risk to the life or grave permanent injury to the physical or mental health of the pregnant woman, and when "there is a substantial risk that if the child were born it would suffer from such physical or mental abnormalities as to be seriously handicapped." Health care providers, however, have a right of conscientious objection, and cannot be required to participate in abortion procedures.

Since 1967, about seventy-five countries in all regions of the world, including Guyana, India,

South Africa, and Romania, have liberalized their abortion laws. Reformed laws allow abortion at various times from conception to twelve or more weeks, and to save life, health, and other interests. Perhaps the best-known reforming court judgment was made by the United States Supreme Court in 1973, in the case of *Roe v. Wade*. The Court recognized that a woman has a constitutionally protected right to terminate pregnancy until her fetus is viable, which is at the end of the second trimester of pregnancy (about twenty-four weeks' gestation), and that after viability states may regulate abortion to save the life or health of the mother. The judgment triggered a strong backlash, and continuing attempts have been made to have the Court reverse the judgment—and to change the Court's composition for this purpose. The Court was criticized for making new law, although sympathetic analysts found the Court had simply restored the law as it stood in 1787, when the United States wrote its Constitution and adopted much of the pre-1803 English criminal law.

ABORTION AS A RIGHT OF WOMEN

An increasing number of countries now recognize a woman's right to exercise abortion choice for a time, usually until about twelve weeks after the beginning of pregnancy, and allow the procedure afterwards when faced with health, social, or other risk. In 1988, the Supreme Court of Canada, in the case of *R. v. Morgentaler*, held the country's restrictive abortion law unconstitutional. The Chief Justice found that "forcing a woman, by threat of criminal sanction, to carry a fetus to term unless she meets certain criteria unrelated to her own priorities and aspirations is a profound interference with a woman's body and thus a violation of security of the person." The law was accordingly ruled void, and abortion is now regulated like any other medical procedure, allowing a woman to make her decision according to her own ethical judgment.

Human rights laws are increasingly giving priority to women's health, dignity, and capacity as the principal decision makers over their own reproduction. Countries whose laws criminalize abortion and compromise women's health and welfare are facing louder calls for reform. To counter

this, conservative governments and religious authorities support restrictive laws and urge more prohibitions against abortion.

REBECCA J. COOK

(SEE ALSO: *Abortion; Maternal and Child Health; Public Health and the Law*)

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ABSENTEEISM

Illness imposes a number of costs on the individuals who suffer the illnesses, their families and loved ones, their coworkers, and, more broadly, society as a whole. When estimating the social costs of illness, both in general and with regard to specific diseases or unhealthy behaviors, health economists and others focus on two categories of costs: medical expenditures required to treat the conditions, referred to as direct costs; and productivity losses associated with the conditions, called indirect costs. Indirect costs, often the larger of the two burdens, consist of productivity lost due to the premature deaths of disease victims and to morbidity (sickness) and disability that cause victims to miss work days.

Absenteeism is the term used to describe the fact of an individual's missing his or her regular daily activity. For children and adolescents, absenteeism typically refers to school days missed. For adults, absenteeism generally refers to individuals' absence from their jobs. In analyses of the indirect costs of all illness, all days of absence from work

attributable to sickness are included in calculating the absenteeism component of indirect cost. In analyses of the indirect costs of specific illnesses or unhealthful behaviors like cigarette smoking, the productivity loss of interest is that associated with excess absenteeism due to the disease or condition at issue. The essential word here is "excess." Nearly all workers experience some days of absenteeism during the course of the normal work year. However, workers who suffer from specific acute or chronic illnesses are likely to miss more work days than usual. It is these extra days of missed work that create the lost productivity calculated as an indirect cost of specific illnesses.

The costs associated with absenteeism are estimated by multiplying the number of days of absenteeism by the best measure of workers' contribution to productivity: their daily wage rate. In the case of conditions that are distributed among the population reasonably independent of people's age and occupational status, an average wage rate for the population as a whole may be applied. In the case of many illnesses, however, the distribution of the conditions is not independent of age and occupation. In these instances, analysts attempt to associate age- and occupation-specific wage rates with the days of work missed due to morbidity or disability. For example, were one interested in assessing the costs associated with back pain, one of the most common causes of work loss in America, one would emphasize wage rates paid to industrial and other blue-collar workers whose jobs require them to lift and move heavy objects. An analysis of the social costs of breast cancer, a disease that afflicts primarily women, would utilize wages earned by women in calculating the burden of absenteeism attributable to the disease.

Not all disease-related work loss occurs among paid workers. Conditions that afflict people caring for their children or cleaning their homes also impose costs on society. A complete estimate of the burden of disease must account for absenteeism in this sector of the society as well. Formal analyses often include unpaid work loss by multiplying days lost by what economists call a "shadow price," an estimate of the value of the unpaid labor performed. For example, unpaid child care may be valued at the wages of paid day-care providers.

Similarly, housework time lost may be valued by the wage rate of paid domestic house cleaners.

Although there is no argument about whether absenteeism imposes a significant cost on members of society, economists and public health analysts frequently differ on whether they consider such absenteeism a social cost. To public health analysts, illness- and injury-related absenteeism represents a burden on society as a whole, a social cost of enormous proportions. In contrast, to economists such productivity losses represent primarily private costs borne directly by the sick and disabled workers and their families, not the broader society. How one classifies such costs is not merely an academic exercise. Certain public health policies, such as the taxation of cigarettes and alcoholic beverages, are based in part on determination of the social cost of the consumption of these products. If the cost to society is deemed large, a high tax may be warranted to signal smokers and drinkers that the implications of their behaviors burden the rest of society, not merely themselves.

However this argument is resolved, no one challenges the notion that illness- and behavior-related absenteeism constitutes an important element of the burden of disease.

KENNETH E. WARNER

(SEE ALSO: *Alcohol Use and Abuse; Child Care, Daycare*)

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ABSTINENCE

Abstinence is the act of refraining from engaging in a positively reinforced, or pleasurable, behavior. It is typically a voluntary act, but it can also be imposed, and it typically occurs when an individual experiences a sense of decreased personal control over a behavior (e.g., consumption of alcohol). Not engaging in the problematic behavior connotes increased self-control—and the hope of improved social interactions and personal health as a consequence. For example, decreased heart disease and lung cancer prevalence has occurred in the United States as a result of more smokers quitting and then maintaining abstinence from tobacco. Similarly, abstinence from alcohol reduces the risk of developing cirrhosis of the liver.

SCOTT J. LEISCHOW

(SEE ALSO: *Addiction and Habituation; Alcohol Use and Abuse; Behavior, Health-Related; Contraception; Counseling; Drug Abuse Resistance Education [DARE]; Predisposing Factors; Smoking Cessation; Substance Abuse, Definition of*)

ACCEPTABLE RISK

The term “acceptable risk” describes the likelihood of an event whose probability of occurrence is small, whose consequences are so slight, or whose benefits (perceived or real) are so great, that individuals or groups in society are willing to take or be subjected to the risk that the event might occur. The concept of acceptable risk evolved partly from the realization that absolute safety is generally an unachievable goal, and that even very low exposures to certain toxic substances may confer some level of risk. The notion of virtual safety corresponding to an acceptable level of risk emerged as a risk management objective in cases where such exposures could not be completely or cost-effectively eliminated.

Two proxy measures have been used to determine acceptable risk levels. The revealed-preference approach assumes that society, through trial and error, has achieved a nearly optimal, and thus acceptable, balance of risks and benefits. The expressed-preference approach uses opinion surveys and public consultations to obtain information about risk levels warranting mitigation action.

Although regulatory authorities are reluctant to define a precise level of acceptable risk, lifetime risks in the order of one in a million have been discussed in regulatory applications of the acceptable risk concept. This level of risk is considered to be *de minimis*, an abbreviation of the legal concept *de minimus non curat lex* (the law does not concern itself with trifles). Attempts have also been made to establish benchmarks, such as the risk of being hit by lightning, to help interpret such small risks. Higher levels of risk might be tolerated in the presence of offsetting health or economic benefits, when the risk is voluntary rather than involuntary, or when the population at risk is small.

Although conceptually attractive, application of the concept of acceptable risk is fraught with difficulty, ultimately involving consideration of social values. Inequities in the distribution of risks and benefits across society further complicate the determination of an acceptable level of risk.

DANIEL KREWSKI

(SEE ALSO: *Benefits, Ethics, and Risks; Risk Assessment, Risk Management*)

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ACCESS TO HEALTH SERVICES

Rural environments present unique challenges for health care access. There are often shortages of medical personnel in rural areas, as well as transportation and distance barriers to care and an increasing economic destabilization of rural health care services.

Since the mid-twentieth century, physicians have favored urban and suburban practice locations over rural areas. Physicians often need lucrative practices to repay high education debts, and they have been trained to use costly new technologies in diagnosis and treatment. Rural practice locations typically generate lower income for the physician and have fewer and older technology resources than urban and suburban locations. Modern medical school graduates are rarely well prepared to practice in rural environments. Consequently, rural communities suffer chronic physician shortages.

Physician shortages are most visible in primary prevention, diagnosis, and treatment. Public health systems and an array of alternative primary-care providers often fill in the gaps. Primary care may be provided by nurse practitioners, physician assistants, or home-health nurses. Practice locations include publicly or charitably subsidized comprehensive primary-care centers or categorical service clinics (e.g., prenatal care, family planning, immunizations) situated in central locations, mobile clinics, and in patient's homes. Specialty physician services (such as psychiatry or dermatology) may also be available through intermittent clinics in local facilities, such as health departments, churches, or schools.

Advances in medical technology, increasing costs, and market forces contribute to the economic destabilization of many rural health care systems. Small rural health care providers, especially hospitals, cannot afford the equipment and personnel necessary to treat the entire array of modern disease and injury. Coronary bypass surgery, artery repair, advanced trauma care, and other complex procedures require specialized medical teams, equipment, and facilities. Such resources are economically viable only in hospitals and surgical centers with high volumes of patients. Consequently, rural residents must often travel great distances to access more costly and complex levels of care.

Accessing complex care in urban medical centers often generates a patient perception that all rural hospital care is of lower quality. People with financial resources and the ability to travel tend to use distant urban centers even for less complex needs. The majority of patients admitted to rural hospitals are either too frail to withstand travel to

distant hospitals or cannot afford either the travel or the cost of care in urban areas. Neither of these populations generates reimbursements adequate to cover the costs of services. Many rural hospitals and providers have diversified services to increase revenues. However, this strategy often fails and the hospital must close. Closures leave the very old, the disabled, and the poor with no access to hospital inpatient care, and the entire community is left with no access to urgent or emergency care. In addition, the area suffers from the significant loss of employment.

As costs increase, public and private insurers must struggle to control their expenditures. Prices, or fee scales, for services include the minimum estimated cost of providing each service. Price controls most severely affect rural health systems, especially home-based or mobile services. Because of the distances between service locations or patient residences, the cost per unit of service is often many times greater than in urban locations. For example, a home health nurse may visit five patients in a morning within an urban apartment building, while a nurse in a rural setting may visit only one or two patients, spending most of the time traveling. The urban nurse will be reimbursed for five visits and the rural nurse for two, yet the time expended is the same. Home-based services in rural areas must, therefore, access public or charitable subsidization in order to remain economically viable.

Low population density and greater travel times and barriers in rural areas affect service availability, the ability of people to get to those services, and the economic viability of the services. Lower population density also means a lower volume of patients and less provider income. Reduced fees and the refusal of insurers to pay for care often destabilize private professional practices in rural areas, leading to greater shortages of personnel.

The lower the population density and the larger the area over which the population is distributed, the fewer the available health services and the longer the travel distances to access these services. Emergency medical services in such areas are scattered over great distances and often staffed with volunteers who have other jobs. Emergency care for severe trauma or major acute illnesses, such as stroke and heart attack, may take longer to

arrive than in other areas, causing increased morbidity and mortality. Poor roads or geographic barriers, such as mountains or rivers, magnify the effects of distance. More remote areas with the capacity to pay for the technology, such as western Kansas, are beginning to use telemedicine to improve access for primary care and certain specialty care, such as psychiatry and dermatology.

SUSAN W. ISAAC
HEATHER REED

(SEE ALSO: *Immunizations; Migrant Workers; Poverty and Health; Prenatal Care; Prevention; Primary Care; Public Health Nursing*)

ACCOUNTABILITY

Professionals in any field can be called upon to justify their professional actions. The criteria against which they can be held accountable are those embodied in the normative standards of their particular profession. These standards are expressed in ethics guidelines or codes of conduct for each specialty area within public health. They also may be embodied in law. Likewise, other professionals engaged in public health work, including physicians, policy makers, and corporations, are accountable according to their own professions' codes of conduct.

If any undesirable consequences result from a health professional's work, every effort must be made to undo the damage, without dismissing or denying the problem. Consultation with other professionals or a professional organization can be helpful. Furthermore, various assessment techniques are available to help ensure that one's work is serving its intended purpose.

People can defend themselves against accusations of malpractice of any kind when they can show that they have behaved in an ethical fashion consistent with professional standards. Documentation helps in defending one's actions and makes a person's professional actions "transparent" or easily assessed. Transparency is necessary because accountability may involve defending one's actions or decisions to a professional or legal authority. Because public health professionals are ultimately responsible to the people they serve, transparency and accountability generally mean that processes

and criteria for decision making are available for public inspection. Public health researchers have a duty to make their research practices transparent to the scientific community.

In a research context, researchers commit to maintaining the confidentiality of information provided by study participants. The process of informed consent provides assurances to this effect and provides both documentation and transparency. If a research participant discovers that a friend has received information that could only have come from a confidential research study, then the researcher could be called to account for a breach of confidentiality. By virtue of the written consent, the research participant would have grounds to hold the researcher responsible, and the transparency provided by documentation makes it possible to do so.

For two reasons, confidentiality and transparency do not generally conflict in public health. First, transparency relates to the process of data collection, analysis, and archiving, whereas confidentiality relates specifically to the data (i.e., the content). Second, any apparent conflict between confidentiality and transparency is always easily resolved because confidentiality trumps transparency, except in the rare circumstance where the researcher is legally required to breach confidentiality.

COLIN L. SOSKOLNE
LEE E. SIESWERDA

(SEE ALSO: *Codes of Conduct and Ethics Guidelines; Confidentiality; Ethics of Public Health; Informed Consent; Practice Standards*)

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ACCREDITATION OF LOCAL AND STATE HEALTH DEPARTMENTS

The United States has nearly 3,000 local public health departments. These range in size from those with only one employee to very large departments with over 20,000 employees. With such a

wide range in size there is also a wide range of services and capabilities. Yet, regardless of whether they are in small rural communities or in large urban cities, public health departments should assure that the communities they serve have safe water supplies, clear air, safe food to eat in restaurants, and protection from many emerging diseases like the West Nile virus, HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency disease), and other preventable conditions.

Accreditation is one way to maintain the quality of the goods and services people receive. Accreditation is the approval given to an organization or institution (or a program at that organization or institution) by an independent review board to assure the specific requirements have been met. An institution that is accredited has shown that it meets a set of standards that have been established by its peers.

The U.S. Centers for Disease Control (CDC) in Atlanta, Georgia, has developed a set of model standards for state and local departments and their partners. These standards define the level and quality of service that public health departments and their partners should achieve. The CDC is a strong advocate that the model standards can be the basis of a voluntary accreditation program for public health departments. Such a program could benefit public health departments by stimulating quality improvement, increasing accountability, and increasing their credibility.

POMEROY SINNOCK

(SEE ALSO: *Centers for Disease Control and Prevention; State and Local Health Departments*)

ACCREDITATION OF PUBLIC HEALTH TRAINING PROGRAMS

Accreditation is widely used in higher education in the United States as a nongovernmental means to evaluate colleges and universities and to evaluate and attest to the quality of an individual educational program that prepares students for entry into a recognized profession. Regional accrediting bodies, whose membership is made up of universities and colleges in six geographic regions of the country, carry out institution-wide accreditation

focusing on the university as a whole. Approximately fifty specialized accrediting agencies, composed of representatives of the universities and the various professions, evaluate the educational programs that prepare graduates for practice in different fields. Public health is one of the established fields of practice for which there is a recognized accrediting agency.

The Council on Education for Public Health (CEPH) serves as the accrediting body for graduate schools of public health and graduate public health programs outside schools of public health. Established in 1974 by the American Public Health Association and the Association of Schools of Public Health, CEPH is recognized by the U.S. Department of Education. This recognition, which is based on periodic assessment of CEPH's performance against federal requirements, designates CEPH as one of the agencies that the secretary of education considers "reliable authorities as to the quality of education or training provided by the institutions of higher education and the higher education programs they accredit."

The council, with a staff based in Washington, DC, accredits schools of public health, graduate community health education programs, and graduate community health and preventive medicine programs. As of October 2000, there were 29 accredited schools, 13 accredited health-education programs, and 30 accredited community health and preventive medicine programs. The number of accredited schools and programs grows annually as new applicants pursue accreditation.

In general, accreditation is widely embraced as a major quality control mechanism in higher education and as one of the primary means by which higher education demonstrates accountability to its various constituents. Four elements are common to all accreditation in higher education: (1) agreed-upon criteria serve as the basis for evaluation, (2) self-study allows the institution or program to document how it meets the criteria, (3) an on-site visit by a team of peer reviewers allows for verification of the self-study conclusions, and (4) the results of the evaluation become public. The results are used for various purposes. In public health, for example, accreditation establishes the eligibility of schools and programs for certain federal funds and qualifies students for selected employment and training opportunities.

The criteria used to evaluate schools and programs are adopted and periodically revised by CEPH's ten-member governing body. The criteria establish major responsibilities, including mission and goals, organizational setting, governance, instructional programs, research, service, faculty, students, and evaluation and planning. The evaluation takes place in the context of the school's own mission and the focus is on educational effectiveness and assessment of outcomes.

There are three accreditation criteria documents, one for each category of school or program served by CEPH. A companion document, *Accreditation Procedures*, outlines the procedures and processes a school or program must follow to seek accreditation. All documents are available on the CEPH web site at <http://www.ceph.org>.

PATRICIA P. EVANS

(SEE ALSO: *American Public Health Association; Association of Schools of Public Health; Council on Education for Public Health*)

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ACCULTURATION

Acculturation is the process whereby the attitudes and/or behaviors of people from one culture are modified as a result of contact with a different culture. Acculturation implies a mutual influence in which elements of two cultures mingle and merge. It has been hypothesized that in order for acculturation to occur, some relative cultural equality has to exist between the giving and the receiving culture. In contrast, assimilation is a process of

cultural absorption of a minority group into the main cultural body. In assimilation, the tendency is for the ruling cultural group to enforce the adoption of their values rather than the blending of values. From a practical point of view it may be hard to differentiate between acculturation and assimilation, for it is difficult to judge whether people are free or not free to choose one or another aspect of a culture. The term "ethnic identity" has sometimes been used in association with acculturation, but the two terms should be distinguished. The concept of acculturation deals broadly with changes in cultural attitudes between two distinct cultures. The focus is on the group rather than the individual, and on how minority or immigrant groups relate to the dominant or host society. Ethnic identity may be thought of as an aspect of acculturation in which the concern is with individuals and how they relate to their own group as a subgroup of the larger society.

Acculturation is a complex concept, and two distinct models have guided its definition: a linear model and a two-dimensional model. The linear model is based on the assumption that a strong ethnic identity is not possible among those who become involved in the mainstream society and that acculturation is inevitably accompanied by a weakening of ethnic identity. Alternatively, the two-dimensional model suggests that both the relationship with the traditional or ethnic culture and the relationship with the new or dominant culture play important roles in the process. Using the two-dimensional model, J. W. Berry has suggested that there are four possible outcomes of the acculturation process: assimilation (movement toward the dominant culture), integration (synthesis of the two cultures), rejection (reaffirmation of the traditional culture), or marginalization (alienation from both cultures). Similarly, Sodowsky and Plake have defined three dimensions of acculturation: assimilation, biculturalism (the ability to live in both worlds, with denial of neither), and observance of traditionality (rejection of the dominant culture).

The term "acculturation" was first used in anthropology in the late 1800s. Early studies dealt with the patterns in Indian-Spanish assimilation and acculturation in Central and South America, the consequences of contact between Native American tribes and whites, and the study of the culture of Haiti as a derivative of West African and French

patterns. Increasingly, the importance of acculturation has been recognized in the social sciences, sociology, psychology, epidemiology, and public health.

MEASURES OF ACCULTURATION

It has long been known that race, ethnicity, and socioeconomic status are interrelated, and that there are marked variations in health status among racial, ethnic, and socioeconomic groups. There are many factors that can contribute to these variations, including the level of acculturation of a particular group. It is therefore important to have a method of measurement of acculturation.

The acculturation process affects a range of behaviors, values, and beliefs. All of the scales used to measure acculturation include items on second-language proficiency, because being able to communicate in the language of the host culture is a prerequisite to learning about it. Some scales also assess patterns of language use, friendship choices, food, music or movie preferences, cultural awareness, ethnic pride, place of birth, and contact with one's homeland. Acculturation scales have been developed for different ethnic groups, including Hispanics, Filipinos, Asian Americans, and Southeast Asian immigrants to the United States.

For immigrants, the percentage of one's lifetime spent in the host country and one's age at the time of immigration have been shown to correlate with more extensive and detailed measures of acculturation, and are therefore good indicators of an individual's level of acculturation when more detailed information is unavailable.

RELEVANCE TO PUBLIC HEALTH

Level of acculturation has been shown to be associated with many aspects of health behavior in the United States. High levels of acculturation have been shown to be associated with greater use of mental health services among female Chinese immigrants, increased alcohol intake among Mexican-American women and Southeast Asian immigrants, and increased smoking prevalence among Asian-American youth and Mexican-American women. In contrast, a study among African Americans showed a lower prevalence of smoking among men and women with higher levels of acculturation. Dietary patterns have been shown to change

with acculturation. For example, among Hispanics, those with a higher level of acculturation are less likely to consume rice, beans, fruits, meat, fried foods, and whole milk than those with lower levels of acculturation. Many studies have shown high levels of acculturation to be associated with increased cervical and breast cancer screening among Latinos and Asian Americans, and with increased cervical, breast, and colorectal cancer screening among Filipino and Korean immigrants. Such studies show that while acculturation can increase one's health risk in some cases, it can also promote health by creating access to certain forms of health care and by contributing to the abandonment of risky health-related behaviors and the adoption of behaviors that promote good health.

Acculturation has also been shown to influence knowledge and attitudes that shape and influence health behaviors. For example, several theoretical models postulate that knowledge of cancer screening guidelines, perceived severity of cancer, perceived susceptibility to contracting cancer, perceived group norms regarding cancer screening, and perceived barriers to cancer screening will influence whether or not a person will get screened. Many studies have demonstrated that these underlying beliefs differ between individuals with high and low levels of acculturation. A 1996 study showed that Latino women with lower acculturation levels were less knowledgeable about breast cancer risk factors and symptoms and had less favorable attitudes about breast cancer compared to their more acculturated peers. Another study showed that unacculturated Korean-American women were less likely to have friends who had mammograms, were less likely to receive a doctor's recommendation to get screened, and were more likely to state that it was difficult for them to go to a mammography facility than were their more acculturated peers. A study among Hispanic women found that the members of the more acculturated group were more confident in their abilities to acquire health-related information and to seek assistance than the less acculturated group. Still another study among first- and second-generation Japanese-American women found differences in general knowledge of osteoporosis, attributions of its causes, anticipated and preferred support mechanisms for care, treatment compliance, and feelings toward physicians.

These studies show the importance of considering acculturation in developing health-education

messages and interventions that are culturally appropriate in terms of language and content, and in terms of psychological factors related to health behavior change. Program planners, researchers, and health educators who understand and take into account the level of acculturation in a target population will be better able to design effective programs of health intervention.

ANNETTE E. MAXWELL

(SEE ALSO: *African Americans; American Indians and Alaska Natives; Asian Americans; Assimilation; Biculturalism; Cultural Anthropology; Cultural Factors; Cultural Identity; Ethnicity and Health; Hispanic Cultures; Indigenous Populations*)

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ACID RAIN

"Acid rain" is the common term for a complex process more appropriately referred to as acid deposition. It includes the deposition of acidic compounds onto the ground and onto surface waters when it rains (wet deposition), and at other times as well (dry deposition). The acid compounds include both acidic gases, such as sulfur dioxide (SO₂) and nitrogen dioxide (NO₂), and acidic particles, such as sulfate and nitrate compounds. Acid deposition is believed to have adversely affected lakes and forests in the northeastern United States, Canada, and Europe, and to have caused material damage as well.

The primary anthropogenic source of airborne acidity is the burning of fossil fuels. Coal- and oil-fired electric utilities and industries emit gaseous SO₂ and nitrogen oxides (NO and NO₂) into the atmosphere. Automobiles and other mobile sources also contribute significant amounts of nitrogen oxides.

As these primary pollutants are transported by the wind, sometimes over long distances, they are slowly transformed through a variety of atmospheric reactions to secondary pollutants, such as nitric acid vapor and sulfuric acid droplets, which are strongly acidic. With further transport and reactions with ammonia gas (NH₃) from biological decay processes at the ground level, they are transformed to less strongly acidic sulfate and nitrate particles. These atmospheric reaction products

can remain suspended, impairing visibility, reducing air quality, and causing adverse human health effects or these products can be deposited directly onto surfaces at ground level.

The area affected by the emission sources is determined to a large extent by the time that pollutants stay in the atmosphere before removal through deposition.

Sulfur and nitrogen deposition have caused adverse impacts on highly sensitive forest ecosystems in the United States and northern Europe, such as high-elevation spruce and fir forests in the eastern United States. On the other hand, most U.S. forest ecosystems are not currently known to be adversely impacted. The gradual leaching of soil nutrients from sustained acid deposition can impede forest nutrition and growth. Potential risk depends on numerous factors, including rate of cation (positively charged ion) deposition, soil cation reserves, age of forest, weathering rates, species composition, and disturbance history. Dry deposition is now considered to be more damaging to stone than wet deposition.

Since sulfate significantly contributes to visibility-reducing particles in the eastern United States, reduced SO₂ emissions will reduce sulfate concentrations and, in turn, their contribution to haze. In the 1990 U.S. Clean Air Act Amendments, Congress mandated reductions in annual emissions of SO₂ by 1995 and nitrogen oxides from utilities burning fossil fuels starting in 1995.

As a result, statistically significant reductions in the acidity (represented by hydrogen ion content) and sulfate concentrations in precipitation were reported at deposition-monitoring sites in the Midwest, Mid-Atlantic, and northeast United States. Although utilities have significantly reduced their emissions, observable responses will lag due to inherent time lags between changes in emissions and responses by sensitive receptors, especially within ecosystems.

It is still too early to determine whether changes in aquatic ecosystems have resulted from emission reductions. Over the last fifteen years, lakes and streams throughout many areas of the United States have experienced decreases in sulfate concentrations in response to decreased emissions and deposition of sulfur, and there is evidence of

recovery from acidification in New England lakes. In contrast, the acidity levels of the majority of Adirondack lakes have remained fairly constant, while the most sensitive Adirondack lakes have continued to acidify.

The kind of damages seen in forests and lakes in the northeastern United States have also been witnessed in Scandinavia and other parts of northern Europe.

MORTON LIPPMANN

(SEE ALSO: *Airborne Particles; Ambient Air Quality [Air Pollution]; Clean Air Act; Environmental Determinants of Health; Inhalable Particles [Sulfates]; Total Suspended Particles [TSP]*)

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ACUTE RESPIRATORY DISEASES

Most acute respiratory diseases are viral infections. They may be complicated by bacterial superinfections in which a bacterial infection develops after a viral infection. In such a situation, however, an illness would be of longer duration and not be considered acute. Acute respiratory infections (ARIs) are the most frequent illnesses experienced by most people globally. Young children have between five and seven of these illnesses per year, with a general decrease in frequency with increasing age. Adults will have about two such illnesses per year. It has been shown that among adults women have a higher frequency of respiratory disease than men do, and women who do not work outside the home have more frequent illnesses than those who do. This indicates that children are responsible for spreading illnesses in the family. Further evidence for this conclusion comes from the seasonal occurrence of the illnesses. While these acute infections occur year-round, in the temperate zones most begin in the colder season, and the first peak of illnesses follows the opening of schools by about two weeks.

Table 1

Infectious Agents Causing Common Respiratory Infections		
Virus	Number of Types	Illness Syndrome
Rhinoviruses	110+	Common cold
Coronavirus	2+ (?)	Common cold
Parainfluenza	4	Croup or pneumonia in children Colds in adults
Respiratory Syncytial Virus (RSV)	2	Bronchiolitis or pneumonia in children Common cold in adults
Adenovirus		Acute Respiratory Disease, Pharyngoconjunctival fever, pneumonia, etc.

SOURCE: Courtesy of author.

One reason why there are so many acute illnesses experienced throughout life is the large number of viruses that can cause the common cold and other similar syndromes (see Table 1). In addition, when infection with one of these agents occurs it does not result in lifetime immunity. Since the actual infection is on the surface of the respiratory tract rather than disseminated in the blood, it is much more affected by secretory IgA antibodies than circulatory IgG antibodies. As a result, immunity produced by past experience with the same virus is relative rather than absolute. This means there may be protection from reinfection over a period of months rather than years, and if reinfection occurs, it may produce an inapparent infection or milder illness than would be experienced without prior infection. This situation is most dramatic with agents such as respiratory syncytial virus (RSV) and parainfluenza viruses. The initial infection can produce potentially life-threatening illnesses in young children, such as bronchitis or croup, but later in life reinfection will produce only a common cold-like syndrome.

AGENTS CAUSING RESPIRATORY INFECTION

A wide variety of viruses, containing both RNA and DNA, cause ARIs. The most important viruses are listed in Table 1. Rhinoviruses are the most frequent cause of the common cold. They circulate all year, along with the other viruses listed in

the table, and are the major cause for the major autumn increase in respiratory illness. Multiple types of virus cause this rhinovirus outbreak, which is different from the typical outbreak of an infectious disease, in which only one viral type is responsible. It is thought that children are responsible for spreading the different types of virus in schools, and that they are then introduced into families.

Coronaviruses are also important agents of the common cold. Scientists have had difficulty in the laboratory working with these viruses, and the usual methods of virus detection have not yielded complete results. For this reason, less is known about them than the others listed in Table 1. There are at least two major types of coronaviruses, each of which appears to occur over a limited period of time, usually in winter and spring.

While significantly different virologically, parainfluenza viruses and RSVs will be considered together because of similarities in overall behavior. There are four types of parainfluenza viruses. Parainfluenza type 4 is an agent that is sporadic in occurrence, producing little more than the common cold. As such, its activity is rarely described except when the virus is encountered as part of a comprehensive investigation in which a variety of different agents are sought. In contrast, whenever the severe respiratory illnesses causing hospitalization of young children are studied, parainfluenza types 1, 2, and 3, and RSV, are identified. Both types 1 and 2 most typically cause laryngotracheobronchitis, more commonly called croup. First infection with these viruses is essentially universal by three to four years of age, and, based on the number of infants and young children requiring medical attention, it can be estimated that well over 10 percent of children first encountering these viruses require medical attention specific for this syndrome. Like all respiratory viruses, these agents reinfect repeatedly throughout life, with later infections becoming milder or asymptomatic. Parainfluenza type 3 does not produce this syndrome, but rather one of pneumonia, often with features of obstruction. Again, first infection is universal at an early age, but only occasionally results in the most severe of the potential manifestations of the disease. Reinfection with or without symptoms also recurs throughout life.

RSV was formerly thought to comprise only one viral type, but recent work has identified two groups that are not as distinctively different as the types of parainfluenza virus. There are suggestions that group A viruses are more virulent in the illnesses they produce and more frequent in occurrence, but these differences are not dramatic. RSV produces what is undoubtedly the most severe respiratory illness in a small proportion of young children infected for the first time in life. The typical syndrome is usually bronchiolitis, but pneumonia is sometimes diagnosed as well. Because of the severity of this illness, a vaccine to prevent RSV has been identified as a high priority for development. The purpose of the vaccine would not be to prevent the disease, since absolute immunity is not possible, but rather to modify the disease expression so that initial illness becomes similar in characteristics to a reinfection.

Adenoviruses are different in many respects from the viruses described above. First, they are DNA viruses, and as such have been examined in terms of issues such as the induction of tumors in humans. The ability of these viruses to produce tumors has been demonstrated in laboratory animals, but never in humans. The viruses themselves are divided into many types that produce distinctly different syndromes. While childhood pneumonia does occur, it is not a major public health problem except in East Asia, where reports of epidemics have come from North China. Types 4, 7, and others produce a syndrome called acute respiratory disease, which becomes epidemic in military recruits worldwide. A vaccine has been developed, but because of the limited target population, maintaining supplies has been an issue.

There are nonviral agents that cause acute respiratory infections, but not with the same frequency as the viruses, at least not in developed countries. *Legionella pneumophila* causes Legionnaires' disease, a bacterial pneumonia, sporadically in adults, and reported outbreaks have been associated with contaminated water supplies in hospitals and other institutions. *Chlamydia pneumoniae* causes lower respiratory illnesses in a small proportion of older children and adults. However, the most important role of this agent may be as a risk factor for development of atherosclerosis. Evidence for the association of the infection with coronary artery disease is not yet conclusive.

GLOBAL ASPECTS AND PROSPECTS OF PREVENTION

ARIs are a leading cause of death in children under age five in developing countries. While the viral agents occur in a similar pattern as in developed countries, it is certain bacteria, particularly *Streptococcus pneumoniae* and *Haemophilus influenzae*, once prominent worldwide in lower respiratory infections, that are the causes of death. The likely scenario is that the viruses initiate the acute illness, followed by a superinfection caused by the bacteria. However, certain of the viruses, such as RSV, may alone be responsible for life-threatening illness. Antibiotics can be used to treat the bacterial infections, but resistance of *S. pneumoniae*, also called pneumococcus, is becoming widespread. Vaccines should be an important approach to control. A vaccine is already in use for *H. influenzae* type B, and conjugated vaccines are either licensed or being tested for *S. pneumoniae*. Vaccines, aside from influenza, have been more difficult to develop for the viral pathogens. RSV remains at the top of the priority list for development, but as yet no such vaccine is available.

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(SEE ALSO: *Contagion; Influenza*)

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ADDICTION AND HABITUATION

Although there is no definition of "addiction" that is universally accepted, in general, addiction refers to a physiological and psychological dependency on a drug. While some drugs of abuse induce physiological addiction, others do not. Alternatively, some drugs that are physiologically addictive generally are not abused (e.g., caffeine). Tolerance to drug effects, and withdrawal symptoms upon abrupt cessation of use, which develop over time, are characteristic features of physiological addiction. "Habituation" is the term used to refer to psychological dependence on a drug. Some drugs of abuse are highly rewarding because of their influence on reinforcing neurobiological processes, but they do not necessarily result in "tissue"-related withdrawal symptoms. Cessation of such drugs may lead primarily to subjective craving due to previous drug conditioning (perhaps true of some marijuana users) and craving may be more readily evoked or deeply conditioned among some persons than others ("addictive personalities"). Primary methods of assessment of addiction and habituation are completed through clinical interviews or self-report surveys (e.g., American Psychiatric Association DSM-IV, World Health Organization ICD-10). Treatment paradigms for the cessation of addiction begin with initial detoxification

or withdrawal, followed by inpatient or outpatient program participation (e.g., 12-step programs, milieu, cognitive-behavioral, or behavioral). Pharmacological efforts (e.g., methadone maintenance) may be used as harm-reduction strategies among those who seem unable to quit drug use.

It is estimated that approximately 15 percent of the world's adults have serious substance abuse problems (not including nicotine addiction), and that this percentage has remained fairly constant over the past twenty-five years. Of these substance abusers, about two-thirds abuse alcohol and one-third abuse other substances, mainly marijuana, amphetamines, cocaine, and heroin. Approximately 2.5 percent of the population abuse marijuana, 0.5 percent abuse stimulants, 0.3 percent abuse cocaine or opioids (such as heroin), and up to 0.8 percent abuse other substances (e.g., inhalants, depressants, hallucinogens). Sites of drug production and manufacturing, and distribution routes, tend to identify regions at high risk for abuse.

Drug abuse causes significant health-related consequences and financial losses to legitimate economies. The financial cost to society is estimated to be approximately \$600 billion per year worldwide. This does not include the cost of nicotine abuse, which, through its influence on heart disease, lung cancer, chronic obstructive lung disease, and numerous other consequences, is the number one behavioral killer of people worldwide. Drugs of abuse are also associated with the production of psychotic symptoms (e.g., paranoid ideation) and with injuries due to accidents and violence. Approximately 50 percent of automobile fatalities involve alcohol-impaired drivers, and many auto crashes also involve chronic marijuana or amphetamine users.

In addition, each drug class is associated with a unique set of potential consequences. Some drugs of abuse are likely to have lethal consequences (e.g., opiates and depressants), and some have a high potential for addiction. Health consequences can also vary by drug. For example, depressants, PCP, stimulants, steroids, and cannabis are associated with cardiovascular diseases. Stimulant use is linked to seizure, digestion problems, and lung problems. Documented consequences of marijuana use include lung damage and short-term memory problems. Dementia, seizure, memory impairment,

central and peripheral nervous systems impairment, gastrointestinal diseases, and cancers of the gastrointestinal tract are all consequences of alcohol consumption. Steroid use is associated with high blood pressure, potential heart attacks, liver tumors, transient infertility, and tendon degeneration. Inhalants are well-known causes of kidney, brain, and liver damage.

The development and maintenance of the addictive process involves multiple pathways and levels of influence within biological, psychological, and sociological domains. Influences exogenous to the individual include environmental, cultural, and social factors. Cultural and social norms, variations in drug use practices, and the values and behaviors of parents, siblings, friends, and role models can all affect an individual's drug experiences. Processes contributing to individual differences in substance use include physiological susceptibility, as measured in genetics studies; affective states; personality; and cognition—including expectancies and memory processes. Substance abuse versus substance use is more strongly related to intra-personal processes (e.g., self-medication for emotional distress) than social processes, although both are influential in the addictive process.

SUBSTANCE ABUSE AND DEPENDENCE

Substance use pertains simply to the use of a drug. Substance misuse means using a drug for a purpose or in a manner in which it was not intended or prescribed. Substance abuse is marked by an accumulation of negative consequences resulting from drug use. Substance use that leads to a decreased level of performance in major life roles, or to dangerous actions, legal problems, or social problems, indicates abuse. Substance dependence is a more severe form of drug abuse that also includes tolerance (the need for markedly increased amounts of the substance to achieve the desired drug effect), withdrawal symptoms when stopping substance use, unpredictability of substance use, and an inability to control the use of a substance to the point that it consumes one's daily life.

Withdrawal symptoms vary from drug to drug. For example, withdrawal from alcohol, sedatives, or anxiolytic agents may involve autonomic

reactivity, hand tremor, insomnia, nausea or vomiting, transient illusions or hallucinations, psychomotor agitation, anxiety, and grand mal seizures. Amphetamine or cocaine withdrawal can include fatigue, unpleasant and vivid dreams, insomnia or hypersomnia, increased appetite, and psychomotor retardation or agitation. For substance abusers, withdrawal is often a difficult process with numerous symptoms, while abstaining from drug use can lead to recovery from physical and psychological problems and an improvement in overall health.

THE DRUG ABUSE CONTINUUM

Conceptually, substance abuse can be seen as a continuum, with individuals at one end being relatively "disease-free" but engaging in maladaptive behaviors over which they have some control. These individuals may repetitively use drugs, and over time they may abuse drugs. They choose to live a certain lifestyle in which their maladaptive behavior may or may not result in other disease states associated with use (e.g., cirrhosis of the liver). If these individuals stop this negative cycle they can, perhaps on their own, learn alternative coping mechanisms and self-efficacy. Individuals at the other end of the continuum, however, seemingly have no control over their use. Some individuals appear to lose control the first time they use drugs. For these individuals drug use is like a toggle switch that is either on or off. For them, total abstinence is the only alternative because they have no control processes once the switch is turned on. They may use until they die unless someone else can turn their switch off and keep it off. There is no logic to this behavior, and no choice. Users of this type will often ruin their own lives and the lives of those around them in their drive to use their drugs of choice. It seems that as one moves toward a more "at-risk" end of the continuum there is less and less control over substance use.

It is unclear what causes the difference in loss of control among those at different points of the continuum. Researchers do not understand the process very well. They do know that other factors may exacerbate the process, including biologically based differences in metabolic processes, different levels of susceptibility to the reinforcing effects of drugs, personality disorders or depression, and

an inability to tolerate frustration or emotional discomfort. Some processes are under individual control, but many are not, and it does appear that the less control the individual has over these types of processes, the more likely he or she is to fall into substance abuse.

STAGES OF ALCOHOLISM AND DRUG ABUSE

During the early stages of substance abuse, the alcoholic or drug abuser experiences increasing tolerance and use. Substance use at this stage is generally for purposes of self-medication. In the later stages of abuse, life becomes centered around obtaining, using, and recovering from drug use. Loss of control, ethical deterioration, and noticeable withdrawal symptoms ensue. It is unclear, however, whether such a progression is inevitable.

In a 1991 empirical review of the study of progression in alcoholism, Jill Littrell found that approximately 60 percent of adolescent problem drinkers remit to nonproblematic levels of drinking when they reach their 20s, and that 25 percent of young adults remit to nonproblematic levels of drinking before they reach age 35. Studies examining data on adult alcoholics who have undergone a variety of treatments as inpatients and outpatients during follow-up periods of up to fifteen years provide a general profile of outcomes. Between 25 and 35 percent remain abstinent, whether or not they continue treatment. An additional 15 to 25 percent will be abstinent most of the time, with some lapse periods. Approximately 6 to 9 percent will become nonproblematic or controlled drinkers (particularly those who were lighter drinkers and suffered fewer negative consequences while drinking). Another 20 to 33 percent become stable problematic drinkers, while 15 to 25 percent will die from alcohol-related causes.

It is uncertain whether drug abusers follow a progression similar to that of alcoholics. There probably is some validity to a notion of progression for drug use in general, but more longitudinal studies are needed in this area. It is possible that such a progression might simply express the accumulation of consequences one endures each time one takes a chance by drinking or using drugs. As opposed to the stages outlined above, a substance

abuser may simply incur more problems over time, along with an increased tolerance for alcohol or other drugs of abuse.

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(SEE ALSO: *Abstinence; Alcohol Use and Abuse; Behavior, Health-Related; Cocaine and Crack Cocaine; Drug Abuse Resistance Education [DARE]; Marijuana; Medications Abuse, Elderly; National Institute on Drug Abuse; Smoking Behavior; Smoking Cessation; Substance Abuse, Definition of*)

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ADHERENCE OR COMPLIANCE BEHAVIOR

Hippocrates once wrote that patients often lied about taking their medicine. Adherence to medication was a big problem then, and still is today. Indeed, one of the most challenging problems facing physicians is their ability to improve patient compliance with prescribed regimens. Estimates for nonadherence across diverse areas of treatment range from a low of 4 percent to a high of 92 percent, with an average ranging from 30 to 60 percent. Adherence rates for preventive health behaviors are generally lower than those behaviors

requiring long-term management or control of a chronic condition. For example, adherence for patients with ischemic heart disease is 74 percent, while adherence to a prescribed wear-and-care regimen of disposable contact lenses is 31 percent, despite the risk of complications related to extended wear lenses.

Given that many diseases are preventable, curable, or at least treatable, patient adherence is often a crucial step toward improving treatment status and achieving good health. The diagnosis, the carefully weighted treatment plan, and the expanded time and effort in patient education all become wasted efforts if a patient does not adhere to the prescriptions and proscriptions recommended by a health care provider. Gerald H. Friedland and Ann Williams identified adherence as the "greatest barrier to overall therapeutic success" (1999, p. S64).

BACKGROUND

Adherence became a topic of considerable research by multidisciplinary teams beginning in the 1970s, when studies showed that as many as 50 percent of patients diagnosed with hypertension were not taking sufficient amounts of their antihypertensive medication, and that nonadherence was common, particularly with long-term treatments for conditions such as diabetes, asthma, hypertension, and HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome).

What is adherence and why do many patients fail to comply with a medication regimen? Adherence to medical recommendations has been defined as the extent to which a person's behavior coincides with medical or health advice, such as taking medication regularly, returning to a doctor's office for follow-up appointments, and observing preventive and healthful lifestyle changes. Despite the positive health benefits that adherence engenders, however, many patients fail to adhere or comply to medical advice for a variety of reasons.

With the advent of complex treatment regimens for HIV infection (often characterized as among the most complicated long-term regimens in history), and the risk of drug resistance resulting from missed doses, research on adherence has centered on who is and is not likely to be adherent,

how adherent one needs to be in order to prevent drug resistance, and what strategies are likely to work for improving adherence. Controversial ethical issues have emerged regarding the provision of complex treatments to HIV/AIDS patients who may seem unable to adhere to them, and possibly contributing to the passing of resistant HIV strains to others. Drug formulation and regimens that allow for simplified dosing have become a research priority, and novel devices and techniques have been developed that can assist patients in adhering to medication regimens.

CAUSES OF NONADHERENCE

Studies of nonadherence indicate that from 10 to 90 percent of patients do not fully follow their doctor's orders. Most researchers agree that at least half of all patients do not take their prescribed drugs correctly. Adherence to lifestyle regimens such as diet and exercise is probably far worse. It is difficult to predict who will adhere to a given course of medication and who will not. According to most published studies, adherence does not correlate with age, sex, race, occupation, education, income level, or socioeconomic status. Even homelessness is not an indicator of a low likelihood of adherence in all patients; given appropriate access to treatment, encouragement, and rewards, homeless individuals can be as adherent as any group. In fact, about the only good indicator of future adherence is how a patient has behaved in the past.

The five most common types of nonadherence with medication are: 1) failing to have a prescription filled, (2) taking an incomplete dose, (3) taking the medication at the wrong time, (4) forgetting to take one or more medications, and (5) stopping the medication. Each of these behaviors requires individual consideration in order to formulate strategies to enhance patient compliance.

Failure to obtain a medication is especially problematic in patients with asymptomatic conditions, such as hypertension or latent tuberculosis. The health care provider must reinforce the importance of taking medications daily, even if one does not "feel sick," to prevent the effects of target organ damage or developing resistant strains of the infection. Once a patient obtains a medication, the two most common nonadherence behaviors include omitting one or more doses or taking a

medication at the wrong time. This behavior has been termed “partial compliance.”

While partial compliance is intentional in a minority of patients, in others, such as the elderly, it is often unintentional. Forgetting to take a medication is the most common cause of taking insufficient medication in this population and is attributed to such factors as using more than one pharmacy, seeing different physicians, confusion regarding the regimen, inaccurately labeled containers, and the inability to open childproof containers. The health care provider must make special efforts during the patient visit to address these potential concerns related to nonadherence.

STRATEGIES TO IMPROVE ADHERENCE

Adherence to medical recommendations is a multifactorial behavior and requires a multifactorial response. Therefore, strategies to encourage adherence must not only address intrapsychic factors such as knowledge of the regimen, belief in benefits of treatment, subjective norms, and attitudes toward medication-taking behavior, but also environmental and social factors such as the interpersonal relationship between the provider and the patient and social support from family members and friends.

Educational approaches to enhancing non-adherence generally begin with providing the patient with a general understanding of the importance of the medical recommendations. Although information and increased knowledge is necessary for the behavior to take place, it is often insufficient to sustain or reinforce the behavior over time. Health care providers who employ a combination of verbal and written instruction often see enhanced levels of adherence among their patients. This is especially true for disadvantaged populations and for individuals with low literacy skills, who often benefit from tailored educational messages regarding the duration of treatment, dosage, frequency, or purpose of medication. Studies have also demonstrated that personalized follow-up on adherence through the pharmacy results in increased rates of adherence. Considerable interest among community pharmacists in expanding their role to include more prevention is evident in recent surveys. Changing office visit appointment schedules from a block approach to

individualized appointments also results in higher rates of kept appointments and provides greater opportunities for behavioral reinforcement by the health care provider.

Medication assessment techniques such as electronic medication monitors indicate that approximately 50 to 60 percent of patients achieve near-optimal or excellent adherence. This result is similar to other measurement strategies utilizing self-reported measures. A simple self-reported medication-taking measure is described in D. E. Morisky et al. (1986), consisting of four questions, such as “Do you ever have problems remembering to take your medication?” or “Do you sometimes forget to take your medication?” Individuals who score high on this assessment (i.e., answer each question with a “no”) are significantly more likely to have their blood pressure under control compared to individuals who scored lower. This simple adherence assessment allows the health practitioner to assess the various determinants of medication-taking behavior, thereby providing opportunities for behavioral reinforcement, such as enlisting social support (informational, emotional, and tangible) from provider staff and family members.

Many behavioral strategies have been found to be successful in increasing adherence with medications. Multicomponent strategies are much more effective than single-component approaches. Some of the most effective behavioral strategies include tailoring the medical regimen to the patient’s daily routine and lifestyle, developing cues and rewards, and contingency contracting. Cues, or prompts, are often one of the most effective and efficient behavioral strategies to enhance medication adherence. Specialized pill containers in which the day of the week appears on each cell can be conveniently near one’s toothbrush to prompt daily, habitual behaviors. Toothbrushing becomes the behavioral cue and reinforces medication-taking behaviors.

A final intervention found to be quite successful in improving and maintaining high levels of adherence to medical recommendations is that of social support, either from a health care professional or within one’s personal environment. Factors that increase adherence include perceived support from the provider, patient satisfaction with the medical visit, and the support of family members in the home environment.

Adherence to medical recommendations continues to be a major concern for patients with long-term medical conditions. In order to maximize the benefit of the medical treatment, both physician and patient need to work together to achieve the common goal. The health care professional can enhance adherence by clarifying and tailoring the regimen, identifying behavioral cues, and enlisting and encouraging family members to be supportive.

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(SEE ALSO: *Behavior, Health-Related; Enabling Factors; Health Belief Model; Health Promotion and Education; Patient Educational Media; PRECEDE-PROCEED Model; Predisposing Factors; Primary Care*)

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ADMINISTRATION FOR CHILDREN AND FAMILIES

The Administration for Children and Families (ACF) is an operating division of the U.S. Department of Health and Human Services. ACF's responsibilities include public welfare, renamed

"Temporary Assistance for Needy Families" or TANF in 1996 by welfare reform legislation; Head Start, providing early child development for children of low-income families; child support enforcement, assisting states with paternity establishment and child support collection systems; child protection, family preservation, foster care, and adoption assistance, supporting states with their child-welfare responsibilities; refugee resettlement; and programs for the developmentally disabled, Native American economic development, low-income community development, social services, and energy assistance for low-income families.

JAMES A. HARRELL

(SEE ALSO: *United States Department of Health and Human Services [USDHHS]; United States Public Health Service [USPHS]*)

ADMINISTRATION OF PUBLIC HEALTH

See Director of Health

ADOLESCENT SMOKING

In 1999, the Youth Risk Behavior Survey found that 35 percent of U.S. high school students were smokers and only 13.5 percent of them quit during high school. This represented a large increase since 1991, when 27.5 percent of high school students smoked. These facts frame key public health issues: Youth start smoking before the legal age, and therefore need societal protection from unreasonable influences (e.g., marketing) that encourage them to smoke. Teenagers tend to become more addicted than they expect, and they have trouble quitting.

Health-promotion programs to teach skills for managing social influences regarding smoking—or more broadly focused on life skills—have shown only modest success. Few if any effective cessation programs are currently available. In general, however, prevention programs are more effective if combined with comprehensive community programs for tobacco control. Multicomponent programs addressing individual, interpersonal, and organizational levels of behavior are likely to be

the most effective because they influence the societal and cultural context in which adolescent smoking occurs. Regulations that increase price, control sales, or create nonsmoking areas can also help reduce adolescent smoking rates.

ALLAN BEST
ROY CAMERON
CHRIS LOVATO

(SEE ALSO: *Advertising of Unhealthy Products; Behavior, Health-Related; Enforcement of Retail Sales of Tobacco; Smoking Behavior; Smoking Cessation; Tobacco Sales to Youth, Regulation of*)

ADOLESCENT VIOLENCE

Interpersonal violence among young people aged eleven to nineteen is a significant public health concern. Adolescent violence involves behaviors ranging from physical fighting to more severe forms of physical assault that can result in serious injury or death. In 1998, homicides in the United States claimed the lives of 2,573 persons between eleven and nineteen years old, making it the second leading cause of death for adolescents that year.

Compared to other industrialized countries, “adolescent violence is greater in the United States, more likely to involve firearms, and more lethal in its consequences” (USDHHS 2001, p. 27). One study showed that from 1990 to 1995 the rates of firearm-related homicide in the United States for youth below age fifteen was nearly sixteen times higher than that of twenty-five other countries combined. While this epidemic has substantially subsided, the adolescent homicide rates in the United States by firearms continues to be high when compared with other countries.

During the period from 1980 through 2000, trend patterns in violence among adolescents showed a steep rise and fall. The decade between 1983 and 1993 was marked by an epidemic of increasingly deadly violence associated with increased firearm use. For example, both total and firearm-related homicide rates increased dramatically, peaking in the mid-1990s, and then declined. Arrest rates for homicide, robbery, and rape among

adolescents followed a similar pattern. Although these recent downward trends are encouraging, rates of adolescent violence remain at historically high levels.

PREVALENCE AND DESCRIPTIVE EPIDEMIOLOGY

Based on reports from twelfth-grade students from 1980 to 1998, about three out of ten high school seniors commit a violent act (e.g., take part in a fight) each year. Ten to 15 percent of high school seniors reported physically injuring someone severely enough to require medical care. Involvement in violence varies by gender and, to a larger extent, by race. Adolescent males are more likely to be victims and perpetrators of violence than are adolescent females. In 1998 there were about four and one-half male victims for every female victim of homicide. Males also committed about four violent acts for every one violent act by females. Minorities (e.g., African Americans, Hispanics) are disproportionately victimized by, and arrested for, violence. In 1998, African-American adolescents were six times more likely to be victims of homicide, and between one and a half and four times more likely to commit (or be arrested for) a violent act compared to white adolescents. Differences in the rates of violence across racial and ethnic groups must be viewed in terms of the life circumstances of various groups. For example, minorities are more likely than whites to live in poor neighborhoods, a situation that has been found to increase the likelihood of violence (see “Causes”).

COSTS

Adolescent interpersonal violence costs the United States an estimated \$6 billion each year in medical costs alone. Other costs of adolescent violence include the costs for criminal processing, security, public programs for prevention and treatment, property damage, and lost productivity. In total, the monetary costs are nearly \$160 billion each year. To these figures, one must add the costs of years of potential life lost, and the psychological trauma resulting from violent injuries.

CAUSES

There is no single cause of violence among adolescents. Many risk factors have been found to increase the likelihood of violence during adolescence. Important influences include a history of early aggression in childhood, being exposed to family or neighborhood violence, poor relations with parents, drug and alcohol use, having delinquent peers, gang membership, poor school performance, and residing in a poor community with diminished economic opportunities. Some factors, termed "protective factors," help to reduce the chances of violence during adolescence. These include personal intolerance toward violent behavior and commitment to school. Other possible protective factors include a supportive relationship with parents (or other adults), and having friends who disapprove of violence. Individual characteristics (e.g., being male), as well as family (e.g., poor parent-child relations), school (e.g., academic failure), and peer group (e.g., gang membership) influences interact in complex ways with environmental conditions (e.g., neighborhood crime) to produce violent behavior. Family influences are most important before age twelve, whereas peer influences are most important during later adolescence.

PREVENTION

Although many violence prevention programs have not been properly studied or have been studied and shown to be ineffective, there are programs and strategies that work to reduce violence among adolescents. Some of these programs focus on youth in general (universal or primary prevention), whereas others are designed for youth with several risk factors (secondary prevention), or even youth that are already violent (tertiary prevention).

According to the U.S. Surgeon General's *Youth Violence Report*, primary and secondary strategies, such as programs that build individual skills and competencies (e.g., self-control, problem solving) or skills of the parent(s), that improve the social climate of the school, and that encourage positive peer relations, are highly effective approaches to prevent the onset of adolescent violence and related risk factors. Evidence also suggests that mentoring programs (pairing a young person with a supportive, nonjudgmental role model) are a viable strategy for reducing violent behaviors in

certain settings. Strategies previously believed to be effective that do not work to curb violence among youth include peer-led programs (e.g., peer counseling) and nonpromotion of youth to succeeding grades.

For already violent youth, boot camps (modeled after military basic training), shock programs that allow youth to have brief encounters with inmates who describe the brutality of prison life (e.g., "Scared Straight" programs), waivers from juvenile to adult courts, and firearm training do not deter violent behavior. In fact, some of these strategies may actually lead to higher rates of arrests and expose youth to personal harm. On the other hand, tertiary prevention programs that enhance family interaction and communication, reduce school dropout rates, change antisocial beliefs and behaviors, and provide skills training and individually tailored comprehensive services are among the most effective. Prevention efforts on all levels should use model programs that have demonstrated their effectiveness so that resources are not wasted on ineffective or harmful interventions and strategies.

LA MAR HASBROUCK

(SEE ALSO: *Antisocial Behavior; Behavior, Health-Related; Crime; Domestic Violence; Gun Control; Street Violence; Violence*)

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ADVERTISING OF UNHEALTHY PRODUCTS

The average person is exposed to over 2,500 advertisements per day, and some of these advertising messages are for products that could be considered unhealthy. Some obvious examples are cigarettes, cigars, and chewing tobacco. Other products that may be unhealthy if used to excess are alcohol, over-the-counter drugs, fast foods, and high-fat or high-cholesterol foods. Consumers need to be aware that some advertised products may be unhealthy.

ADVERTISING OF TOBACCO

According to the *Federal Trade Commission Report to Congress for 1997 Pursuant to the Federal Cigarette Labeling and Advertising Act*, tobacco companies in the United States spent a total of \$5.66 billion on advertising, promotion, and sampling in 1997.

Tobacco products, such as cigarettes, cigars, snuff, and chewing tobacco, are associated with many types of illnesses. Cigarette smoking has been connected to lung cancer, heart disease, and emphysema; the use of cigars to cancers of the mouth and throat; and the use of snuff and chewing tobacco to lesions and cancers of the mouth and lips. It is also dangerous for nonsmokers to breathe secondhand smoke and sidestream smoke

from cigarettes. Secondhand smoke has been associated with sudden infant death syndrome (SIDS). Mothers who smoke during pregnancy tend to have babies of lower birth weight.

In spite of these known risks, advertising tobacco products is still allowed in the United States and many other countries, albeit with some restrictions. For example, in the United States tobacco advertisements may not appear on radio or television, although they are allowed in newspapers and magazines intended for adult readers. Many countries require warning labels on tobacco products. Some countries require similar warning labels on the tobacco advertisements themselves. Other types of advertising restrictions may dictate the content of tobacco advertising. Most jurisdictions in the United States now forbid the use of cartoon characters in tobacco ads, a result of the mid-1990s Joe Camel campaign for R.J. Reynolds, which featured a "cool" cartoon camel that appealed to children. Canada's Tobacco Act forbids the use of people in tobacco ads, as well as the use of lifestyle advertising.

Proponents of tobacco advertising cite freedom of commercial speech as a principle. They argue that if a product is legal to sell, it should be legal to advertise. Furthermore, they insist that tobacco brand advertising is intended to encourage brand switching among adult smokers and is not intended to increase the number of smokers or the size of the tobacco market.

Opponents of tobacco advertising point out that such ads are viewed by children and underage teens. Research shows that cigarette advertising has predisposing effects, leading children to view smoking in a favorable light. As well, cigarette advertising also has reinforcing effects, encouraging youths who have started smoking to continue the habit. Many tobacco ads portray images of independence, freedom, and rebelliousness that particularly appeal to teenagers.

Tobacco companies commonly focus their campaigns on specific demographic groups. Brands such as Virginia Slims are targeted at young women aged 18 to 34, while many menthol brands are aimed at African Americans. Opponents of this practice complain that these advertising campaigns may be taking advantage of vulnerable groups. Tobacco companies commonly respond by arguing that these consumers are all adults who are able to make their own decisions.

In addition to media advertising, tobacco marketers also use other forms of promotion, such as sponsorship of cultural and sporting events. When such sporting events—for example, auto racing, golf, and tennis—are televised, cigarette marketers' brand names are prominently displayed on the screen, even though marketers may not be legally allowed to advertise on television. This loophole has been closed in some countries that have passed legislation restricting sponsorships by tobacco companies. The Olympic Committee has declared the International Olympic Games a smoke-free event.

ADVERTISING OF ALCOHOL

Taken in moderation, alcoholic beverages are not harmful for most people. Unfortunately, alcoholism has become a common problem in the United States and throughout the world. Its long-term effects can include cirrhosis of the liver and increased risk of other chronic diseases. Also, driving or operating machinery while under the influence of alcohol is extremely dangerous as well as illegal throughout North America and most parts of the world. Binge drinking, or drinking large quantities of alcohol in a short period of time, can have serious health effects including blackouts and alcohol poisoning. Women who consume alcohol during pregnancy may bear children with fetal alcohol syndrome, a serious medical condition that is characterized by decreased intellectual capacity and developmental deficits.

In spite of these dangers, alcoholic beverages are widely available and are commonly advertised around the world. In the United States beer commercials are frequently seen or heard on television, on billboards, in magazines, and on the radio. These beer commercials are often targeted toward a male young adult audience and are scheduled to appear in television shows such as football, hockey, and other sporting events, as well as sitcoms and dramas that appeal to this target group. Critics of beer advertising point out that beer commercials, with their party atmosphere and youthful spirit, may make the product more appealing to underage teens who watch many of the same television programs as young adult males.

Advertisements for hard liquor are usually not seen on television or heard on radio in the United States. The American liquor industry has made a

voluntary agreement to limit its advertising to print media, such as outdoor billboards, newspapers, and magazines. Critics of the liquor industry have charged that these billboards are disproportionately located in poor, inner-city neighborhoods, targeting low-income residents who can ill-afford these products and who are more vulnerable to the social damage they can do. The liquor industry responds to these charges by pointing out that many of these billboards are on high-traffic routes that carry traffic from all parts of the city, not just from the local neighborhood. By the same token, however, children are exposed to this advertising on their way to and from school on a daily basis.

The introduction and advertising of high-alcohol malt liquor products specifically aimed at young African-American adult males has been of particular concern to some health advocates. The liquor industry's response has been to emphasize that all adults can make their own choices about alcohol consumption, regardless of their race or ethnicity. The industry has also pointed out that the suggestion that specific ethnic groups are somehow particularly vulnerable to advertising for alcoholic beverages not only is patronizing, but is also insulting and demeaning to those groups.

ADVERTISING FOR FAST FOOD AND HIGH-FAT FOODS

Taken in small quantities, foods that are high in fat or cholesterol do not pose a health risk for most people. However, approximately 25 percent of North American adults are overweight or obese. Health professionals blame this epidemic of obesity on a sedentary lifestyle and over-consumption of foods that are high in cholesterol and fat, including high-fat meat, junk food snacks, and most types of restaurant fast food. Being overweight and having high cholesterol levels are indicators for risk of heart disease and other serious health problems.

But in spite of North America's problems with obesity and overweight, consumption at fast food restaurants continues to rise, as has consumption of snack foods such as potato chips, taco chips, and pretzels. Consumers are bombarded with advertising for McDonald's, Burger King, and other fast-food outlets. Advertisements for corn chips, potato chips, pizzas, and other snack foods surround the public. While food advertising in the United

States and many other countries must be approved by regulatory agencies, there is no limit on the quantity or type of food advertising that consumers are exposed to. Regulatory agencies simply ensure that ads are truthful and no false claims are made about food products. The fast-food industry and snack-food industry sell legitimate products that many consumers enjoy in moderation, and their commercials will continue to form a major part of the advertising landscape in most countries.

CONCLUSION

While tobacco, alcohol, and high-fat food all fall under the category of “unhealthy products,” it is important to note that they differ significantly in their degree of unhealthiness. Tobacco is the only product that kills nearly a third of its long-term users, and the addictive nature of nicotine makes it difficult for occasional smokers to avoid turning into regular users. Alcohol and high-fat food, on the other hand, can be enjoyed occasionally within the context of a healthy lifestyle. For this reason, there are usually more restrictions placed on tobacco advertising compared to other unhealthy products.

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(SEE ALSO: *Alcohol Use and Abuse; Behavioral Change; Communication Theory; Counter-Marketing of Tobacco; Eating Disorders; Mass Media; Nutrition; Smoking Behavior; Tobacco Control*)

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ADVOCACY GROUPS

See Pressure Groups

AFRICAN AMERICANS

The use of the taxonomic category African American, either in public or health or other disciplines, fundamentally reflects the historic and contemporary systems of racial stratification in American society. The term “African American,” as a categorical descriptor, includes many different segments of the American population referred to as “black” or Americans of sub-Saharan African ancestry. It is also a product of the group self-definition process in which African Americans have historically engaged as an expression of identity, power, defiance, pride, and the struggle for human rights. These designations were often in contradistinction to official government classifications and popular characterizations, which frequently reflected prevailing ideas about white supremacy intended to denigrate African Americans.

The historical roots of the nominal identity of African Americans date back to the early nineteenth century, when there were intense debates

and political movements, mostly among free blacks in the North, to reunite with their African heritage. Part of the discussion and designation also involved classification of “mixed-race” populations, whose identity raised serious questions about the relevance of racial classification based on pigmentation. According to Collier-Thomas and Turner,

From the 1830s to the middle of the 1890s, Colored American and the more commonly used derivation Colored were the most popular terms. At the beginning of the twentieth century, Negro gained considerable support as a generic term, becoming by 1920 the most commonly used expression of race. Increasing dissatisfaction with the term Negro, most noted in the late 1930s, culminated with the Black power movement of the 1960s.

During the latter period of heightened cultural nationalism, “Black” and “Afro-American” emerged as key terms for race designation and were frequently used interchangeably. More recently, in the late 1980s, “African American” was posited as the most appropriate and comprehensive race designation. This current designation not only reflects a historical lineage, but it also establishes an identity that is rooted in cultural and ethnogeographic origins, rather than skin pigmentation as defined by United States politics and policy.

One reason for the attention African Americans have given to group designations is that group classifications by the white majority were highly instrumental in attempting to justify slavery, deny basic human rights, and restrain social opportunities. These oppressive practices had the effect of subordinating African Americans. Richard B. Moore in a book entitled *The Name “Negro”: Its Origin and Evil Use* described how the skin color and other physical features of Africans who were brought into slavery “were identified in the mind of the people generally with ugliness, repulsion, and baseness.” During earlier periods of the twentieth century, white media, publishers, and the scientific community largely refused to capitalize group designations such as Black, Colored, Negro, or African. This practice was in clear contrast to references in print to whites or the Caucasian “race.” Moreover, scientific research and theories about so-called racial group differences (e.g., eugenics) were highly influential in promoting white supremacy.

Public health and medicine have historically reflected the racial inequities of American society as manifested in discrimination in medical care, research ethics and applications, professional education, and ideas about the disease etiology. Physicians in the antebellum period gave different treatment to blacks because of the belief that the black physiology was inferior to whites and thus differed with regard to intelligence, sexuality, and sensitivity to pain. These racist beliefs in the subhuman qualities of the “Black race” were responsible for blacks being used as subjects in excruciating medical experiments. For example, between 1845 and 1849, Dr. J. Marion Sims, the father of modern gynecology, subjected three African-American women in Alabama to 30 operations without anesthesia to perfect a surgical technique to repair vesicovaginal fistulas. During the same period, another physician in Georgia, Dr. Thomas Hamilton, subjected black bodies to high temperatures by burying them with their heads above ground in his quest to test the remedy for heatstroke so that slaves could work longer hours in the field. This tragic legacy of unethical race biology research was evident in the infamous Tuskegee syphilis study, in which 399 black men in Alabama unknowingly participated in a study (from 1932 to 1972) to determine the health consequences of untreated syphilis, even though there were known treatments for the disease during this period.

Some scholars have asserted that a lasting effect of this type of institutional racism has been the reluctance of many African Americans to seek medical care. The apprehension of being given different and inferior treatment or being used as guinea pigs in unethical medical research is also believed to have led to the present distrust by African Americans of prevention and treatment in HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome). Indeed, the persistence in the disparity of health outcomes between African Americans and the white population was the subject of a governmental report in 1985 documenting 60,000 excess deaths among African Americans.

Implicit in most discussions of race and health is the suggestion of a direct “racial” or genetic lineage between African Americans and Africans, advancing the notion of a defective gene pool in these populations. Ancestors of most African Americans were primarily from West Africa, and

therefore the imputed genetic heritage may not necessarily be applicable to Africans from other parts of the continent. Additionally, sickle cell anemia, which has been conventionally viewed as an African-American or "Black" genetic disease, actually evolved from a biologic adaptation among persons residing in tropical climates as a protection against malaria. However, many non-West Africans, for example, people of the Mediterranean region or descent, also have a high incidence of this disease or carry the trait but would not be considered "Black" or African American. Also, some diseases such as stomach, lung, and esophageal cancers, as well as hypertension, are higher in African Americans than many Africans and, according to a study in Chicago, low birthweight is higher among African Americans compared to Africans. These examples suggest the strong role of environmental influences rather than genetic factors. Thus putative associations with "black" skin color or other phenotypic similarities are more complex and will continue to be the subject of more public health debate with regard to the human genome project, gene therapy applications, and sociobiologic research.

Within the field of public health, there has been extensive discussion of what the term "race" actually means and its overall value. One problem is that it is seldom defined by researchers. References are frequently made to biologic, cultural, and socioeconomic factors, as well as racism and political differences, without explicitly stating their meaning or relevance. For example, although the term "African American" is generally used interchangeably with "Black" or "Negro," this is not the case with the descriptor of "non-white," which was widely used prior to 1960. This "racial" category included mostly African Americans but also Hispanic populations, Asian Americans, and Native Americans.

About 30 million persons were identified as African American in the U.S. Census of 1990. From the perspective of public health research, practice, and policy, it is not possible to view them as a monolithic or single group. While they have many commonalities, especially in terms of political opinions and interests, geographic concentrations, and some cultural patterns, it is crucial that public health professionals recognize within-group differences. Social heterogeneity among African

Americans regarding health practices or risk factors and outcomes must be carefully examined in terms of age, gender, geographic location, migratory status, social class or socioeconomic status (e.g., education and income), and nativity.

The history of social designations applied to African Americans suggests that the nominal identity of this group may change in the future to reflect the evolution of internal group consciousness, political interests, and social heterogeneity or diversity. Some groups such as "biracial" persons or foreign-born immigrants from African or Caribbean countries may choose in increasing numbers not to be viewed strictly as African American. These issues point to the dynamic nature and significance of racial classification—it has changed and will continue to change. It is also important to note that African American as a racial classification in the United States reflects the unique historical experience and journey of identity in ways that render international comparisons problematic.

In summary, being classified as African American is quite significant because it reflects an important social group transformation and reality in terms of group identity, political orientation, life chances or social opportunity, normative standards and lifestyles, and discriminatory behavior. These are some of the factors that strongly relate to disease susceptibility, quality of life, morbidity and mortality, and longevity. It is only when the reality of racial classification carries little social impact that the term will become obsolete. At the present time, it is unlikely that serious consideration can be given to eliminating the use of racial designations such as "African American" in public health.

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(SEE ALSO: *Ethnicity and Health; Ethnocentrism; Immigrants, Immigration*)

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AGENCY FOR HEALTHCARE RESEARCH AND QUALITY

The Agency for Healthcare Research and Quality (AHRQ), a part of the U.S. Department of Health and Human Services, is the lead federal agency for

research on improving the quality of health care, reducing its cost, and broadening access to appropriate services. This research is intended to bring practical, science-based information to health care practitioners, consumers, purchasers, and policy makers. Formerly known as the Agency for Health Care Policy and Research, the AHRQ is composed of ten major components, including the following six research centers: health care costs and financing, organization and delivery systems, primary care, quality measurement and improvement, outcomes and effectiveness, and practice and technology assessment. The agency also sponsors individual researchers (both within the agency and in outside institutions); national surveys (e.g., of health care costs or of health-plan members); and other projects (e.g., the National Guideline Clearinghouse, and the U.S. Preventive Services Task Force).

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(SEE ALSO: *Health Care Financing; Research in Health Departments; United States Department of Health and Human Services [USDHHS]*)

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AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Hazardous waste and toxic substances in the environment are a matter of both public concern and public health. Of particular interest to many communities are waste treatment facilities and abandoned hazardous waste sites. In response to concerns about such sites, the U.S. Congress enacted the Superfund Act of 1980, which requires the U.S. Environmental Protection Agency, in cooperation with the states, to identify hazardous waste sites and clean up those deemed most hazardous to human health and environmental quality. The act also created the Agency for Toxic Substances and Disease Registry (ATSDR) to investigate the health of persons who are potentially at risk from hazardous substances released into the environment.

Located in Atlanta, Georgia, the ATSDR is a component of the U.S. Department of Health and Human Services.

As its primary duty, in cooperation with state and local health departments, the ATSDR conducts health assessments of communities that are at risk from hazardous waste and toxic substances. The agency also develops and distributes toxicologic profiles of known toxic substances, conducts epidemiologic investigations and health surveillance programs, responds to emergency chemical events, coordinates toxicologic research on specific toxic substances, and provides environmental health training for physicians and other health care providers.

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(SEE ALSO *Environmental Determinants of Health; Environmental Protection Agency; Hazardous Waste; Toxicology; Toxic Substances Control Act*)

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AGING OF POPULATION

This term is used by demographers when referring to an increase over time in the proportion of older persons in the population. It does not necessarily imply an increase in life expectancy, that "people are living longer than they used to," or that they are dying on average at older ages, although these phenomena are usually observed in association with aging of the population. From the demographic perspective, the principal determinant of aging in the population is a decline in the birth rate. When fewer children are born than in earlier years, the consequence is a decline in the proportion of younger persons, and it necessarily follows that there is an increase in the proportion of older persons. The proportion is further weighted toward older persons by improved survival rates from conditions that can cause death in early life, that is, in infancy and childhood and among younger adults.

In the industrialized nations, a more recent phenomenon has been an increase in life expectancy that has accompanied improved survival rates, and this, of course, contributes further to the increased proportion of older persons. However, if birth rates remain high, there is also an increase in the numbers, and therefore in the proportion, of infants and children in the population. This happened in many industrialized nations after World War II, during the "baby boom" period, roughly 1946 to 1960. There was a secondary surge in birth rates when the children born during that period reached peak reproductive ages (the echo of the baby boom) in the 1980s and 1990s. The baby boom and its echo temporarily retarded and in some nations even briefly reversed the long-term trend toward smaller families. This trend began in the Western industrial nations before the 1920s and continued through the 1930s, aggravated by the Great Depression, but persisting through good times as well as bad.

Although it is true that in the past, declining birth rates were primarily responsible and reductions in mortality rates played little part in the process of aging the population, in the future it can be expected that increases in life expectancy will contribute more to the process. Little further reduction in mortality rates in the first half of life can be expected to occur, so increased life expectancy, or mortality rate reduction, in the second half of life, from age forty-five onward, is beginning to exert more influence on the structure of the population (the shape of the population pyramid). This too is contributing to an increase in the proportion of older persons in the population, and over the coming decades, other things being equal, this will play an increasingly prominent role in the process.

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(SEE ALSO: *Birthrate; Demography; Life Expectancy and Life Tables; Mortality Rates; Population Pyramid*)

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AIDS

See HIV/AIDS

AIR

See Atmosphere

AIR POLLUTION

See Ambient Air Quality (Air Pollution)

AIR QUALITY INDEX

The U.S. Environmental Protection Agency (EPA) has established an overall air quality index known as the Pollutant Standards Index (PSI). PSI values are derived from measured pollutant concentrations, which are reported daily in all urban areas of the United States with populations exceeding 200,000. The PSI is reported as a value between zero and five hundred, or as a descriptive word (e.g., “unhealthy”), and is often featured on local television or radio news programs and in newspapers.

Based on the short-term National Ambient Air Quality Standards (NAAQS), Federal Episode Criteria, and Significant Harm Levels, the PSI is computed for particulate matter that can penetrate into the lungs (PM₁₀), sulfur dioxide (SO₂), carbon monoxide (CO), ozone (O₃), and nitrogen dioxide (NO₂). Since the PSI is a tool used to communicate pollution concerns to a wide audience, there are also colors linked to the general descriptors of air quality.

The PSI integrates information on pollutant concentrations across an entire monitoring network into a single number that represents the worst daily air quality experienced in an urban area. For each of the criteria pollutants, concentrations are converted into an index value between zero and five hundred. The pollutant with the highest index value is reported as the PSI for that day. Therefore, the PSI does not take into account the possible adverse effects associated with combinations of pollutants.

A PSI value of 100 corresponds to the NAAQS established under the Clean Air Act. A PSI value greater than 100 (yellow) indicates that at least one criteria pollutant (with the exception of NO₂) exceeded the level of the NAAQS, therefore designating air quality to be in the unhealthful range on that day. Relatively high PSI values activate public health warnings. For example, a PSI above 200 (orange) initiates a First Stage Alert, at which time sensitive populations (e.g., the elderly and persons with respiratory illnesses) are advised to remain indoors and reduce physical activity. A PSI above 300 (red) initiates a Second Stage Alert, at which time the general public is advised to avoid outdoor activity.

Since a PSI value greater than 100 indicates that the level of the NAAQS for at least one criteria pollutant has been exceeded on a given day, the number of days with PSI values greater than 100 provides an indicator of air quality in urban areas. Between 1988 and 1997, the total number of days with PSI values greater than 100 decreased 56 percent in Southern California and 66 percent in the remaining major cities across the United States.

PSI estimates depend on the number of pollutants monitored as well as the number of monitoring sites where data are collected. The more pollutants measured and sites that are available in an area, the better the estimate of the PSI for a given day. Ozone accounts for the majority of days with PSI values above 100, and the number of days with a PSI above 100 are increasingly due to ozone. In fact, the percentage of days with a PSI above 100 due to ozone increased from 92 percent in 1988 to 97 percent in 1997. The increase is even more dramatic when the unusual meteorology experienced in 1988 is taken into account (the 1989 percentage was 82%).

MORTON LIPPMANN

(SEE ALSO: *Airborne Particles; Ambient Air Quality [Air Pollution]; Atmosphere; Carbon Monoxide; Environmental Determinants of Health; Hazardous Air Pollutants*)

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AIRBORNE PARTICLES

A suspension of airborne particles, whether liquid droplets or solids, is generally referred to as an aerosol. As toxicants, airborne particles are more complex than pollutant gases and vapors because of the additional variables of particle size and mixed chemical composition. Size affects particle motion and the probabilities for physical phenomena such as coagulation, dispersion, sedimentation, and impaction onto surfaces. It is not possible to fully characterize a given particle by a single size parameter. For example, a particle's aerodynamic properties depend on density and shape as well as linear dimensions.

Typically, aerosols are composed of particles of many different sizes and are therefore called "heterodisperse" or "polydisperse." Different aerosols have different degrees of size dispersion. It is therefore necessary to specify at least two parameters in characterizing aerosol size: a measure of central tendency, such as a mean or median, and a measure of dispersion, such as a geometric standard deviation.

Many properties of particles, other than their linear size, can greatly influence their airborne behavior and their effects on the environment and health. For spherical particles, the surface increases with the square of the diameter. However, for an aerosol of given mass concentration, the total aerosol surface increases with decreasing particle size. Particle volume varies as the cube of diameter, therefore the few largest particles in an aerosol tend to dominate its volume concentration, and a particle's shape affects its motion and deposition probabilities. A particle's velocity in response to gravitational or inertial forces increases as the square root of its density. The diameter of a unit-density sphere having the same terminal settling velocity as the particle under consideration is equal to its aerodynamic diameter. Aerodynamic diameter is determined by the actual particle size, the particle density, and an aerodynamic shape factor.

Aerosols are generally classified in terms of their processes of formation. Dust is an aerosol formed by mechanical subdivision of bulk material into airborne fines having the same chemical composition. Dust particles are generally solid and irregular in shape and have diameters greater than

1 micrometer. A fume is an aerosol of solid particles formed by condensation of vapors formed at elevated temperatures. The primary particles are generally very small (less than 0.1 micrometer) and have spherical or characteristic crystalline shapes. Since they may be formed in high number concentrations, they often rapidly coagulate, forming aggregate clusters of low overall density.

Smoke is formed by condensation of combustion products, generally of organic materials. The particles are generally liquid droplets with diameters of less than 0.5 micrometer. Mist is droplet aerosol formed by mechanical shearing of a bulk liquid; for example, by atomization, nebulization, bubbling, or spraying. The droplet size can cover a very large range, usually from about 2 micrometers to greater than 50 micrometers.

Fog is an aqueous aerosol formed by condensation of water vapor on atmospheric nuclei at high relative humidities. The droplet sizes are generally greater than 1 micrometer. Smog is a popular term for a pollution aerosol derived from a combination of smoke and fog. The term is now commonly used for any atmospheric pollution mixture.

Aerosols have integral properties that depend upon the concentration and size distribution of the particles. Some integral properties such as light-scattering ability or electrical charge depend on other particle parameters as well. Some of the important integral properties are:

- Number concentration, which is the total number of airborne particles per unit volume of air, without distinction as to their sizes.
- Surface concentration, which is the total external surface area of all the particles in the aerosol, may be of interest when surface catalysis or gas adsorption processes are of concern. Aerosol surface is one factor affecting light-scatter and atmospheric-visibility reductions.
- Mass concentration, which is the total mass of all the particles in the aerosol, is frequently of interest. The mass of a particle is the product of its volume and density. If all of the particles have the same density, the total mass concentration is simply the volume concentration

times the density. In some cases, such as “respirable,” “thoracic,” and “inhalable” dust sampling, the parameter of interest is the mass concentration over a restricted range of particle size.

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(SEE ALSO: *Ambient Air Quality [Air Pollution]; Hazardous Air Pollutants; Inhalable Particles [Sulfates]; National Ambient Air Quality Standards; Smog [Air Pollution]; Sulfur-Containing Air Pollutants [Particulates]; Total Suspended Particles [TSP]*)

ALCOHOL USE AND ABUSE

Ethyl alcohol, or ethanol, is the most commonly used drug in the world. Pharmacologically, alcohol is classified as a central nervous system depressant. Like other depressants, in small doses alcohol slows heart rate and respiration, decreases muscular coordination and energy, dulls the senses, and lowers inhibitions—resulting in feelings of relaxation and greater sociability. Large amounts of alcohol can result in depression of the various body systems, resulting in coma or death. The immediate physical effects of alcohol depend on the amount and frequency of drinking, while the mental and emotional effects are influenced by the mood of the drinker and the setting in which drinking takes place.

Two physical effects resulting from prolonged, heavy alcohol use include tolerance and withdrawal. Alcohol tolerance refers to the need for increased amounts of alcohol to achieve the same level of intoxication. For example, five or six drinks may be needed to achieve the same effects produced by one or two drinks when the individual first began drinking. Alcohol withdrawal, on the other hand, refers to a number of physical and psychological reactions an individual experiences when significantly reducing or stopping prolonged heavy drinking. Symptoms of withdrawal include nausea, vomiting, anxiety, and hand tremors.

An interaction of biological, psychological, and environmental factors come into play in the development of drinking behaviors and problems. For example, some individuals may be genetically predisposed to alcohol problems, but whether or

not they actually experience negative alcohol consequences will also depend upon their immediate social and physical surroundings, such as family drinking patterns and alcohol availability, as well as their drinking habits.

ALCOHOL USE AND MISUSE

Most people who drink alcohol do so without negative consequences. Others may actually obtain a health benefit from its use. Some, however, drink in ways that place themselves or others at risk for experiencing alcohol-related problems. While no pattern of alcohol use is without risk, certain drinking patterns may help reduce risk significantly.

The Dietary Guidelines for Americans, issued jointly by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services, define moderate drinking as no more than two standard drinks per day for men, and no more than one per day for women and people sixty-five years of age and older. A standard drink is 0.5 ounces of alcohol, equivalent to 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of 80-proof distilled spirits. These guidelines suggest that moderate or low alcohol use is linked to a reduced risk for the occurrence of negative alcohol consequences. For others, however, abstaining from all alcohol consumption is the safest thing to do. Groups who should avoid all alcohol use include pregnant women, children and adolescents, those planning to drive or participate in other activities requiring alertness, people who cannot maintain moderate alcohol use, and those who are using over-the-counter or prescription medicines that interact with alcohol.

Another way to understand drinking problems is to examine definitions of alcohol misuse. The World Health Organization (WHO) defines alcohol misuse as alcohol use that places people at risk for problems, including “at-risk use,” “clinical alcohol abuse,” and “dependence.” At-risk alcohol use is the consumption of alcohol in a way that is not consistent with legal or medical guidelines, and it is likely to present risks of acute or chronic health or social problems for the user or others. Examples include underage drinking; drinking by individuals with a family history of alcoholism or problem drinking; or drinking if one has a medical

condition that could be worsened by drinking, such as a stomach ulcer or liver disease. Clinical alcohol abuse is a more serious type of misuse that results in one or more recurrent, adverse consequences, such as failure to fulfill important obligations or the repeated use of alcohol in physically dangerous situations. Alcohol dependence is the most severe type of alcohol misuse and involves a chronic disorder characterized by three or more symptoms within a twelve-month period. These symptoms include alcohol tolerance, withdrawal, loss of control, and continued use despite knowledge of having a physical or psychological problem.

Negative consequences resulting from alcohol use are estimated to affect more than 10 percent of the U.S. population, with many of these individuals going undetected. A number of brief screening tools are available to help detect possible alcohol problems. One of the most widely used among these is the four-item CAGE questionnaire, which derives its name from the following four self-administrated questions:

1. Have you ever felt you should **C**ut down on your drinking?
2. Have people **A**nnoyed you by criticizing your drinking?
3. Have you ever felt bad or **G**uilty about your drinking?
4. Have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover (**E**ye-opener)?

Answering “yes” to as few as one or two items on the CAGE questionnaire may indicate a drinking problem.

PREVALENCE

In the United States, 44 percent of adults eighteen years of age and older are current drinkers, consuming at least twelve drinks in the last year. Meanwhile, 7.4 percent, or approximately 14 million Americans, experience alcohol abuse or alcohol dependence. Heavy episodic or binge drinking has remained at the same approximate level of 16 percent for all adults since 1988, with the highest rate, 32 percent, among young adults ages eighteen to twenty-five. Over one-half of adults report having a close family member who has experienced alcoholism.

As few as 5 percent of the heaviest drinkers consume as much as 42 percent of the alcohol drunk in the United States, and 20 percent of drinkers account for nearly 90 percent of the alcohol consumed. The bulk of the alcohol drunk in the United States, therefore, is consumed by a relatively small population of very heavy drinkers.

Alcohol is also the drug most frequently used by children and adolescents. In 1999, over half (52%) of eighth graders (14-year-olds) and 80 percent of twelfth graders (18-year-olds) reported having used alcohol at least once. More problematic drinking occurs in 15 percent of eighth graders and 31 percent of twelfth graders, who reported binge drinking (consuming five or more drinks in a row) in the previous two weeks. Of American high school adolescents, over half (51%) currently drink alcohol. In 1999, one in three high school students reported heavy episodic drinking of five or more drinks on at least one occasion during the previous thirty days. The prevalence of heavy drinking commonly increases through adolescence into early adulthood.

HEALTH OUTCOMES

Alcohol use has health and social consequences for those who drink, for those around them, and for the nation as a whole. Approximately 100,000 deaths each year are attributed to alcohol use, making it the third leading cause of preventable mortality in the United States. Worldwide, 750,000 deaths are attributed to alcohol use each year. Alcohol-related deaths occur from cancer, cirrhosis of the liver, pancreatitis, motor-vehicle crashes, falls, drowning, suicide, and homicide. Alcohol affects nearly every system in the body, and contributes to a range of medical problems, including altered immune system functioning, bone disease, hypertension, stroke, cardiovascular disease, reduced cognitive functioning, fetal abnormalities, traumatic injury, depression, gastrointestinal disorders, and cancers of the neck, head, stomach, pancreas, colon, breast, and prostate. Alcohol also produces significant social problems, including domestic violence, child abuse, marital and family disruption, violent crime, motor-vehicle crashes, worksite productivity losses, absenteeism, and lowered school achievement. The estimated cost of alcohol misuse in the United States in 1998 was nearly \$185 billion.

Young people are particularly vulnerable to acute alcohol effects due to their lower tolerance to alcohol, their lack of experience with drinking, and drinking patterns that often include heavy episodic drinking in high-risk situations, such as during driving and sexual encounters. Leading causes of mortality and morbidity among youths include alcohol-related motor-vehicle injuries, homicide, and suicide. Alcohol use among young people is associated with reduced scholastic achievement, increased delinquency, and the development of psychiatric problems later in life. Alcohol has also been found to precede other illicit drug use, thereby serving as a “gateway” to other drug consumption, including marijuana and cocaine use.

Women and the elderly are also at greater risk for experiencing alcohol harm because of their lower levels of body water, meaning that smaller amounts of alcohol result in higher levels of intoxication than in younger men. Drinking during pregnancy has been linked to higher rates of miscarriage, stillbirth, and premature births, and fetal alcohol syndrome—a set of birth defects caused by maternal consumption of alcohol during pregnancy. For the elderly, drinking even modest amounts of alcohol may cause considerable problems due to chronic illness, interactions with medications, and grief and loneliness from the death of loved ones.

At the same time, moderate to low levels of alcohol consumption have been linked to a lower risk for heart disease and stroke. These positive effects appear to be confined primarily, however, to middle-aged and older individuals in industrialized countries with high rates of cardiovascular diseases. Individuals and populations must weigh the risks and benefits of drinking to themselves and others, including such factors as the situations under which drinking is to take place and the amount likely to be consumed, to determine the net results of drinking.

SOLUTIONS

The burden of alcohol misuse is measured in a number of ways, including the prevalence and incidence of deaths, injuries, and illnesses attributed to alcohol; hospitalization rates; potential years of life lost to alcohol misuse; and quality of life indicators. Vast resources are expended each year in the United States to address the health and

social problems resulting from alcohol misuse. Because no single solution can reduce all alcohol-related harm to individuals and populations, a comprehensive approach using a range of strategies that address the multiple causes and dimensions of alcohol problems is needed. These strategies should include educational approaches—such as public health education and awareness programs, including school, family, and community-based prevention programs; environmental approaches—such as controls on the price and availability of alcohol, minimum age for purchase of alcohol, legislative measures to curb driving under the influence of alcohol, and restrictions on the promotion, marketing, and advertising of alcohol; and health care efforts—such as primary health care screening, advice by health care providers, preventive services, and effective treatment using psychological and pharmacological approaches.

For more information about alcohol use among individuals and populations, its relation to health and social problems, or how to reduce alcohol risk, contact the following:

- National Institute on Alcohol Abuse and Alcoholism (NIAAA), Scientific Communications Branch, (301) 443-3860, or online at <http://www.niaaa.nih.gov>.
- Substance Abuse and Mental Health Services Administration, National Clearinghouse for Alcohol and Drug Information, (800) 729-6686, or online at <http://www.health.org>.
- National Council on Alcoholism and Drug Dependence, (800) NCA-CALL, or online at <http://www.ncadd.org>.
- *Healthy People 2010*, Objectives on Substance Abuse, (800) 336-4797, or online at <http://www.health.gov/healthypeople>.
- World Health Organization, Health Communication and Public Relations, 41 22/791/2543, or online at <http://www.who.ch/>.

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(SEE ALSO: *Addiction and Habituation*; *Center for Substance Abuse Prevention*; *Drug Abuse Resistance Education [DARE]*; *Substance Abuse, Definition of*)

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ALCOHOLISM

See Alcohol Use and Abuse

ALMA-ATA DECLARATION

The International Conference on Primary Health Care was convened in Alma-Ata, Kazakhstan, in 1978, and was attended by virtually all the member nations of the World Health Organization (WHO) and UNICEF. The Alma-Ata Declaration of 1978 emerged as a major milestone of the twentieth century in the field of public health, and it identified primary health care (PHC) as the key to the attainment of the goal of Health for All (HFA). Following are excerpts from the declaration:

1. The Conference strongly reaffirms that health, which is a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity, is a fundamental human right and that the attainment of the highest possible level of health is a most important world-wide social goal whose realization requires the action of many other social and economic sectors in addition to the health sector.
2. The existing gross inequality in the health status of the people, particularly between developed and developing countries as well as within countries, is politically, socially, and economically unacceptable and is, therefore, of common concern to all countries.
4. The people have a right and duty to participate individually and collectively in the planning and implementation of their health care.
6. Primary health care is essential health care based on practical, scientifically sound, and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination. It forms an integral part both of the country's health

system, of which it is the central function and main focus, and of the overall social and economic development of the community. It is the first level of contact of individuals, the family, and community with the national health system bringing health care as close as possible to where people live and work, and constitutes the first elements of a continuing health care process.

10. An acceptable level of health for all the people of the world by the year 2000 can be attained through a fuller and better use of the world's resources, a considerable part of which is now spent on armaments and military conflicts. A genuine policy of independence, peace, détente, and disarmament could and should release additional resources that could well be devoted to peaceful aims and in particular to the acceleration of social and economic development of which primary health care, as an essential part, should be allotted its proper share.

TWENTIETH-ANNIVERSARY MEETING IN ALMATY

In the ensuing years, several United Nations agencies and conferences have formulated strategies for human development stressing equity, the well-being of populations, and the alleviation of suffering and ill health.

In 1998, an International Meeting on Primary Health Care, held in Almaty, Kazakhstan (same city, changed name) recognized the historical significance of the 1978 conference and the Declaration of Alma-Ata. It is useful to quote some of the reflections of leaders in the health sector with respect to the twentieth-anniversary meeting in Almaty on their reflections on Alma-Ata.

- *Dr. Gro Harlem Brundtland, Director General of WHO:* "Health for All is a message to all stakeholders. Considering the forces shaping the world, with both progress in health and growing inequalities, there is a place for 'a new universalism' in health: with universal access to quality care as the bedrock principle. Commitment to primary health care, still a crucial part of

the health sector twenty years after Alma-Ata. Reduce disparity between the outcomes of poor and those better off, anchored in equity and solidarity."

- *Dr. Halfdan Mahler, Director General Emeritus of WHO:* "Health is not a commodity that is given. It must be generated from within. Health action should not be imposed from the outside, foreign to the people; it must be a response of the communities to problems they perceive, supported by an adequate infrastructure. This is the essence of the filtering inwards process of primary health care."
- *Dr. Jo E. Asvall, Regional Director Emeritus, European Office of WHO:* "The European Health for All Policy—Health 21—takes the PHC issue more seriously than ever before. Health 21 goes deeper into discussions of how PHC in our pluralistic societies at the end of the twenty-first century needs to be designed to embrace all the major components of lifestyles, environment, and health care issues."
- *Dr. Carl Taylor, Professor Emeritus, Johns Hopkins University:* "New understanding of growing social pressures and rapidly growing impatience of deprived millions around the world make this a critical time to promote community-based primary health care and social mobilization—goals which have recently been given special priority by UNICEF."

At the twentieth-anniversary meeting in Almaty, those present recognized that the principles and actions that characterize PHC at a global level include the strengthening of equity, health gain, quality of care, gender sensitivity, acceptability, participation, cost-effectiveness, and other HFA values.

PRIMARY HEALTH CARE IN RURAL HAITI

Given the global importance of primary health care on the one hand, and the need to adapt it to the specific concerns of local populations on the other, it is instructive to look at a case study that illustrates some of its essential dimensions.

The Hospital Albert Schweitzer (HAS) in the Artibonite Valley of rural Haiti was founded in 1952 as a private, not-for-profit organization. The HAS programs evolved from being mainly hospital based—serving those who could reach the institution—to recognizing the importance of primary health care that can reach every person in the population. This is accomplished through programs organized around three levels of health care: (1) home visiting by local health workers trained in fundamental disease-prevention and health-promotion programs; (2) health centers within reach of every community, where local health workers can provide curative and preventive care; and (3) hospital care, which serves as a back-up for all peripheral services and can provide advanced curative care as needed.

While there are modest financial charges for care, no one is denied care because of cost. The programs are built on extensive discussions and interactions with community people as well as with the government of Haiti. A health information system provides data that directs care toward all in the population, with particular concern for those who may be in special need, such as people who live in remote mountain areas. Responding to differential needs is an example of the pursuit of equity. Continuous interactions with government are oriented toward sharing knowledge and methods so as to benefit the larger population of Haiti.

The Declaration of Alma-Ata was a foundational event in the modern history of public health. While not all of its goals have been achieved, and the changing international health and development sector have called for adaptations of the PHC concept, there is no doubting the importance of Alma-Ata and its contributions through the concepts of Health for All and primary health care.

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(SEE ALSO: *Health; International Health; Primary Care; UNICEF; World Health Organization*)

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ALTERNATIVE, COMPLEMENTARY, AND INTEGRATIVE MEDICINE

CONVENTIONAL MEDICINE AND PUBLIC HEALTH

Traditionally, public health relies extensively on conventional (allopathic) medicine in its mission to prevent and treat disease. It accepts reductionistic methods to identify the origin of illness at the cellular and subcellular level, and then applies these principles in assessing and addressing risk factors in populations. This results in a three-tiered approach to the delivery of public health services: (1) primary prevention, which involves efforts to reduce exposure to risk factors for injury and illness; (2) secondary prevention, which involves the identification and control of disease in its early stages; and (3) tertiary prevention, which attempts to control the impact of existing illness and injury through prolonged treatment and rehabilitative services.

Paralleling the growth of technology-based medicine (and its effectiveness), however, has been a simultaneous rise in chronic illnesses that are resistant to current treatment modalities and very costly to society. Leading causes of morbidity in the early 1900s, such as trauma and infectious disease, have been supplanted by chronic conditions such as cancer, heart disease, and HIV (human immunodeficiency virus) infection. This requires the development of a new model of health care that is multidimensional and that recognizes all factors influencing health and illness. At a public health level, multidimensional problems require multidimensional interventions, which is the basis of the integrative medical approach.

COMPLEMENTARY AND ALTERNATIVE MEDICINE

In 1948, the World Health Organization (WHO) defined health as “a complete state of physical,

mental, and social well-being and not merely the absence of disease or infirmity.” The public increasingly embraces “holistic” medicine when seeking treatment for chronic medical conditions. This philosophical shift has led to a sharp increase in the use of complementary and alternative medicine (CAM), defined as modalities (e.g., acupuncture, herbal therapy, massage therapy), employed in place of, or as adjuncts to, conventional medical therapies. Surveys reveal that almost half of the U.S. population turns to such modalities, with acceptance and use of CAM expanding during the 1990s. Studies showing that CAM use tends to be higher among patients with diseases (e.g., cancer, arthritis), that are often inadequately treated by conventional approaches may suggest an inherent dissatisfaction with Western medicine. Research suggests, however, that the public is actually turning to CAM because its doctrines parallel their own personal values and belief systems. For example, patients want physicians who regard them as whole persons—minds and spirits as well as bodies—and who believe in the healing power of nature. In fact, although CAM therapies are very diverse, ranging from well-established cultural traditions (e.g., Chinese traditional medicine) to quasi-allopathic modalities marginally supported by current science (e.g., chelation therapy), most share common underlying philosophies. These include a belief in the interconnectedness of mind and body and respect for the innate mechanisms of healing.

INTEGRATIVE MEDICINE

Practitioners of conventional medicine are justifiably proud of the achievements of their profession—most notably the diagnostic, pharmacological, and surgical advances of the twentieth century. Total reliance on such technologies, however, has led to the dismissal of CAM modalities as archaic or ineffective. The result has been increasing divisiveness between proponents and opponents of unconventional therapies.

The descriptive phrase “integrative medicine,” coined in the late twentieth century, characterizes a new model of health care rooted both in conventional and alternative medicine. In the broadest sense, integrative medicine employs modalities drawn from all medical therapeutic paradigms,

providing patients with individualized treatment plans optimized for their specific clinical situations. The underlying philosophy recognizes and relies upon the innate healing capacity of the human body and emphasizes the importance of the relationship between practitioner and patient in fostering this capacity.

While incorporating aspects of both conventional medicine and CAM, integrative medicine does not uncritically accept either without evidence of validity and efficacy. Additionally, in weighing both the benefits and risks inherent to any therapy, regardless of its origin, the integrative practitioner initially selects the least invasive, least toxic, and least costly interventions appropriate to the situation.

A cornerstone of the integrative model is the assertion that health and healing optimally occur when all factors that influence the organism are addressed. To quote Sir William Osler (1849–1919), “It is more important to know what sort of patient has a disease than what sort of disease a patient has.” Therefore, although a patient presents specific symptoms, the integrative practitioner inquires into all lifestyle, psychosocial, and spiritual influences affecting quality of life. The ensuing treatment plan includes recommendations such as dietary change, increase in physical activity, and stress reduction in addition to any specific therapies. Positive coping skills such as biofeedback, yoga, prayer, meditation, and community involvement are promoted.

Although the breadth and depth of CAM is beyond the scope of this chapter, a few of the more recognized and researched modalities are listed below:

1. *Acupuncture*: The insertion of thin, stainless steel needles into the skin at specific locations (channels or acupoints) to affect the flow of Qi (energy) in the body. Releasing blockages of energy flow facilitates symptom relief and healing of illness.
2. *Homeopathy*: Developed in Germany in the eighteenth century, homeopathic remedies are created from plant, animal, or mineral products diluted thousands-fold in water or alcohol. Based on the theory of “like cures like,” the remedies are used to treat

illnesses whose symptoms might be elicited by administration of the full-strength product.

3. *Massage therapy*: A wide variety of physical manipulative techniques designed to promote relaxation, thereby treating conditions exacerbated by tension such as headaches, insomnia, and post-surgical trauma.
4. *Naturopathic medicine*: Although similar to allopathic medicine in diagnostic techniques, naturopathic physicians avoid drugs, major surgery, and cutting-edge technology and instead rely on treatment approaches designed to strengthen the body's own healing capabilities.
5. *Prayer and spirituality*: Often considered "alternative" by conventional medical standards, prayer and spirituality help patients maintain a sense of purpose, meaning, and hope in the face of pain, suffering, and uncertainty through relationship with one's own God or supreme being.
6. *Chinese traditional medicine*: Utilizing methods such as herbal remedies, acupuncture, diet, meditation, and exercises such as qigong and tai chi, CTM seeks to achieve overall balance of health in preventing as well as treating illness.

Fundamental to the integrative model is the therapeutic relationship between the patient and doctor. Practitioners recognize that they are not the source of healing, but the means by which patients discover, or rediscover, their innate capacity to regain health. Therapeutic modalities, whether conventional or alternative, are simply adjuncts to this process; patients must take responsibility for their own health and well-being. To this end, each therapeutic decision is the result of a consideration of all appropriate modalities, whether conventional or CAM. Patients are thus active partners in choosing therapies consistent with their values and philosophical beliefs.

INTEGRATIVE MEDICINE AND THE FUTURE OF HEALTH CARE

No one denies the existence of a crisis in the delivery and financing of health care. The arrangement of unregulated fee-for-service practices, reimbursement through managed care, and costly

defensive medicine has complicated rather than alleviated the burden of escalating chronic illness associated with an aging population. The ensuing national debate has focused upon repair of this system, rather than the creation of a new design.

An integrative approach to public health redefines the ideology of the system rather than attempting to repair the current model. It looks to equitable and universal access to health maintenance services, and focuses on disease prevention as well as on current treatments, which may not always be effective. Decisions regarding the provision of health care therefore do not simply originate from within the medical and reimbursement sectors, but become a social contract among individuals, providers, hospitals, academic institutions, corporations, communities, and governmental agencies. Individuals become accountable for the impact their behavioral choices have upon the community as well as on their own personal well-being. Health care providers and hospitals work to prevent illness as well as treat it, emphasizing accountability to the individual and the community over financial profit. Academic institutions develop programs that promote the synergistic training of students of medicine, nursing, pharmacy, and others involved in patient care. Corporations recognize the overall value of healthy employees and invest in individual and organized wellness programs. Communities acknowledge that health is not only the result of good medical care, but also of adequate housing, sanitation, and education. Finally, government serves as a safety net, ensuring access to medical care when all other resources fail, as well as enacting and enforcing legislation designed to protect both the individual and the health care system. Thus, the concept of integrative medicine encompasses not only the health of the individual, but of society as a whole.

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(SEE ALSO: *Chinese Traditional Medicine; Holistic Medicine; Prevention; Preventive Health Behavior; Preventive Medicine*)

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ALZHEIMER'S DISEASE

Alzheimer's disease is a neurodegenerative disorder characterized by loss of memory along with other cognitive changes, including aphasia (language impairment), apraxia (difficulty carrying out motor activities despite intact motor function), and agnosia (difficulty recognizing or identifying objects despite intact sensory function). There is a significant impairment in social and occupational functioning, as well as a behavioral disturbance commonly occurring in the disorder that may include apathy, loss of interest in daily activities, delusions, hallucinations, preservation, disinhibition, and depression. The cognitive, functional, and behavioral components have different manifestations at different stages of the disease, and the course of the disease is characterized by gradual onset and continuing cognitive decline.

The functional change is generally hierarchical, beginning with changes in instrumental activities of daily living (using the telephone, shopping, food preparation, housekeeping, accessing transportation, taking medications, handling finances)

and later affecting the basic activities of daily living (toileting, feeding, dressing, grooming, physical ambulation, and bathing). The onset of the disorder is insidious, and the disease progresses over ten to twenty years. In the early stages the individual may require supervision or assistance for activities such as managing finances and shopping. In the later stages, 24-hour help may be required. Social skills are often preserved until the later stages, and individuals may be very impaired or be at significant risk before the disease is recognized.

CAUSES

The cause of Alzheimer's disease is not understood completely. Age is the biggest risk factor, but other risk factors may be involved, including a low level of education and significant head injury. A family history of the disease also increases the risk. With familial Alzheimer's the inheritance is autosomal dominant, and chromosomes 1, 14, 19, and 21 have been identified as important in the inheritance. It appears that individuals with the gene apolipoprotein E4 have an increased risk, while the genes apoE2 and apoE3 may have a protective function. ApoE status, however, is not considered a part of predictive testing and apoE4 is not considered a cause of the disease. The genetics of Alzheimer's disease suggest a heterogeneous disorder, and several other genes are being investigated.

Alzheimer's disease is the most common type of dementia in older people. Prevalence estimates of dementia in Canada suggest that 8 percent of all Canadians age 65 and over have some type of dementia. Of these, 5.1 percent have Alzheimer's disease. In the larger population, rate for Alzheimer's disease was 1 percent in the 65 to 74 age group and 26 percent in those over 85 years. For all types of dementia the rates were 2.4 percent and 34.5 percent respectively. These rates are comparable to those found in incidence studies conducted in New York.

DIAGNOSIS AND TREATMENT

The diagnosis of Alzheimer's disease is made by taking a history documenting the changes in capacity compared with previous abilities. It is usually necessary to obtain collateral information from

a close relative or friend in order to ascertain changes, particularly in the early stages of the disorder. An individual's general medical and surgical histories also need to be reviewed, including neurological and psychiatric histories. A complete physical examination, including a neurological examination, is imperative, along with a mental status screening test and blood work. A computed tomographic scan of the head may be helpful in some cases, particularly in patients under sixty years of age, or when there is rapid unexplained decline in cognition or function, a duration of dementia of less than two years, recent and significant head trauma, unexplained neurologic symptoms such as new onset of severe headache or seizures, and in various other instances. Other radiologic evaluations may be done, as well as certain specialized evaluations not usually part of routine clinical practice, including functional MRI and proton emission tomography (PET).

Management of Alzheimer's disease includes attention to specific problems such as safety, driving capacity, medication compliance, managing finances, and nutrition. Assistance by family members, friends, and professional persons such as lawyers and accountants can be very helpful, as can access to support services such as adult day centers and local Alzheimer's support groups. Identifying and specifically treating depression, agitation, and sleeplessness with medication and environmental modification is also important.

Judicious use of certain drugs to treat various symptoms of the disease can be undertaken as appropriate. These often include cholinesterase inhibitors such as donepezil, rivastigmin, and tacrine. In addition, some individuals advocate up to 2000 IU of vitamin E per day, ginkgo biloba, and other compounds. These therapies tend to provide symptomatic treatment and potential stabilization of the disorder for a period of time. Future therapies may include biomedical engineering for beta amyloid protein and immunization.

A diagnosis of Alzheimer's disease can be confirmed only with a brain biopsy, or through microscopical study of the brain after death. The typical lesions found include neurofibrillary tangles, senile (amyloid) plaques, and neuritic plaques. The latter is composed of a central core of homogeneous material, primarily beta amyloid, and a

reactive outer zone with fibrillary and cellular material. Tau protein is the main constituent of the paired helical filaments of the neurofibrillary tangles. Other constituents include ubiquitin, a widely distributed protein. Attempts to standardize neuropathological diagnosis of Alzheimer's disease have been undertaken by Zaben Khachaturian and by the Consortium to Establish a Registry for Alzheimer's Disease (CERAD).

Diagnosis can be confusing because there are other disorders that cause dementia, including multiple strokes, Pick disease, Lewy body dementia, and disorders associated with other neurodegenerative diseases such as progressive palsy (PSP), Parkinson's disease, and Huntington's disease. Differential diagnosis is therefore an important consideration.

As with many diseases, a number of ethical and legal issues are raised when dealing with those afflicted with Alzheimer's disease. These issues revolve around questions of daily living, such as whether it is safe for an individual to drive, to continue to live at home, and to handle financial responsibilities; and around scientific questions, particularly how cognitively impaired persons can take part in research programs. Disclosing the diagnosis of Alzheimer's disease to family members and others also causes concerns. Disclosure of the diagnosis should include a discussion of prognosis, advance planning, treatment options, support groups, and future plans.

B. LYNN BEATTIE

(SEE ALSO: *AARP; Dementia; Geriatrics; Gerontology; National Institute on Aging*)

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AMBIENT AIR QUALITY (AIR POLLUTION)

Human exposures to airborne chemicals vary widely among inhalation microenvironment categories, which include workplaces, residences, outdoor ambient air, transportation, recreation areas, and public spaces. There are also wide variations in exposure within each category, depending on the number and strength of the sources of the airborne chemicals, the volume and mixing characteristics of the air within the defined microenvironment, the rate of air exchange between indoor and outdoor air, and the rate of loss to surfaces within the microenvironment.

Exposures to airborne chemicals in the workplace are extremely variable in terms of composition and concentration, depending on the materials being handled, the process design and operation, the kinds and degree of engineering controls applied to minimize releases to the air, work practices followed, and personal protection provided. Airborne chemicals in residential microenvironments are attributable to their presence in the air infiltrating from out of doors and to their release from indoor sources, such as unvented cooking stoves and space heaters, cigarettes, and consumer products, including volatile emissions from wallboard, textiles, carpets, and other materials. Indoor

sources can release nitrogen dioxide (NO₂), fine particle mass (FPM), and formaldehyde (HCHO) to such an extent that indoor concentrations for these chemicals can be much higher than those in ambient outdoor air.

For pollutants having National Ambient Air Quality Standards (NAAQS), such as particulate matter, NO₂, carbon monoxide (CO), ozone (O₂), lead (PB), and sulfur dioxide (SO₂), there is an extensive network of fixed-site monitors, generally on rooftops. Although these devices generate large volumes of data, the concentrations at these sites may differ substantially from the concentrations that people breathe, especially for tailpipe pollutants such as carbon monoxide.

Transportation sources represent a significant source of exposures. Many people spend up to three hours each day in autos or buses as they go to work, to school, or shopping. Inhalation exposures to CO in vehicles and garages can represent a significant fraction of total CO exposures. Recreational exposure while exercising may also be important to total daily exposure because the increased respiratory ventilation associated with exercise can produce much more than proportional increases in delivered dose and functional responses.

Current concern regarding community air quality, is focused on particulate matter (PM) and ozone. A broad variety of processes produce suspended particulate matter (PM) in the ambient air in which we live and breathe, and there are statistically significant associations between the concentrations of airborne PM and the rates of mortality and morbidity in human populations. The PM concentrations have almost always been expressed in terms of mass. Also, in studies that reported on associations between health effects and more than one mass concentration, the strength of the association generally improves as one goes from total suspended particulate matter (TSP) to thoracic particulate matter (PM10 microns or less in aerodynamic diameter [PM10]), to fine particulate matter (PM2.5 microns or less in aerodynamic diameter [PM2.5]).

MORTON LIPPMANN

(SEE ALSO: *Airborne Particles; Carbon Monoxide; Clean Air Act; Hazardous Air Pollutants; Inhalable*

Particles [Sulfates]; Lead; National Ambient Air Quality Standards; Smog [Air Pollution]; Sulfur-Containing Air Pollutants [Particulates]; Total Suspended Particles [TSP]

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AMBIENT WATER QUALITY

Water is a major pathway by which humans and all life-forms can be exposed to chemicals and pathogens. Several different sources of water pollution exist. "Point source" and "nonpoint source" are terms used to describe two such routes of entry.

Point-source pollutants, the most common violators of water quality standards, enter waterways at well-defined locations, such as a pipe or sewer outflow. These discharges are even and continuous. Industrial factories, sewage treatment plants, and storm-sewer outflows are common point sources of water pollution. A reduction of point-source pollutants has been accomplished during recent decades, because the products of these sources are easy to find and treat.

Unlike point sources, which have distinct entries, nonpoint-source pollutants run off or seep into waterways from broad areas of land. Nonpoint sources are the largest contributors to water pollution. It is estimated that 98 percent of bacterial contaminants and 73 percent of biological oxygen demand are due to nonpoint sources. Various human land-use practices cause nonpoint-source pollution, including agriculture, construction activities, urban street runoff, acid mine drainage, and fallout of airborne pollutants.

Agriculture is the main source of water pollution in the United States and is estimated to decrease the quality of 50 to 70 percent of U.S. surface waters. Soil is the main contaminant from farmland runoff. Soil increases the turbidity of water, which impacts agricultural productivity and

damages aquatic life. Chemical fertilizers and pesticides are also detrimental to water quality since they can promote algal growth or destroy fish. Buffer zones (e.g., planting vegetation along waterways) can prevent runoff from farmlands.

Runoff from construction sites contributes the greatest amount of sediments. Approximately 5 percent of the United States' surface waters are affected by these contaminants. Mitigation strategies include mulches, vegetation, retention basins to detain runoff water and allow settlement of suspended sediments, and maintaining existing trees and shrubs.

Storms add large amounts of sediment and other pollutants into local waterways in urban areas. Urban runoff is the main contributor of oil to surface water. Frequent street cleaning, litter control, adding more vegetation and plants along waterways, and limited applications of salt and sand can reduce urban street runoff.

Byproducts of coal mining and mine drainage can also cause adverse effects when they enter bodies of water. Naturally occurring iron pyrite produces iron hydroxide and sulfuric acid. Iron hydroxide covers the bottom of streams and thus destroys life at the bottom. Sulfuric acid increases the acidity of water and destroys any species which cannot survive in such an environment. The lowered pH also causes certain metals to leach from soil and rocks and enter streams. Recent efforts such as regrading and revegetation have proven effective in counteracting the effects of acid mine drainage. Sealing openings to abandoned underground mines and creating engineered wetlands have also had positive results.

Airborne pollutant fallout is the leading source of PCBs and hydrocarbons in the oceans and waterways. Increasing the land's capacity to retain water and decreasing the overall amount of airborne pollutants and the amount of pollutants are two important ways of addressing water pollution from nonpoint sources.

MARK G. ROBSON

(SEE ALSO: *Acid Rain; Clean Water Act; Ecosystems; Pollution; Sewage System; Wastewater Treatment; Waterborne Diseases; Water Quality; Water Reuse; Water Treatment*)

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AMENORRHEA

See Menstrual Cycle

AMERICAN ASSOCIATION OF PUBLIC HEALTH DENTISTRY

The American Association of Public Health Dentistry (AAPHD) is the largest dental public health organization in the world. Since its founding in 1937, the AAPHD has provided leadership in improving the oral health of the public through the discipline of public health dentistry.

The American Board of Dental Public Health defines dental public health as:

The science and art of preventing and controlling dental diseases and promoting dental health through organized community efforts. It is that form of dental practice which serves the community as a patient rather than the individual. It is concerned with the dental health education of the public, with applied research, and with the administration of group dental care programs as well as the prevention and control of dental diseases on a community basis.

The purpose of the AAPHD is to improve the oral health of the public through education and leadership based on the principles of dental public health. The AAPHD had over 900 members in the year 2000, including dentists, dental hygienists, health educators, clinicians, researchers, administrators, and academicians. Approximately 10 percent of members reside outside the United States. As the sponsoring organization for the American Board of Dental Public Health (ABDPH), the AAPHD seeks to develop the knowledge base of dental public health and to maintain competency in the practice of dental public health.

The AAPHD is publisher of the internationally recognized *Journal of Public Health Dentistry*, and of the *Communiqué* newsletter. The association's annual meeting, now held jointly with the Association of State and Territorial Dental Directors, draws approximately 350 participants.

JAMES W. TOOTHAKER

(SEE ALSO: *Association of State and Territorial Dental Directors; Community Dental Preventive Programs; Oral Health*)

AMERICAN ASSOCIATION OF PUBLIC HEALTH PHYSICIANS

The American Association of Public Health Physicians (AAPHP) was founded in 1954 as an organization of physician-directors of state and local health departments. Its initial purpose was to serve as the voice of these physicians and bring their concerns to the attention of the American Medical Association (AMA), the American College of Preventive Medicine (ACPM), other public health organizations, the news media, government agencies, and the general public. The term "public health physician" is defined by AAPHP as a physician interested in the pursuit of group or community health goals. Group members are primarily public health physicians that are Board Certified in public health or preventive medicine. However, such certification is not a prerequisite for membership.

The AAPHP has maintained its mission as an advocate for public health issues and services, and for improved education and scholarship. In comparison to other public health and physician organizations, the AAPHP focuses on tobacco control, injury prevention, public health surveillance, and job market issues, in addition to a wide range of other policy concerns. The AAPHP also offers a more substantial opportunity for rank and file members to participate directly in national public health and prevention-related policy deliberations. Over 80 percent of the AAPHP's 200 members are also members of the AMA, the ACPM, the American Public Health Association (APHA), and other public health and physician-related organizations.

During the early 1990s, the AAPHP broadened its mission and scope to serve as the voice of

public health physicians in public and private settings, academia, and private medical practice. It also developed an advocacy role on behalf of public health and preventive medicine physicians, wherever they are employed, in response to changes in the public health physician job market. This advocacy is intended to create an environment in which physicians contemplating a career in public health can anticipate a range of job opportunities that offer both stability of employment and portability of retirement benefits.

The Board of Directors meets ten times per year, by conference telephone call, and the General Membership meets twice a year—in the spring at the annual Prevention meeting, and in the fall at the annual meeting of the American Public Health Association. AAHP publishes a Bulletin, by both mail and e-mail, four to six times per year, and hosts an Internet site.

JOEL NITZKIN

(SEE ALSO: *American Medical Association; American Public Health Association; Preventive Medicine*)

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AMERICAN ASSOCIATION OF RETIRED PERSONS

See AARP

AMERICAN CANCER SOCIETY

The American Cancer Society (ACS) is a nationwide community-based health organization dedicated to eliminating cancer as a major health problem. Established in 1913 by a handful of physicians and business people in New York City, the ACS has grown into one of the world's largest voluntary health organizations. It has a staff of 6,000, over 2 million volunteers, and receives financial donations from over 10 million people annually. With assets of over \$1 billion and an income of approximately \$700 million per year, the society has established ambitious goals for

controlling cancer incidence and mortality and improving the quality of life for survivors and their families.

While the ACS is recognized for its unique research programs, which have provided critical support for thirty Nobel laureates, it is also the major nonprofit sponsor of cancer control programs, advocacy efforts, and cancer information delivery systems. The American Cancer Society created a "cancer-conscious public," pioneering research and public programs that reduce mortality through prevention and early detection. ACS created the National Cancer Institute in the 1930s and lobbied for the renewal of the National Cancer Act in 1971. Currently, the ACS operates a 24-hour cancer information telephone line and publishes the widely used "Cancer Facts and Figures."

The ACS consists of a national organization, seventeen individually chartered and incorporated divisions, and local offices in 3,000 communities throughout the country. The national organization is governed by a 267-member volunteer assembly and a 43-member board of directors. The primary staff officer, the chief executive officer, works with the other officers and with volunteer and staff leaders to develop and implement methodologies designed to implement the society's mission.

HELENE BROWN
JOHN R. SEFFRIN

(SEE ALSO: *Cancer*)

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AMERICAN COLLEGE OF OCCUPATIONAL AND ENVIRONMENTAL MEDICINE

The American College of Occupational and Environmental Medicine (ACOEM) is the medical society in the United States that represents the over seven thousand physicians specializing in occupational and environmental medicine. ACOEM was founded in 1916 by surgeons caring for the nation's work force, and it has grown to become the

world's largest organization of "physicians dedicated to the health of workers and our environment." The college is composed of thirty-one component societies in the United States, Canada, and Mexico that hold scientific meetings and network on a regular basis. The oldest and largest of these societies is the Central States Occupational Medical Association, which was established in 1919 and granted component status in 1937. The board of directors of ACOEM governs two councils (Special Occupational Health Interests, and International Occupational and Environmental Medicine). Each council is composed of sections that focus on subspecialty areas.

The vision of ACOEM is that it is "the pre-eminent organization of physicians who champion the health and safety of workers, workplaces, and environment." The mission is to provide "leadership to promote optimal health and safety of workers, workplaces, and environments by: educating health professionals and the public; stimulating research; enhancing the quality of practice; guiding public policy; and advancing the field of occupational and environmental medicine." ACOEM defines the mission of occupational and environmental medicine as "the medical specialty devoted to prevention and management of occupational and environmental injury, illness, and disability, and promotion of health and productivity of workers, their families, and communities."

ACOEM presents a wide variety of educational activities. ACOEM cosponsors the annual American Occupational Health Conference each spring in association with the American Association of Occupational Health Nurses. Each fall the college conducts the State-of-the-Art Conference. Continuing education courses are offered on topics such as the basic curriculum in occupational medicine and the core curriculum in environmental medicine; and training programs are offered in drug/alcohol testing, impairment and disability evaluation, as well as board review courses in occupational medicine courses and medical review officer (MRO) courses. These courses are offered in print, web, and seminar formats. ACOEM recognizes the finest health programs in North American companies through the Corporate Health Achievement Award, and publishes the monthly *Journal of Occupational and Environmental Medicine*, the *ACOEM Report Newsletter*, and the *MRO Update Newsletter*, as well as a variety of texts.

ACOEM supports manpower development in occupational and environmental medicine and residency training. In 1998 and 1999, the college opened a Washington office to complement its Chicago area headquarters in order to provide leadership and direction in public-policy efforts. ACOEM produces guidelines and physician statements to assist in this effort—including guidelines for employee health services, health care facilities, and for protecting health care workers against tuberculosis; as well as ethical guidelines and a code of ethical conduct. A variety of physician statements are produced on topics such as the epidemiologic basis for an occupational and environmental policy on environmental tobacco smoke; multiple chemical sensitivities; idiopathic environmental intolerance; potential adverse human and environmental health impacts of chlorinated chemicals; and the role of the occupational physician in enhancing productivity.

ACOEM's national headquarters are located at 1114 North Arlington Heights Road, Arlington Heights, Illinois 60004. Information and various publications can be accessed online at <http://www.acoem.org>.

WILLIAM W. GREAVE

(SEE ALSO: *National Institute for Occupational Safety and Health; Occupational Disease; Occupational Lung Disease; Occupational Safety and Health; Occupational Safety and Health Administration*)

AMERICAN COLLEGE OF PREVENTIVE MEDICINE

Founded in 1954, the American College of Preventive Medicine (ACPM) is the national professional society of physicians engaged in the practice, teaching, and research of preventive medicine. Committed to preventing disease and promoting the health of the individual, the community, and the nation, the college's goals focus on advancing the science and art of the medical specialty of preventive medicine. ACPM provides educational opportunities for its members, advocates public policies consistent with scientific principles of the discipline, participates in national forums to address important professional concerns,

and communicates developments in the specialty through its publications.

ACPM is a private, not-for-profit organization with 501(c)(3) status. It has an elected board of regents, which serves as the governing and decision-making body of the organization. The college has several committees that address important issues related to the science and practice of preventive medicine, such as practice guidelines and international health.

ACPM's membership is composed of over two thousand physicians. college members hold clinical, research, teaching, administrative, and policy positions in public agencies, managed care organizations, industry, and academia. The college membership constitutes a major national resource of expertise in areas vital to protecting and improving the nation's health, and provides guidance and direction to policy makers, planners, practicing physicians, and other health professionals, and to the public on health promotion and disease prevention issues.

ACPM is represented in the House of Delegates of the American Medical Association and has close ties with other medical specialty groups, particularly those with a primary care focus such as the American Academy of Family Practice, the American Academy of Pediatrics, the American Society of Internal Medicine, and the American College of Physicians. ACPM is a member of the Council of Medical Specialties/American College of Physicians and sends a delegate to the American Society of Internal Medicine House of Delegates.

ACPM works closely with other organizations representing preventive medicine and public health, including the American Public Health Association of Schools of Public Health, the Association of Teachers of Preventive Medicine (which jointly sponsors publication of the *American Journal of Preventive Medicine* with ACPM), the Association of State and Territorial Health Officials, the American Association of Public Health Physicians, and the National Association of City and County Health Officials. ACPM cooperates with many governmental and nongovernmental agencies, including the Centers for Disease Control and Prevention, the Health Resources and Services Administration, the National Heart, Lung and Blood Institute, the National Cancer Institute, and Agency for Toxic Substances and Disease Registry. ACPM

is represented on the National Coordinating Committee on Clinical Preventive Services, and several ACPM members have served on the U.S. Preventive Services Task Force.

ACPM serves as the major information resource concerning postgraduate training and careers in the field. ACPM also holds an annual review course for people wishing to prepare for the certifying examination, courses on clinical prevention and managing care for defined populations, along with many other educational offerings. ACPM also works with the Agency for Toxic Substances and Disease Registry to develop environmental health education programs for preventive medicine physicians.

JENNIFER S. EDWARDS

(SEE ALSO: *American Association of Public Health Physicians; American Medical Association; American Public Health Association; Association of Schools of Public Health; Association of State and Territorial Health Officials; Association of Teachers of Preventive Medicine; Centers for Disease Control and Prevention; Health Resources and Services Administration; National Association of County and City Health Officials*)

AMERICAN HEART ASSOCIATION

Founded in 1924, the American Heart Association was formed as a medical society to share knowledge about heart disease. In 1948, the association was reorganized into a voluntary health organization whose mission is to reduce disability and death from cardiovascular disease and stroke.

With headquarters in Dallas, Texas, there are fifteen regional American Heart Association affiliates and more than 3,000 full-time and part-time staff. More than 22.5 million volunteers and supporters carry out the association's mission in communities across the country. A volunteer board of directors, with members from science, medicine, business, and industry, governs the association.

In 2000 a budget of about \$337 million supported research, public and professional education, community programs, and advocacy. Research

funded by the association has contributed significantly to CPR training, bypass surgery, pacemakers, artificial heart valves, microsurgery, and life-extending drugs. Education messages emphasize quitting smoking; controlling blood pressure; eating a low-fat, low-cholesterol diet; being physically active; and maintaining a healthy weight.

A major goal of the American Heart Association is to reduce coronary heart disease and stroke (and the risk factors for these conditions) by 25 percent by the year 2010. To achieve this goal, the association is partnering with emergency medical and hospital systems in communities to implement two new health initiatives: Operation Heartbeat and Operation Stroke. These initiatives will raise awareness about heart disease and stroke warning signs and the need to act urgently when such signs occur.

In November 1998, the association created a division called the American Stroke Association. Its goal is to support stroke-education programs, stroke-related research, and stroke survivors and their caregivers.

CAROL LEBEN

(SEE ALSO: *American Cancer Society; American Lung Association; Atherosclerosis; Blood Pressure; Cardiovascular Diseases; Coronary Artery Disease; Stroke*)

AMERICAN INDIANS AND ALASKA NATIVES

The term “American Indian and Alaska Native” (AI/AN) is used to refer to indigenous peoples of the United States. It is encompassed by the broader term “Native American,” which also includes indigenous peoples of Canada (known as Aboriginal Canadians, Native Canadians, or First Nations), Mexico, and Central and South America. “Alaska Native” is used to refer jointly to Eskimos (Inuit), Indians, and Aleuts living in that state. (The Inuit are also native to Canada.) “Native American” is widely accepted as the “correct” term for the indigenous peoples that were residing in North America when Europeans first arrived on the continent, and for their descendants. Although the terms Native American and AI/AN imply a certain degree of cultural homogeneity, the indigenous

peoples of North America do not form a monolithic ethnic or cultural group, despite their sharing broadly similar experiences. There are hundreds of Native American groups, each with distinctive traditions, customs, values, spiritual beliefs, lifestyles, and languages. In considering Native Americans generally, or AIs/ANs specifically, it is important to recognize their internal diversity.

DEMOGRAPHICS

Contemporary AI/AN populations live in urban areas and on reservations. In the United States an estimated 2.5 million persons were projected to identify themselves in the 2000 Census as American Indian or Alaska Native, nearly 0.9 percent of the total United States population. These persons, most of whom will indicate an affiliation with one of the more than five hundred federally designated tribal organizations, are predominantly located in the western United States (48%), the South (29%), and the Midwest (17%), with just 6 percent in the Northeast. This distribution of the AI/AN population reflects the consequences of the historical pattern of settlement of the United States and the displacement of American Indians to primarily western and southern parts of the country. Alaska Natives numbered some 106,000 persons in 1999, approximately 4.3 percent of the total AI/AN population. Of persons who identified themselves as AI/AN in the 1990 Census, 1.2 million (57%) resided in the 33 reservation states served by the Indian Health Service (IHS), an agency of the U.S. Department of Health and Human Services. The AI/AN population, however, has become increasingly urbanized; in 1990, close to 66 percent of AIs/ANs resided in urban areas, while just 20 percent lived on reservations. This was a marked increase from 1980, when 54 percent of AIs/ANs lived in urban areas, and from 1970, when 45 percent did so.

According to 1990 Census projections to November 1, 2000, the estimated median age for AIs/ANs was twenty-eight—a full eight years below that of the national population. The distribution of sex for AIs/ANs (51% female and 49% male) did not differ from that of the national population. The AI/AN population did have a greater prevalence of poverty (32% versus 13% nationally) and unemployment (16% versus 6%

nationally), and a lower prevalence of high school graduates (65% versus 75% nationally) and college graduates (9% versus 20% nationally).

HISTORICAL, SOCIAL, AND POLITICAL CONTEXTS OF NATIVE-AMERICAN HEALTH

Since their initial contact with Europeans in the late fifteenth century, AI/AN populations have experienced catastrophic losses of life, land, political autonomy, and social cohesion. Illness was often the first, and most ravaging, effect of colonization felt by indigenous peoples. Infectious diseases such as smallpox, measles, and influenza were introduced by Europeans and reached epidemic proportions among Native Americans, who had never been exposed to these diseases and had no immunity to them. As colonization and westward expansion continued, Native Americans were subject to war, genocide, removal from tribal lands, relocation, and forced labor. These factors all contributed to the decimation of 50 to 90 percent of the indigenous populations by the end of the nineteenth century.

The experience of forcible relocation onto reservations under the Bureau of Indian Affairs' assimilation program, and similar programs of Canadian churches and other institutions, designed to "civilize" AIs/ANs in the late nineteenth century, brought drastic changes to the social organization and living conditions of Native Americans. These changes led to an increase in health problems, including diseases such as tuberculosis, venereal disease, and alcoholism. The transfer in 1954 of responsibility for Indian health from the Bureau of Indian Affairs to the IHS heralded not only an administrative change but also the emergence of a new medical ideology by which the poor health status of Native Americans was no longer attributed to "savage ignorance," but to a lack of sufficient medical knowledge. The IHS did in fact bring many infectious diseases under control; however, chronic diseases emerged to take their place. Further, social pathologies began to have an increasing impact on the AI/AN population in the latter half of the twentieth century.

In the 1950s and 1960s, the federal government again pursued a policy of "assimilation," by which AIs/ANs were encouraged to relocate from

reservations to urban areas. At the same time, though, the IHS was establishing itself as a highly centralized, largely reservation-based (and thus rural), health care service. In the 1970s the IHS reversed this trend with an increasingly decentralized service—concomitant with encouragement of tribes to directly operate or contract their own health services. Today there are problems not only with the ongoing provision of adequate health services in rural areas, but the AIs/ANs living in urban areas also have difficulty gaining care from the IHS, which devotes just 2 percent of its budget to urban programs.

NATIVE AMERICANS' HEALTH IN THE TWENTY-FIRST CENTURY

As North America enters the twenty-first century, Native Americans carry a disproportionate burden of ill health relative to the general population. Life expectancy for AIs/ANs is 71 years, in contrast to 75 years for the United States population. While the infant mortality rate does not differ between AIs/ANs and the national population, infant mortality due to sudden infant death syndrome and accidents is greater by factors of two and three, respectively, for the AI/AN population. AI/AN children between ages one and four have a 70 percent higher mortality rate than the general population, while those aged five to fourteen have a 40 percent higher rate. Mortality due to accidents and homicide is greater by a factor of two for both age groups, in contrast to the national population. For AI/AN adults, relative to the national population, age-adjusted mortality rates are lower for heart disease and cancer, the two most common causes of death, but nearly three times higher for death due to accidental injuries and diabetes, four times higher for death due to liver disease, and 50 percent higher for death due to pneumonia, influenza, suicide, and homicide. Mortality data contrasting urban and rural dwelling AIs/ANs indicate a pattern favoring urban AIs/ANs in terms of lower infant mortality rates and lower cause-specific mortality rates.

Relative to the national population, AIs/ANs are distinguished by a high prevalence and incidence of chronic disease (e.g., diabetes, obesity, and gallbladder disease) as well as infectious disease (e.g., tuberculosis, meningitis, gastroenteritis, pneumonia, and sexually transmitted diseases).

Age-adjusted prevalence rates of diagnosed diabetes (11%) and obesity (30%) are three and two times higher, respectively, for AIs/ANs than for non-Hispanic whites. High rates of disease and disease-specific mortality in AIs/ANs correspond to a high prevalence of behavioral risk factors (e.g., poor diet, physical inactivity, and smoking). These are expressed concomitant with high rates of social pathologies (e.g., alcohol or substance abuse, homicide, suicide, violence) and unintentional injuries (e.g., vehicle injuries, fires, burns, and drowning), and the morbidity and mortality associated with them. Thus, disease indicators and social indicators converge in their correspondence to ill health in AIs/ANs.

An understanding of individual-level risk factors is important for disease prevention and control, but such knowledge is of limited use without consideration of risk conditions. Health and health-related behavior interact with and emerge from social, political, and economic contexts. Unfortunately, however, some approaches to health promotion in AI/AN populations have tended to focus on changing behavior to the exclusion of environmental factors and have had limited success in Native American populations. Social pathologies and unintentional injuries in AIs/ANs have also been attributed largely to individual-level factors, though an understanding of the historical context of oppression and subjugation and its extension to the current context of economic disadvantage, unemployment, and undereducation is essential to adequately address these problems.

The health of AI/AN populations cannot be understood separately from their history of oppression and their continuing experience of marginalization. The adequate provision of health services and medical knowledge to AI/AN populations, while an important need and goal, is insufficient on its own to remove health disparities. So, too, is a well-intentioned emphasis by nonindigenous health practitioners and researchers on "cultural sensitivity" in community-based intervention and in clinical treatment and prevention settings unlikely, on its own, to yield substantial improvements in the health of AI/AN populations. The unequal distribution of wealth, power, and opportunity are the fundamental determinants of the health status of Native Americans. Only by addressing the social structure and the economic, political, and sociocultural forces that

create this inequality can the health status of Native Americans be improved.

MARK DANIEL
SARA ACKERMAN

(SEE ALSO: *Cultural Factors; Cultural Identity; Ethnicity and Health; Indigenous Populations; Minority Rights*)

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AMERICAN JOURNAL OF PUBLIC HEALTH

The *American Journal of Public Health* is a monthly publication of the American Public Health Association. The mission of the *Journal*, which began

publication in 1911 as a continuation of the *American Journal of Public Hygiene*, is to advance public health research, policy, practice, and education worldwide. Regularly published in its pages are scientific papers, authoritative editorials and commentaries, policy analyses, reports on ethical controversies, historical papers, program evaluations, and in-depth essays and reviews. Only 20 percent of submitted research papers are eventually published, and scientific papers undergo rigorous peer review. Readers of the journal include researchers, administrators, planners, physicians, dentists, nurses, scientists, educators, allied health professionals, and social workers. Continuing education credits and classified job advertisements are also offered.

NANCY JOHNSON
MARY E. NORTHRIDGE

(SEE ALSO: *American Public Health Association*)

AMERICAN LUNG ASSOCIATION

The mission of the American Lung Association (ALA) is to prevent lung disease and promote lung health. ALA is the oldest voluntary health agency in the United States. The American Lung Association was founded in 1904 as the National Association for the Study and Prevention of Tuberculosis. As the number of tuberculosis cases drastically declined, the association widened its interest to include other forms of lung disease and, in 1973, changed its name to the American Lung Association. ALA is dedicated to the prevention, cure, and control of all types of lung disease, such as asthma, emphysema, tuberculosis, and lung cancer. This is accomplished through community service, public health education, advocacy, and research.

Indoor and outdoor air pollution contributes to lung disease, including respiratory tract infections, asthma, and lung cancer. The American Lung Association provides information and public education on the health hazards of indoor and outdoor air pollution. ALA has developed Open Airways for Schools, a comprehensive asthma management program designed to empower elementary children to better manage their asthma with the assistance of parents, teachers, school nurses,

and other volunteers. The association also provides tobacco prevention and control programs for schools, community organizations, and the public at large. ALA discourages children from becoming smokers and advocates restrictions on smoking in public places to protect nonsmokers from environmental tobacco smoke.

JOHN GARRISON

(SEE ALSO: *American Cancer Society; American Heart Association; Nongovernmental Organizations, United States*)

AMERICAN MEDICAL ASSOCIATION

The American Medical Association (AMA) was founded in 1847 to “promote the art and science of medicine and the betterment of public health.” Since its beginning, the AMA has been dedicated to improving health and well-being through both clinical and community strategies.

Before the discovery of antibiotics, physicians had few effective clinical tools. In its early years, the AMA directed policy recommendations toward implementing strategies related to emerging discoveries in sanitation and hygiene. For example, the AMA House of Delegates (HOD) recommended that each state develop a board of health and that medical schools include hygiene in curriculums. Physicians became crusaders for prevention in their communities. Dr. Henry I. Bowditch, the twenty-ninth president of the AMA, founded the Massachusetts State Board of Health in 1859—the first agency of its kind in the United States. In 1872, Bowditch was instrumental in starting the American Public Health Association (APHA).

During the twentieth century, biological and technological advances were used by both medical and public health practitioners to implement highly effective strategies for improving public health. It became possible to treat diseased individuals effectively within a clinical setting with less reliance on community interventions. By the mid-1950s, cancer and other chronic diseases had replaced infectious diseases as the main causes of mortality and morbidity, and during the latter half of the century it became clear to both medical and public health

practitioners that personal behaviors such as tobacco use, violence, alcohol misuse, and unsafe sexual practices were responsible for most morbidity and premature mortality.

Although medicine and public health diverged through much of the twentieth century, changes in clinical and public health practice and financing led medicine and public health to form a new alliance in the mid-1900s. Today, the AMA provides leadership to organized medicine in public health areas such as preventive services for adolescents; tobacco control; prevention of alcohol use among youth; special care of the elderly—including health literacy; organ donation; training in end-of-life care; and both domestic and youth violence prevention. Together, the AMA and the APHA chair the Medicine/Public Health Initiative, a national program that uses the power of collaboration to improve health.

Structurally, the AMA functions as a federation. Representatives from medical societies in all states and many counties, from medical specialty organizations, and from federal health organizations (including branches of the military) comprise the AMA House of Delegates. The HOD reviews resolutions from these member organizations, decides on policy for the AMA, and provides direction for AMA programmatic efforts. Thus, the AMA both represents and is responsive to the “house of medicine.” Because of this relationship, the AMA works to build consensus among both medical societies and specialty societies as it promotes its public health agenda. With almost 300,000 members, the AMA maintains a stewardship for ensuring both the standards of the profession and for promoting the health of the nation.

ARTHUR ELSTER

(SEE ALSO: *American Public Health Association; Nongovernmental Organizations, United States*)

AMERICAN PUBLIC HEALTH ASSOCIATION

The American Public Health Association (APHA) is the largest association of public health professionals in the world. The organization represents all of the many disciplines that contribute to contemporary public health practice. APHA’s policies

are determined by a 250-member Governing Council and its ongoing activities and operations are governed by a 21-member Executive Board. There were over 55,000 members in 1999. The APHA is organized in the following Sections and Special Primary Interest Groups.

LIST OF SECTIONS

- 1) Alcohol, Tobacco and Other Drugs
- 2) Chiropractic Health Care
- 3) Community Health Planning and Policy Development
- 4) Environment
- 5) Epidemiology
- 6) Food and Nutrition
- 7) Gerontological Health
- 8) Health Administration
- 9) Injury Control and Emergency Services
- 10) International Health
- 11) Laboratory
- 12) Maternal and Child Health
- 13) Medical Care
- 14) Mental Health
- 15) Occupational Health and Safety
- 16) Oral Health
- 17) Podiatric Health
- 18) Population, Family Planning and Reproductive Health
- 19) Public Health Education and Health Promotion
- 20) Public Health Nursing
- 21) School Health Education and Services
- 22) Social Work
- 23) Statistics
- 24) Vision Care

SPECIAL PRIMARY INTEREST GROUPS

- 1) Alternative and Complementary Health Practices

- 2) Disability Forum
- 3) Forum on Bioethics
- 4) Health Law Forum
- 5) HIV/AIDS
- 6) Community Health Worker
- 7) Radiological Health
- 8) Veterinary Public Health

The APHA was founded in 1872, at a time when scientific advances were helping to reveal the causes of communicable diseases. These discoveries laid the foundation for the public health profession and for the infrastructure to support its work. From its inception, the APHA was dedicated to improving the health of all residents of the United States. The APHA's founders recognized that two of the association's most important functions were advocacy for adoption by the government of the most current scientific advances relevant to public health, and public education on how to improve community health. Along with these efforts, the APHA has also campaigned for the development of well-organized health departments at both the federal and the local level.

In the years since its founding, the APHA has continued to search for and support those policies and practices that are most likely to improve the health of the public. The APHA has played a prominent advocacy role on many issues, including assuring the availability of clean air and water, creating a safe and nutritious food supply, guiding people to adopt healthy lifestyles, monitoring the environment for adverse effects on human health, guaranteeing comprehensive and appropriate maternal and child health services, expediting the full immunization of the population against vaccine-preventable diseases, and facilitating the development of safe work environments.

APHA continues its dedication to the resolution of public health issues and concerns as they arise. The association's headquarters, located in Washington, DC, provides ready access to the country's major policymakers for APHA's advocacy and public policy efforts. APHA's fifty-two state affiliates, including two for California and one each for New York City and Washington, DC, serve to connect it with public health issues at the

local level. Included in the APHA membership are all of the fifty currently recognized disciplines that contribute to public health practice. The large majority of APHA members pursue their special interests through one or more of the association's twenty-four Sections and eight Special Primary Interest Groups.

In recognition of the international dimension of many diseases, APHA adopted global health as part of its mission in 1996. This effort was expedited by the fact that the APHA is an active member of, and serves as the executive secretariat for, the World Federation of Public Health Associations (WFPHA), through which it is involved in public health concerns of WFPHA's sixty member countries. APHA also actively participates in the activities of the World Health Organization and the Pan American Health Organization.

In addition to the development of and advocacy for public health policies and programs, the APHA engages in a number of other activities. For example, the APHA supports the enhancement of the scientific base of public health through reports of its members' research activities at its annual meetings.

The APHA has played a major role in providing continuing education for all public health workers through accredited educational sessions, journal-based educational opportunities, and distance-based educational sessions.

The association publishes the *American Journal of Public Health*, which is a refereed journal, and a number of scientific books and monographs on public health issues. Its members are kept informed about major health-related issues through the news publication, the *Nation's Health*.

The APHA is currently focusing its efforts on assuring access to basic health care and preventive services for all U.S. residents, enhancing collaboration with other professional organizations, and developing public-private partnerships to help solve public health problems.

MOHAMMAD AKHTER

(SEE ALSO: *Careers in Public Health; Council on Education for Public Health; International Health; Research in Health Departments*)

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AMES TEST

The Ames test is a screening test that is used to help identify chemicals that affect the structure of DNA. The test exposes *Salmonella* bacteria to chemicals and looks for changes in the way bacteria grow. These changes result from mutations that occur when the structure of DNA is altered in certain places. Many chemicals that cause mutations can cause cancer in animals or in people. When the test was developed, it was thought that most of the chemicals that produce results in the Ames test could also cause cancer. It was hoped that this simple test would be an easy way to find cancer-causing chemicals. Over time, the test was found to be a less reliable predictor of carcinogenesis than had been hoped. Some chemicals that are known to cause cancer do not test positive in the Ames test and some chemicals that test positive do not cause cancer. Nonetheless, the test is still considered an important part of assessing the safety of new chemicals.

The Ames test uses strains of *Salmonella* that have been altered to make them more susceptible to mutation than normal *Salmonella*. To perform the test, the altered *Salmonella* strains are combined in a test tube with the chemical of interest. Because *Salmonella* bacteria lack the enzymes that animals use to metabolize chemicals, animal liver enzymes are often added to the test tube. That way, the test is able to detect what might happen if the chemical entered a human body. The *Salmonella* are then transferred to a petri dish to grow for one or two days. The altered *Salmonella* used for the test require the amino acid histidine to grow, and a positive result in the test is indicated

when, in response to mutation, the *Salmonella* no longer require histidine to grow.

A positive result in an Ames test does not indicate by itself that a particular chemical is capable of causing cancer. It does suggest that a chemical can produce mutations and that more extensive testing is needed to determine whether the chemical is likely to produce cancer in humans. The test is useful as a screening tool for setting priorities because it is an inexpensive and quick way to help single out chemicals that should be targeted for further testing. It is also used in industry as a primary preventive approach to eliminate potential carcinogens early in the process of developing new commercial chemicals.

The test is named for its creator, Dr. Bruce Ames. Its development depended upon basic scientific advances in understanding the role of mutagenesis in chemical carcinogenesis, and its use was fundamental in the understanding of the mechanisms of carcinogenesis.

GAIL CHARNLEY

(SEE ALSO: *Cancer; Carcinogen; Carcinogenesis; Toxicology*)

ANALYSIS OF VARIANCE

Analysis of variance (ANOVA) is a statistical technique that can be used to evaluate whether there are differences between the average value, or mean, across several population groups. With this model, the response variable is continuous in nature, whereas the predictor variables are categorical. For example, in a clinical trial of hypertensive patients, ANOVA methods could be used to compare the effectiveness of three different drugs in lowering blood pressure. Alternatively, ANOVA could be used to determine whether infant birth weight is significantly different among mothers who smoked during pregnancy relative to those who did not. In the simplest case, where two population means are being compared, ANOVA is equivalent to the independent two-sample t-test.

One-way ANOVA evaluates the effect of a single factor on a single response variable. For

example, a clinician may be interested in determining whether there are differences in the age distribution of patients enrolled in two different study groups. Using ANOVA to make this comparison requires that several assumptions be satisfied. Specifically, the patients must be selected randomly from each of the population groups, a value for the response variable is recorded for each sampled patient, the distribution of the response variable is normally distributed in each population, and the variance of the response variable is the same in each population. In the above example, age would represent the response variable, while the treatment group represents the independent variable, or factor, of interest.

As indicated through its designation, ANOVA compares means by using estimates of variance. Specifically, the sampled observations can be described in terms of the variation of the individual values around their group means, and of the variation of the group means around the overall mean. These measures are frequently referred to as sources of “within-groups” and “between-groups” variability, respectively. If the variability within the k different populations is small relative to the variability between the group means, this suggests that the population means are different. This is formally tested using a test of significance based on the F distribution, which tests the null hypothesis (H_0) that the means of the k groups are equal:

$$H_0 = \mu_1 = \mu_2 = \mu_3 = \dots = \mu_k$$

An F -test is constructed by taking the ratio of the “between-groups” variation to the “within-groups” variation. If n represents the total number of sampled observations, this ratio has an F distribution with $k-1$ and $n-k$ degrees in the numerator and denominator, respectively. Under the null hypothesis, the “within-groups” and “between-groups” variance both estimate the same underlying population variance and the F ratio is close to one. If the between-groups variance is much larger than the within-groups, the F ratio becomes large and the associated p -value becomes small. This leads to rejection of the null hypothesis, thereby concluding that the means of the groups are not all equal. When interpreting the results from the ANOVA procedures it is helpful to comment on the strength of the observed association, as significant differences may result simply from having a very large number of samples.

Multi-way analysis of variance (MANOVA) is an extension of the one-way model that allows for the inclusion of additional independent nominal variables. In some analyses, researchers may wish to adjust for group differences for a variable that is continuous in nature. For example, in the example cited above, when evaluating the effectiveness of hypertensive agents administered to three groups, we may wish to control for group differences in the age of the patients. The addition of a continuous variable to an existing ANOVA model is referred to as analysis of covariance (ANCOVA).

In public health, agriculture, engineering, and other disciplines, there are numerous study designs whereby ANOVA procedures can be used to describe collected data. Subtle differences in these study designs require different analytic strategies. For example, selecting an appropriate ANOVA model is dependent on whether repeated measurements were taken on the same patient, whether the same number of samples were taken in each population, and whether the independent variables are considered as fixed or random variables. A description of these caveats is beyond the scope of this encyclopedia, and the reader is referred to the bibliography for more comprehensive coverage of this material. However, several of the more commonly used ANOVA models include the randomized block, the split-plot, and factorial designs.

PAUL J. VILLENEUVE

(SEE ALSO: *Epidemiology; Statistics for Public Health*)

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ANIMAL CONTROL

See Veterinary Public Health

ANOREXIA

The eating disorder known as anorexia nervosa is commonly described as “self-starvation.” Characteristics of the disorder include a refusal to maintain a minimally normal weight, an intense fear of gaining weight, a disturbed and unrealistic body image, and (in women) the absence of menstrual periods. (Low body weight and/or the cessation of menses distinguishes anorexia from the related disorder, bulimia.) Sufferers may starve themselves simply by restricting the amount of calories or types of food they consume; or there can be a pattern of excessive binge eating followed by purging through self-induced vomiting, inappropriate use of laxatives or enemas, or excessive exercise.

Female gender, low self-esteem, genetics, and social emphasis on thinness all increase the risk for this condition. The consequences of untreated anorexia can be severe, including electrolyte disturbances, heart rhythm abnormalities, and death. Treatment usually involves psychotherapy, medication, nutrition education, and family therapy.

LEONARD J. HAAS
TRISH PALMER

(SEE ALSO: *Eating Disorders; Menstrual Cycle; Mental Health; Nutrition; Social Determinants*)

ANTHRAX

Anthrax, a zoonotic disease, is one of the earliest diseases known to man. Worldwide public health surveillance data are not accurate for either animal or human anthrax up to the 1950s, but it is probable that thousands of human cases occurred annually. Since the 1950s, it is estimated that between 2,000 and 5,000 cases of human anthrax have occurred annually.

Anthrax is seen in three forms in humans: cutaneous, inhalational, and gastrointestinal. Cutaneous anthrax begins as a blister on the skin that, within two to six days, develops into a vesicle which, when ruptured, reveals a depressed ulcer covered by a black eschar, or scab. The patient may have a mild fever and slight edema surrounding the lesion. Within one or two weeks the lesion

gradually becomes covered with tissue, eventually resulting in a small scar. Treatment is with appropriate antibiotics and hygienic care of the lesion. The mortality rate without treatment is approximately 5 percent.

Inhalational anthrax is a systemic toxic disease that involves the mediastinal lymph nodes. It begins with mild respiratory symptoms, and within one or two days, fever, perspiration, and a falling blood pressure develop rapidly. The result is a toxic shock-like condition, which is followed by death in almost 100 percent of cases. Rapid intravenous treatment with antibiotics may reduce the chance of fatality.

Gastrointestinal anthrax can involve either the oropharyngeal area, which results in swelling, redness, and ulcers, or the gastrointestinal tract, with the development of ulcers, hemorrhage, and edema. With appropriate treatment, the patient recovers within approximately one week. The mortality rate is 5 to 20 percent.

Diagnosis of anthrax is made by clinical history; culturing of secretions from lesions, blood, or spinal fluid; and by epidemiological association with contaminated animal products such as wool, goat hair, hides, dried bones, and tissue from animals that have died from anthrax. Serological tests can also be diagnostic. Meningitis may develop with any form of the disease.

There is a safe and effective human anthrax vaccine. Health education is also important for people that may be exposed to diseased animals or their products. Cutaneous anthrax primarily results from occupational exposure to contaminated animal products. Such exposure may occur in the manufacturing of textiles using goat hair or wool, in handling animal hides or rendered products, and in attending to sick animals. Inhalational anthrax results from the inhalation of spores related to industrial sources. Gastrointestinal anthrax results from eating contaminated meat. A major concern today is the threat of the use of the bacterium that causes anthrax, *Bacillus anthracis*, as an agent in bioterrorism or biological warfare.

Animal anthrax occurs primarily in herbivores and results from ingestion of *Bacillus anthracis* in soil or feed. Infected animals develop gastrointestinal anthrax with systemic infection and die

with secretions issuing from their bodily orifices. There is a safe and effective animal vaccine, and antibiotic treatment can be curative if started early enough.

PHILIP S. BRACHMAN

(SEE ALSO: *Communicable Disease Control; Terrorism; Veterinary Public Health; Zoonoses*)

ANTHROPOLOGY IN PUBLIC HEALTH

Public health is often described as having the population or community as its patient, in contrast to the individual-level focus of clinical medicine. This focus on community creates a natural foundation for partnership between public health and anthropology, which takes as its primary focus the study of people in groups, and especially in local communities. Anthropology has four major subfields: cultural anthropology, physical or biological anthropology, archeology, and linguistics. Cross-cutting the subfields are several interdisciplinary foci that have much to contribute to the achievement of public health objectives. The most important for public health is *medical anthropology*, a field that first emerged as a coherent subdiscipline in the 1950s and has rapidly grown to become one of the largest areas of research and practice within anthropology. The richness of this subdiscipline is apparent in the range of theoretical perspectives encompassed by it.

Anthropology has also made important methodological contributions to public health, especially with regard to the use of ethnography for the systematic collection of field data; qualitative methods for the collection and analysis of descriptive, interpretative, and formative data; and the integration of qualitative and quantitative approaches. The ability to translate scientific knowledge into effective practice at the community level is a third area where anthropological approaches have much to offer public health.

THEORETICAL CONTRIBUTIONS

As with anthropology and public health, the basic unit of study in ecology is the population. The *medical-ecological* approach links biomedicine with

biological and cultural anthropology, resulting in important contributions to understanding health and disease as dynamic, adaptive, population-based processes. The ecological model builds on three key assumptions:

1. There are no single causes of disease; rather, disease is ultimately due to a chain of factors related to ecosystem imbalances.
2. Health and disease are part of a set of physical, biological, and cultural subsystems that continually affect one another.
3. The ecological model provides a framework for the study of health in an environmental context, but it does not specify what factors maintain health within any given local system.

Critical medical anthropology raises important questions about the impact of global political and economic structures and processes on health and disease. It expands the context within which medical anthropology operates and brings it closer to the perspective of public health practice by explicitly seeking to contribute to the creation of global health systems that “serve the people.” Critical medical anthropology focuses on health care systems and how they function at multiple levels, including the individual level of patient experience, the *microlevel* of physician-patient relationships, the *intermediate* level of local health care systems, particularly hospitals and clinics, and the *macrosocial* level of global political-economic systems. At each of these levels, the goal is to understand how existing social relations structure the relationships among the participants in the systems. In particular, critical medical anthropologists study the way health care is embedded within dominant relations such as those of class, race, and gender.

The individual level of patient experience has been the focus of *interpretative anthropology* approaches. A. Kleinman (1997) introduced the cultural interpretative model to provide a means of balancing the externalized, objective view of disease with the subjective experience of illness. M. Lock and N. Schepers-Hughes (1990), in turn, developed the concept of “sufferer experience” as an important dimension to the study of health. They developed a metaphorical framework of “the three

bodies” to facilitate understanding of the multiple layers of health and illness. The *individual body* constitutes the layer of lived experience, with an explicit rejection of Cartesian mind-body dualism. The *social body* encompasses the way in which the individual body becomes a kind of canvas upon which nature, society, and culture is represented. The *body politic* refers to “the regulation, surveillance, and control of bodies (individual and collective) in reproduction and sexuality, work, leisure, and sickness” (Lock and Scheper-Hughes 1990, p. 51). Sickness, in this framework, is understood as a “form of communication” among all three levels, a kind of individual-level expression of social truths and social contradictions. It then follows that, in order to effectively treat the individual expression of sickness, the role of social and political factors in generating sickness must also be considered.

The microlevel of physician-patient relationships and the intermediate level of local health care systems have been the focus of *clinical anthropology*. M. Konner (1993) provides a global overview of the many political and economic factors that impact the way doctors are trained and socialized, as well as how they shape the way medical care is enacted in clinics and hospitals. P. Farmer (1999) examines inequalities in the distribution and outcome of infectious diseases such as tuberculosis, AIDS (acquired immunodeficiency syndrome), Ebola, and malaria, as well as social responses such as quarantine and accusations of sorcery that often are associated with infectious diseases. His particular concern is with the emergence of disease from socially produced phenomena such as poverty and political upheaval, which he describes as the “biological reflections of social fault lines” (p. 5). Farmer also critiqued simplistic models of disease causality that fail to incorporate dynamic, systematic global factors and, therefore, slight the need for preventive models that target the social determinants of health.

In a similar mode, M. Singer (1994) proposed a synthesis of two key concepts from the ecological model—that health and disease are ultimately due to a chain of factors, and that they are part of a set of interacting subsystems—with the broader global perspective of critical medical anthropology to describe and explain the dynamics of the AIDS pandemic. Singer coined the term “syndemic” to

describe the synergistic interaction of social factors, especially local and global inequities, with the epidemiological risk factors for HIV (human immunodeficiency virus), TB, hepatitis, and substance abuse. The syndemic model provides an important intermediate model that frames the investigation of community-level outcomes in terms of individual behavior, local processes, and higher level processes. This model raises difficult questions, and it challenges public health to address the root causes of health disparities. By introducing a multilevel, dynamic epidemiological perspective, it points toward the need to develop and evaluate systems- and community-level interventions that target linked processes.

METHODOLOGICAL CONTRIBUTIONS

The application of anthropological methods to public health problems has been another important area of contribution. The use of systematic, descriptive, and qualitative methods has proven effective in identifying context-specific factors that contribute to health and disease outcomes. Another important methodological contribution is the use of triangulation, or the systematic application of multiple methods in order to reduce bias in situations where controlled comparison is not feasible. For example, anthropologists typically use natural observation of behavior along with self-report data and descriptions of normative expectations to obtain highly accurate descriptions of events and social relationships.

The development of rapid assessment techniques, variously called rapid appraisal, rapid assessment, and rapid rural appraisal, is a prime example of anthropological contributions to the public health methodological toolkit. As described by J. Beebe (1995) this is a multidisciplinary team-based approach designed to generate reasonably valid, reliable, and qualitative results within a short time frame. Rapid assessments can provide the contextual information needed to design in-depth community-level and community-based public health research and to guide decisions about implementing programs in local settings.

J. A. Trostle and J. Sommerfeld (1996) describe a number of mutual methodological benefits to be gained from combining anthropological and epidemiological approaches, including:

- Anthropological knowledge of cross-cultural variability can be used to improve the development and measurement of epidemiologic variables.
- Research results can be communicated more effectively to policymakers and to a public audience when both anthropological and epidemiological descriptions are employed.
- Conceptual and experimental work can be undertaken to determine the best measures of complex cultural and behavioral variables.
- Ethnographic and epidemiological information can be used to design health surveillance systems that return data to communities in more comprehensible forms, creating new meanings for the “popular epidemiology.”

The authors also provide a useful overview of the way anthropologists and epidemiologists have approached key social and cultural concepts relevant to the study of health and disease, including culture change and stress; social stratification; risk vulnerability; behavior; and illness constructs. They also review a number of areas of mutual methodological interest. They propose the label of “cultural epidemiology” to describe “cross-cultural analyses of the distribution and determinants of disease and illness and with unpacking variables (e.g., race, class, religion, time) to illustrate and specify their theoretical context and meaning” (p. 266).

TRANSLATING KNOWLEDGE INTO ACTION

Anthropological theory and methods have much to offer public health in the area of translating public health knowledge into effective action. Contributions range from basic issues of cultural sensitivity to enhance the acceptability and effectiveness of proven practices in clinic settings to the development of policy for the provision of complex treatment regimens for emerging epidemics under conditions of inequity in access to health care. As such, anthropologists are asking questions about the root causes of public health’s

toughest problems. These problems are not often amenable to study using controlled clinical trials or cross-sectional survey designs. Rather, they are dynamic, systems-level problems that require field-based observation and the use of multiple methods that are both qualitative and quantitative.

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(SEE ALSO: *Inequalities in Health; Psychology, Health; Social and Behavioral Sciences; Sociology in Public Health*)

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ANTIBIOTICS

Antibiotics represent a class of drugs used in the treatment of infections and infectious diseases caused by bacteria. These bacteria possess unique features (e.g., a cell wall, proteins, enzymes) that differentiate them from animal cells. Antibiotics interfere with the production of these bacterial characteristics, resulting in selective killing or growth inhibition of susceptible microorganisms. For example, prior to 1990, infections caused by *Streptococcus pneumoniae* (e.g., pneumonia, bronchitis, ear infections), were usually treated with penicillin or amoxicillin. *Streptococcus pneumoniae* possess a cell wall that acts as a protective barrier—a unique feature not found on animal or human cells. Penicillin or amoxicillin, two common antibiotics, bind to that cell wall as it is produced, causing it to weaken and “leak,” eventually killing the bacteria without harming the animal host cells.

Antibiotics can be further described by the number of bacteria covered (narrow-spectrum antibiotics versus broad-spectrum antibiotics), and by how strongly the antibiotics work against the bacteria (bactericidal activity versus bacteriostatic activity). Narrow-spectrum antibiotics are used to treat infections limited to a few families and types of bacteria, while broad-spectrum antibiotics are useful to treat infections caused by multiple families of bacteria. An antibiotic that exhibits bactericidal activity will kill bacteria when it comes into contact with it (e.g., *S. pneumoniae*). Bacteriostatic activity, on the other hand, occurs when an antibiotic inhibits the growth of bacteria, without necessarily killing it.

MEGANNE S. KANATANI

(SEE ALSO: *Communicable Disease Control; Drug Resistance; Pathogenic Organisms; Penicillin; Pharmaceutical Industry*)

ANTIBODY, ANTIGEN

An antigen is a substance that is capable of inducing a specific immune response in the host into which it is introduced. The immune response is mediated via an immunoglobulin (protein) molecule, called an antibody, which is formed by B-lymphocytes and T-helper cells that are the basic

ingredients of the host’s immune system. “Antibody” is the generic name for any immunoglobulin thus produced, no matter how this occurs. Humans can produce many specific antibodies. This may be an active process by a healthy host in response to the challenge of exposure to a foreign antigen transmitted via the placenta or in maternal milk from mother to offspring, or it may be artificially induced by immunization with live attenuated organisms, killed organisms, or a protein derivative.

An antigen is an organic compound—a protein, polysaccharide or glycolipid. Sometimes it is an entire organ or tissue that has been transplanted into the host, which rejects it and attempts to destroy it. An antibody has the capacity to bind specifically to the (foreign) antigen and thereby neutralize it so it can be destroyed by the host’s phagocytes.

The antibody is the basic ingredient of the host’s defenses against infection. By measuring the concentration of specific antibodies in individuals and populations it is possible to determine levels of susceptibility and resistance to infection by specific pathogens. At the population level, this is called “sero-epidemiology.”

An antigen is produced by living organisms, which evolve over generations and can therefore undergo subtle changes in protein composition, a process known as “antigen drift.” A more sudden evolutionary change can lead to an abrupt change in protein structure, known as “antigen shift.” Antigen drift renders an antibody less effective, and antigen shift makes an antibody ineffective in combating an antigen to which the host was immunized by exposure to the previous form of the antigen. Antigen drift and antigen shift account for recurrences of infection with viruses, such as those of the common cold and influenza.

JOHN M. LAST

(SEE ALSO: *Epidemiology; Immunizations*)

ANTISEPSIS AND STERILIZATION

During much of the nineteenth century, both the medical community and the general public believed that wound infections and fevers were caused

by foul emanations, or miasmata—poisons produced by rotting animal and vegetable material, soil, and standing water that were subsequently released into the atmosphere as vapors. Sanitary reforms, sewer systems, and fresh air endeavors formed the main components of an emerging public health movement based on this understanding. In the mid-1860s, antiseptics offered a different view of infection, one based on germ theory.

Joseph Lister (1827–1912) experimented with carbolic acid dressings and continuous carbolic acid sprays during surgical operations in the mid-1860s. He reported a reduced incidence of gangrene and mortality. He eventually abandoned carbolic acid around 1890 when Koch demonstrated heat to be more effective than chemicals for sterilizing instruments, and when Ernst von Bergmann (1836–1907) achieved better results through cleaning techniques for operating rooms, instruments, patients, and surgeons.

Antiseptics is the prevention of infection by any procedure that reduces microbes on the skin or mucous membranes to a significant degree. Antiseptics are the substances used to inhibit the growth of bacteria—germicides, in contrast, are substances that kill bacteria. Initially, antiseptics protected patients from contaminating pathogens (disease-producing organisms) in the environment by preventing organisms from entering the body through a wound and by controlling the spread of contagious diseases. During the 1980s, health care agencies implemented “Universal Precautions” for all patients, indicating a shift in thinking related to the transmission of disease by blood and body fluids. With this shift, antiseptics and disinfection became important tools for protecting care providers as well as patients.

Both disinfection and sterilization reduce or eliminate pathogens through either physical or chemical processes. Sterilization is the process of destroying all microorganisms and their pathogenic products. The oldest, most efficient methods to eliminate contamination on objects or in food or water involve the use of various forms of heat: boiling, flaming (passing an object through a flame), or burning. Although burning also destroys the object, it achieves the main goal of preventing the spread of disease. Chemical processes involve the use of a variety of antiseptics and disinfectants in either liquid or gaseous states.

Typically, disinfectants are chemical substances, such as mercury bichloride or phenol solutions, that are too strong for application to body tissues. Inanimate objects that cannot withstand sterilization are soaked in disinfectant solutions for specific amounts of time, depending on the material and the susceptibility of the pathogenic organism to the solution. There are several methods of sterilization, including soaking objects in bactericidal chemical compounds, exposing objects that are heat or moisture sensitive to radioisotopes or bactericidal gases (such as ethylene oxide) or, most commonly, autoclaving objects. Autoclaves are metallic, locking containers within which equipment is exposed either to wet steam under pressure at temperatures of 120°C or higher for fifteen minutes or to dry heat at 360° to 380°C for three hours. These objects may be wrapped in cloth, paper, or certain plastics or left unwrapped. The actual exposure time and temperature varies according to the article, the potential contaminants, and the packaging used.

CYNTHIA TOMAN

(SEE ALSO: *Cross Infection*; *Nosocomial Infections*; *Universal Precautions*)

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ANTISOCIAL BEHAVIOR

Antisocial behavior consists of acts that impose physical or psychological harm on other people or their property. Lying, stealing, assaulting others, being cruel to others, being argumentative, and being sexually promiscuous are all examples of antisocial behavior. Such behavior may sometimes constitute a violation of legal codes, and it is often accompanied by disturbances of thought or emotion. It may be distinguished from delinquency,

which is a more serious form of antisocial behavior and involves the breaking of criminal laws. It may also be distinguished from antisocial personality disorder (also known as sociopathy or psychopathy), in which antisocial behavior is longstanding and continues in a variety of areas during adulthood (e.g., irresponsible parenting, unlawful behaviors, repeated aggressiveness, repeated lying, reckless endangerment of others). Research indicates that family environment, personality characteristics, peer environment, and social contexts all play a role in influencing the development and maintenance of antisocial behavior.

Engaging in antisocial behavior poses great risk to an individual's mental and physical health. It puts one at increased risk for alcoholism, cigarette smoking, illegal drug use, high-risk sexual behavior, depression, and for engaging in violent acts towards others and towards the self. The health risks of interpersonal and intrapersonal violence are readily apparent. It is also well known that substance abuse poses serious health hazards through the direct bodily harm that these substances cause, as well as the indirect effects that result from impaired judgment (e.g., automobile accidents, high-risk sexual behavior). Antisocial behavior has additional health consequences by virtue of its relationship with high-risk sexual behavior and depression. High-risk sexual behavior poses life threatening consequences due to the risk of HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome). Depression, though not life threatening itself, is characterized by negative emotional, cognitive, and motivational symptoms; low self-esteem; and a generally diminished quality of life. By placing individuals at risk for these behaviors and conditions, antisocial behavior is clearly associated with undesirable mental and physical health outcomes that may ultimately lead to loss of life.

Amidst the current theories and models that have been advanced to explain the causes of antisocial behavior, three have been particularly useful in their ability to inform prevention and treatment efforts. *Coercion theory* proposes that antisocial behavior is carried out to force other people to give in to the aversive demands that the individual is imposing. Examples of coercive antisocial behavior include hitting a classmate so that he will stop teasing or having a temper tantrum in response to

a parent who refuses to buy candy. The *social developmental model* hypothesizes that a lack of belief in the moral order, perceived rewards for antisocial interaction and involvement in related behavior, commitment to antisocial lines of action and people, and belief in antisocial values are direct predictors of antisocial behavior. A more general developmental model of child antisocial behavior theorizes that maternal smoking, substance abuse, and poor nutrition during pregnancy are antecedents to the child's antisocial behavior. Thus, this model purports that poor health outcomes are the antecedents, as well as the consequences, of antisocial behavior. This model further hypothesizes that parental style, child characteristics, and characteristics of the school, home, and primary caretaker that occur later in development are antecedents of later antisocial behavior.

Efforts to prevent antisocial behavior are mostly directed at adolescents. The nature of a prevention intervention is based on its underlying theoretical approach and the age group of the individuals being targeted. Interventions that target the prenatal and early childhood environment focus on maternal nutrition, maternal health, smoking reduction, and family problem-solving skills. Interventions that target the family environment seek to facilitate the development of noncoercive discipline, strategies for improving social and educational development, and strategies for improving parental involvement in school and extracurricular activities. Interventions that target the school environment focus on supporting academic success, modifying school environments to inhibit aggressive behavior, increasing academic organization, and teaching positive peer relations. Treatment efforts have largely been based on cognitive-behavioral training, which involves attempts to modify moral reasoning, increase one's ability to take the perspective of another, and to increase frustration tolerance and the ability to resolve interpersonal dilemmas with prosocial solutions. Such treatment also seeks to modify family interactions and create improved parental management and a more positive family atmosphere.

KIMBERLY R. JACOB ARRIOLA

(SEE ALSO: *Behavior, Health-Related; Domestic Violence; Family Health; Reckless Driving; Substance Abuse, Definition of; Violence*)

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AQUIFER

See Groundwater

ARBOVIRAL ENCEPHALITIDES

The viruses that cause arboviral encephalitides are all arthropod-borne. They are maintained in nature through biological transmission between susceptible vertebrate hosts (primarily birds and rodents) by blood-feeding arthropods, primarily mosquitoes, and ticks (see Table 1). Arboviruses replicate and produce viremia (virus in the blood of the host) in the vertebrate host and infect the arthropod when it takes a blood meal. They replicate in the tissue of the arthropod and are passed on to a new vertebrate host when a subsequent blood meal is taken, generally ten to fourteen days later.

All arboviruses that cause meningoencephalitis in humans are zoonoses, having animals other than humans as their natural host. They are maintained in complex life cycles involving a primary

vertebrate host and a primary arthropod vector that usually does not feed on humans. These natural cycles usually remain undetected until humans encroach on the area where the virus escapes the primary cycle via a secondary arthropod vector or vertebrate host as a result of some ecological change. Humans and domestic animals generally become involved only after the virus is introduced into the peridomestic environment (areas where humans normally live) by a bridge vector or vertebrate host. Humans and domestic animals, when infected with these arboviruses, usually do not produce significant viremia and, therefore, do not contribute to the transmission cycle.

The arboviruses that cause meningoencephalitis in humans are found in nearly all parts of the world. Each virus has a geographic distribution that is usually limited by the ecological parameters governing its transmission cycle. Important limiting factors include temperature, rainfall patterns, and the distribution and population densities of the arthropod vectors and the vertebrate reservoir hosts. The greatest number of arboviruses are found in the tropics, where the flora and fauna are diverse.

The majority of these arbovirus infections in humans cause an inapparent infection or a non-specific febrile illness. Onset of illness is usually sudden, with fever, headache, muscle pain, malaise, rash, and occasionally prostration. A small proportion of these patients with febrile illness may develop mild to severe neurologic disease characterized by one or more of the following signs: confusion, delirium, drowsiness, abnormal reflexes, spasticity, muscle weakness, paralysis, cranial-nerve palsies, and convulsions. The cerebrospinal fluid (CSF) is usually under pressure, has elevated protein, and pleocytosis is common. Specific antibodies can be detected in the CSF in properly timed samples. Case fatality rates range from less than 1 percent to 30 percent, depending on the virus.

Globally, the most important arbovirus encephalitis is Japanese encephalitis (JE), an Asian virus ranging from Japan and eastern Siberia in the east to India and Pakistan in the west and Indonesia and northern Australia in the south. Annually, there are 30,000 to 50,000 cases reported, depending on epidemic activity, which occurs primarily in

Table 1

Important arboviruses that are known to cause meningoencephalitis in humans					
Family/Virus	Vector	Vertebrate Host	Geographic Distribution	Ecology	Epidemics
Togaviridae					
Eastern equine encephalitis	Mosquitoes	Birds	Americas	Rural	Yes
Western equine encephalitis	Mosquitoes	Birds, rabbits	Americas	Rural	Yes
Venezuelan equine encephalitis	Mosquitoes	Rodents, equines	Americas	Rural	Yes
Flaviviridae					
Japanese encephalitis	Mosquitoes	Birds, swine	Asia	*Rural, suburban	Yes
Murray Valley encephalitis	Mosquitoes	Birds	Australia	Rural	Yes
St. Louis encephalitis	Mosquitoes	Birds	Americas	*Rural, suburban, urban	Yes
West Nile virus	Mosquitoes, Ticks?	Birds	Africa, Asia, Europe, Americas	*Rural, suburban, urban	Yes
Rocio	Mosquitoes	Birds	South America	Rural	Yes
Tick-borne encephalitis	Ticks	Rodents	Worldwide in temperate latitudes	Rural	No
Kyasanur Forest Disease	Ticks	Primates, rodents, camels	India, Middle East	Rural	No
Bunyaviridae					
Rift Valley fever	Mosquitoes	?	Africa, Middle East	Rural	Yes
LaCrosse encephalitis	Mosquitoes	Rodents	North America	*Rural, suburban	No
California encephalitis	Mosquitoes	Rodents	North America	*Rural, suburban	No
Jamestown Canyon	Mosquitoes	Rodents	North America	*Rural, suburban	No

* Most important ecology

SOURCE: Adapted from: Gubler, D. J. and J. W. LeDuc. *Scientific American Medicine* (1998). II: 7 "Infectious Diseases," XXXI: "Viral Zoonoses," Dale, D. C. and D. D. Federman, eds. Seattle: Scientific American, Inc., pp.1-10.

temperate or subtropical latitudes. The principal mosquito vector of human infection is *Culex tritaeniorhynchus*, which breeds in rice fields. Pigs and certain bird species act as amplification hosts; humans and horses are considered "dead-end" hosts. The highest incidence of disease occurs in children, as persons in older age groups have generally been exposed to infection and are immune. Elderly persons who are not immune are at highest risk for severe neurologic illness. The case fatality rate (CFR) is about 25 percent, but neuropsychiatric sequelae may occur in 30 to 70 percent of survivors.

In the western hemisphere, there are numerous viruses that can cause neurologic illness in humans. Discussion of all of these viruses is beyond the scope of this encyclopedia, but two viruses that are closely related to the Japanese encephalitis virus are important. The St. Louis encephalitis virus occurs from Canada to Argentina, periodically causing epidemics. Surveillance data are not available for most countries, but in the United States there have been 4,480 cases reported since surveillance began in 1964, with an annual average of 124 cases and a median of 26 cases. Like JE,

most outbreaks occur in temperate and subtropical latitudes. *Culex* species mosquitoes are the principal vectors, and certain bird species serve as amplification hosts; humans are "dead-end" hosts. The highest incidence of severe disease occurs in persons over sixty years of age. The CFR is about 8 percent overall, but may be 15 to 20 percent in persons over sixty.

Historically, the West Nile (WN) virus has been infrequently associated with severe human illness. The virus has a wide geographic range throughout most of Africa, west and central Asia, and the Middle East. It was occasionally introduced into Europe, where it caused small outbreaks. In recent years, a number of epidemics of WN virus have been reported in the Middle East, Europe, and North America. These outbreaks have been associated with an increased incidence of neurologic disease and death in humans, horses, and birds. It is uncertain at this time why this apparent change has occurred. WN virus has a wide vector and host range; *Culex* mosquito species and birds are the principal hosts of this virus.

In the U.S., WN virus was introduced for the first time in 1999 and caused large epizootics

in 1999 and 2000 among the American crow and other bird species, and in horses in a twelve-state area of the Northeast. Human cases were documented in New York, New Jersey, and Connecticut—in 1999 and 2000. There were 83 laboratory positive cases, 79 of which had neurologic disease. Age ranged from five to ninety-five years, but 85 percent of these patients were over fifty. There were nine deaths (CFR = 11%), all in persons over sixty-five.

In recent years there has been a dramatic global resurgence of epidemic arboviral diseases, including those that cause encephalitis. This has been caused by a number of demographic, and societal changes that have created ideal conditions for the increased movement and transmission of vector-borne diseases. Increased population growth; increased movement of people, animals, and commodities via modern transportation; uncontrolled urbanization; and changes in agricultural practices all contribute to increased geographic spread, human exposure; and infection by these zoonotic viruses.

DUANE J. GUBLER

(SEE ALSO: *Communicable Disease Control; Vector-Borne Diseases*)

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ARMED FORCES ALCOHOL AND DRUG ABUSE PROGRAMS

Combat readiness, the combination of materiel, logistics, personnel, and training factors that determines a unit's ability to enter combat, is influenced by a host of human behavioral problems.

Illicit drug use, heavy drinking, and tobacco use can jeopardize mission readiness, impair work performance, and put lives at risk.

Since the mid-1960s the Department of Defense (DOD) has kept drug abuse statistics and developed policies for prevention, counseling, and the elimination of drug abuse within the Armed Forces. In the 1960s marijuana was believed to be the primary drug of abuse. However by 1970 it was evident that large quantities of heroin were being used by service members in Vietnam. As much as one-half of all U.S. personnel were using illicit drugs; over one-third were addicted. In response, DOD policy was revised to offer amnesty to encourage voluntary identification and drug abuser enrollment in treatment programs; nonpunitive military rehabilitation programs were developed with a focus on treatment. The Armed Forces began identifying narcotics users as they left Vietnam, detoxifying identified abusers prior to their return to the United States, and providing a minimum of 30 days of treatment in military facilities. As policy was refined, a systematic, random drug testing program was established for active duty military personnel. Those who volunteered for treatment could not be discharged under other than honorable conditions. It was only a matter of time before a drug-related incident erupted.

For the U.S. Navy this proved to be an accident on board the aircraft carrier USS *Nimitz*. On May 26, 1981, flight personnel using illicit drugs caused an aircraft accident that resulted in 7 planes destroyed, 11 planes damaged, 14 personnel killed, and 48 additional personnel injured. Autopsies revealed traces of THC in six of the personnel killed. The Chief of Naval Operations declared a zero tolerance policy for illicit drug use. Military-wide, the strong push for punitive action for drug use was adopted and a White House commission developed guidelines for a forensically solid, DOD unified testing program.

In 1986 the DOD established a formal, integrated health promotion policy designed to improve and maintain military readiness and the quality of life of personnel. Alcohol and tobacco were finally identified as real targets for behavioral change. Specific objectives of the policy included reducing heavy drinking by military personnel (heavy drinking is defined as having five or more drinks per typical occasion at least once a week),

reducing alcohol-related motor vehicle crash deaths, and reducing illicit drug use by military personnel. Emphasis was placed on those most at risk: junior enlisted men, single personnel, and personnel with high school education or less.

In addition to DOD-wide policy implementations, such as nonsmoking regulations and deglamorization of alcohol, all branches of the military have responded with their own comprehensive programs. These have incorporated aggressive education and training, leadership support, involvement and responsibility at every level, and group peer pressure. The Navy's Personal Responsibilities and Values: Education and Training (PreVent) program emphasized individual responsibility concerning alcohol and drugs, as well as violence and sexual harassment, fitness and readiness, and financial management. The Marine Corps' Semper Fit program is based on the "whole health" picture and promotes health awareness at the local command. The focus is on the personal choices that each marine can make to feel and perform his or her best. Army's Installation Prevention Team Training (IPTT) brings together multi-disciplined teams from Army posts to develop collaborative, installation-wide prevention programs. One component of this program is the Soldier Risk Reduction Program, a process of identifying, targeting, and preventing high-risk problem behaviors that can directly effect individual and unit combat readiness.

Today the Department of Defense Demand Reduction Program, in support of the National Drug Control Policy, consists of activity in three areas: randomized testing—unpredictable and without a discernible selection system—for Active Duty Military, the DOD civilian, and National Guard and Reserves; Anti-Drug Education and Training for DOD military and civilians, military dependents, and others through outreach programs; and treatment and rehabilitation to restore the individual to effective duty. The latest *Department of Defense Survey of Health Related Behaviors Among Military Personnel*, conducted worldwide among all military services every three years, speaks to the success of the program. The 1998 survey results show that self-reported use of any illicit drugs within the past 30 days of the survey date is at 2.7 percent, down over 90 percent in the 18 years since the survey began. Use of legal substances, however, remains a concern; nearly one in six

military personnel engages in heavy drinking. Cigarette smoking also remains common, affecting almost one in every three active-duty military personnel. While obvious progress has been made since the 1980s there is room for improvement. With a focus on concerted leadership and those values which maintain that alcohol and other drug abuse is incompatible with military service, the Armed Forces can work toward inculcating a positive culture that may help to effect behavior change.

MALLARY TYTEL

(SEE ALSO: *Addiction and Habituation; Alcohol Use and Abuse; Domestic Violence; Marijuana; Smoking Cessation; Substance Abuse; Tobacco Control; Violence*)

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ARMS CONTROL

It has been said that when elephants fight, it is the grass that suffers most. During times of war, it is generally the most vulnerable members of society who are most affected. While the direct costs of war are often estimated in lives lost or disabilities

incurred, the indirect costs of war can be just as destructive. Damaged infrastructures, disruption of health and other vital services, an increase in the prevalence of disease, and mental and emotional disturbances among participants and civilians are just some of the effects of war. Thus a failure to limit the proliferation of weapons of war and mass destruction has enormous public health consequences.

The tools of war, including land mines, bombs, grenades, and bullets, are all negative devices that maim and kill. Land mines, for example, kill or injure 28,000 men, women, and children a year. Those who survive often suffer lifelong disabilities.

Nuclear weapons are particularly destructive and pose an enormous threat to life. E. F. Frohlich has written that nuclear weapons "have the potential to destroy all civilization and the entire ecosystem of the planet. . . . The radiation released by a nuclear explosion would affect health, agriculture, natural resources, and demography over a wide area. Further use of nuclear weapons would be a serious threat to future generations. Ionizing radiation has the potential to damage the future environment, food and marine ecosystem, and cause genetic defects and illnesses in future generations. . . . There are some forty thousand . . . nuclear weapons in storage in the world today, representing an unimaginable threat to people everywhere" (Frohlich 1997, p. 2). According to Frohlich, the major arguments for eliminating nuclear weapons are based on "their destructiveness, the risk of accidental and inadvertent use, and the threat to the security of all by the danger of proliferation" (Frohlich, p. 5).

The United Nations General Assembly and the International Court of Justice have unanimously agreed that the only guaranteed way of eliminating the threat of nuclear war is to rid the planet completely of these destructive devices. International law, however, cannot dictate whether it is lawful or not to threaten or to use nuclear weapons as a means of self-defense in the face of an impending enemy attack. The International Court of Justice cannot legislate to fill this void, as it is not mandated to do so. One possible way around this problem would be to introduce a joint non-first use undertaking between concerned parties. "China has taken a lead in this regard, by having reiterated its support of the goal of the

elimination of nuclear weapons, and its undertaking not to be the first to use such weapons" (Frohlich, p. 5).

Nuclear weapons are not the only threat to the health and well-being of populations. Chemical and biological weapons also pose grave dangers, especially when they are in the hands of terrorist groups and aggressive regimes. The Carnegie Commission on Preventing Deadly Conflict has reported that "Sadam Hussein . . . used deadly gas to suppress the Iraqi Kurdish populations in 1998 and in 1995 the Japanese sect Aum Shinrikyo used sarin gas in a Tokyo subway. The desire for such inexpensive weapons of mass destruction has, according to some reports, prompted Libya to construct the largest chemical weapons factory in the world and the delivery systems to go with the weapons" (Holl 1996, p. 9).

Imposing sanctions are an effective way of making states realize that their actions can have consequences far beyond their own national boundaries. Sanctions can combine with military and diplomatic measures to limit a state's freedom and pressure it to correct inappropriate behavior. While sanctions can be very effective, they often cause innocent civilians to suffer. States under sanction "suffer economic hardship and fall behind in the increasingly competitive global economy, especially when important trading partners are not similarly constrained" (Holl, p. 12). Imposing more focused sanctions that directly target the malefactors would be one way of ensuring that only those directly responsible for the problem suffer.

Another effective means of combating violence is to work proactively to encourage peaceful, nonviolent solutions to tensions, conflicts, and potential threats. This is the core premise of preventive diplomacy. There is heartening evidence that "where sufficient political, economic, and military resources are properly mobilized for the task, conflict prevention can be successful. . . . Best practices of conflict prevention rely on well-developed systems of early warning, explicitly provide for resource pooling and burden sharing among a range of diverse actors and agencies, aim at redressing underlying structural problems as well as the proximate causes of conflict, and apply diplomatic and military leverage appropriate to the problem at hand" (Carnegie Commission on

Preventing Deadly Conflict, p. 5). The effectiveness of any preventive action appears to rest on three essential elements: "Early reaction to signs of trouble, an extended effort to resolve underlying causes of violence ("root causes"), and a comprehensive, balanced approach to alleviating pressures ("risk factors") that can trigger violent conflict" (Holl, p. 6).

The lives of innocent people are continually threatened by war, and responsible governments and concerned citizens must continue to devise ways to combat violence. The means employed to deal with the problems posed by the proliferation of weapons of mass destruction will vary depending on the kinds of weapon involved, the geographic location in question, and the underlying reasons for the prevailing violence. "Adopting a policy of doing nothing simply defers the problem to a later date when the level of destruction and the costs of intervening are higher and the risks of action are even greater" (Carnegie Commission on Preventing Deadly Conflict, p. 5). Better frameworks for understanding the dynamics of complex violence and mass destruction are needed. Sanctions, the pooling of resources, invoking the international community, and employing preventive diplomacy measures and international conventions such as the Ottawa Convention for the elimination of landmines are some of the workable means of reaching peaceful solutions to these problems.

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(SEE ALSO: *Terrorism; Violence; War*)

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ARSENIC

Arsenic (As) is a silver-gray metal that gained much of its notoriety because of its historical use as a human poison (approximately 70 to 180 milligrams of arsenic is fatal to an adult). Arsenic is present in the earth's crust at an average concentration of 2 to 5 mg/kg, with low levels commonly found in the air, water, and soil. In the eighteenth and nineteenth centuries, arsenic was used as a preservative in animal hides, and as an ingredient in pigments, dyes, glass, pharmaceuticals, and pesticides.

In the first half of the twentieth century, arsenic was used in pharmaceuticals intended to treat syphilis (e.g., arsphenamine), skin diseases (e.g., Fowler's solution, a 1% potassium arsenate solution), and parasites (e.g., Pearson's Arsenical Solution). Arsenic is still used as an ingredient in pesticides, wood preservatives, copper and lead alloys, glass, semiconductor devices, and veterinary medicines.

Although arsenic is found in nature in its elemental form (arsenic metal), it occurs most commonly in inorganic or organic compounds. Common inorganic arsenic compounds are trivalent arsenic (e.g., arsenite, H_3AsO_3) and pentavalent arsenic (e.g., arsenate, H_2AsO_4 , HAsO_4^{2-}). Common organic arsenic compounds are monomethyl arsonic acid (MMA), dimethyl arsinic acid (DMA, also known as cacodylic acid), and roxarsone.

Adverse health effects are dependent on the chemical form and physical state of the specific arsenic compound. In general, organic arsenic is less acutely toxic than inorganic arsenic. The health effects of arsenic are widely variable, and are primarily due to differences in the oxidation state of the two predominant forms: trivalent arsenite and pentavalent arsenate. Several organic arsenicals that accumulate in fish and shellfish are essentially nontoxic. Human exposure to arsenic compounds occurs primarily in occupational settings and by the ingestion of contaminated drinking water and

seafood. Arsenic toxicity due to natural contamination of drinking water has been recently noted as a significant public health problem in Bangladesh. Predominant adverse health effects associated with acute arsenic exposure include fever, melanosis, hepatomegaly, cardiac arrhythmia, peripheral neuropathy, nephrotoxicity, diarrhea and vomiting, and, at sufficiently high doses (70 to 180 milligrams for an adult), death. Chronic exposure to arsenic may lead to neurotoxicity (evidenced by sensory changes, paresthesia, and muscle weakness), cancer (basal cell and squamous cell carcinoma of the skin, lung cancer, or bladder cancer), cardiovascular effects (including “blackfoot disease,” so called because the soles of the feet and toes turn black with gangrene), skin disorders such as hyperpigmentation, and birth defects.

Arsine gas is a potent hemolytic agent. The International Agency for Cancer Research (IARC) and the U.S. Environmental Protection Agency (EPA) classify arsenic as a carcinogen based upon epidemiological evidence demonstrating a causal association between arsenic exposure and specific cancers, such as skin cancer and lung cancer. Arsenic can accumulate in hair and nails, and measurement of arsenic levels in these tissues may be a useful indicator of past exposures, while measurement of urine is considered a good indicator of current arsenic exposure. Arsenic is primarily excreted from the body in urine (30 to 85% of absorbed arsenic is excreted via urine). Scientists have puzzled for decades over arsenic’s mechanism of carcinogenicity due to the discordance between the results of human and animal bioassays. Animals appear to be substantially less susceptible to arsenic-induced toxicity than humans. Investigations in animals have suggested that inorganic arsenic can be an essential trace element in some animals. In contrast, arsenic has not been determined to be an essential trace element in humans.

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(SEE ALSO: *Carcinogen; Heavy Metals*)

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ARTHRITIS

See *Osteoarthritis and Rheumatoid Arthritis*

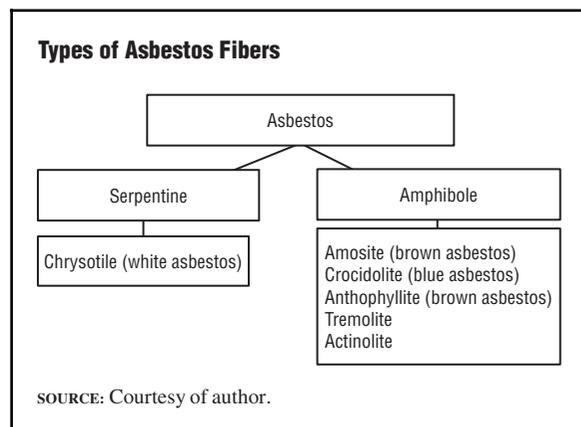
ASBESTOS

“Asbestos” is a term used to describe any of several naturally occurring fibrous silicate minerals of the amphibole or serpentine groups (see Figure 1). Asbestos fibers may be straight (amphibole asbestos) or curled (serpentine asbestos), and have no detectable odor or taste. There are six minerals that are generally described as asbestos: chrysotile, which is a serpentine mineral; and crocidolite, amosite, tremolite, anthophyllite, and actinolite, which are all amphibole minerals. Asbestos fibers vary in length (usually greater than 5 microns), and width (usually less than 0.5 microns).

Almost 95 percent of the world’s mined asbestos is chrysotile asbestos. The world has 200 million tons of identified asbestos resources, and an estimated 45 million tons of additional asbestos resources. Because asbestos fibers are resistant to heat and chemicals, they have been used in the production of building materials (e.g., floor tiles, roof shingles, cement), friction products (e.g., automotive brake pads), and heat-resistant fabrics. However, many countries, including the United States, have banned new uses of asbestos because of its adverse health effects. Worldwide use of asbestos has declined, but certain areas of the world (particularly Southeast Asia, South America, and Eastern Europe) continue to use it, in part because asbestos is an economical and long-lasting building material.

Humans can be exposed to asbestos through inhalation of asbestos fibers, as well as through ingestion (e.g., drinking water from cement pipes

Figure 1



that have been manufactured with asbestos). Asbestos-related diseases commonly occur after a fifteen- to forty-year latency period following initial asbestos exposure, and are primarily associated with occupational inhalation exposure. Nonoccupational exposure to asbestos occurs primarily through exposure to asbestos that is “friable,” meaning it can be reduced to dust by hand pressure. Asbestos fibers are long, thin fibers that can be inhaled deep into the lungs and are able to penetrate the lung’s walls. The immune system is helpless against these fibers, because they are unable to be engulfed (phagocytised) by alveolar macrophages, and therefore remain in the lung for an extended period.

Diseases associated with asbestos exposure primarily involve the respiratory system and include progressive pulmonary fibrosis (asbestosis), pleural disease (the pleura are the membranes that cover the lungs), and cancer of the bronchi (bronchogenic carcinoma) and pleura (malignant mesothelioma). Cigarette smoking along with asbestos exposure increases the risk of lung cancer. There is disagreement within the scientific community as to the difference in the extent of toxicity between serpentine and amphibole asbestos fibers, although studies in humans and animals have demonstrated that both types of fibers increase the risk of asbestosis, malignant mesothelioma, and lung cancer.

The primary public health approach to asbestos is to ban or severely limit its use. In order to further reduce occupational disease from asbestos

exposure, environmental controls should be implemented in the workplace, including ventilation systems, full-face respirators, and changing clothes before and after asbestos exposure.

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(SEE ALSO: *Lung Cancer; Occupational Lung Disease; Occupational Safety and Health*)

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ASIAN AMERICANS

“Asian American” is a general term for Asians and Pacific Islanders (AAPI) living in the United States. According to *U.S. Race and Ethnic Standards for Federal Statistics and Administrative Reporting* (1978), Asian Americans and Pacific Islanders refer to persons who can trace their original background to the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands including Native Hawaiians.

In 1999, there were about 10.9 million AAPIs living in the United States and its Pacific Island jurisdictions. Of them, about half (53.1%) lived in the western region and more than 96 percent resided in metropolitan areas. Together, AAPIs represented approximately 4.0 percent of the total

population in the United States, but they are projected to reach 11 percent (51.6 million) by 2070. The population growth of AAPIs exceeds any other race groups in the United States, and due to this growth rate, AAPIs are relatively younger than other races in the United States. The estimated median age of AAPIs in 1998 was 31.2 years—about 4 years younger than the median age for the U.S. population as a whole.

The key sociodemographic feature of the AAPI population is its great diversity. Six major ethnic subgroups account for more than 95 percent of the AAPI population: Chinese, Filipino, Japanese, Asian Indian, Korean, and Vietnamese. However, it is estimated that entire AAPI population comprises thirty-two different ethnic groups and speaks almost five hundred distinct languages and dialects. Since 1966, AAPI has been called a “model minority” because of their economic success, achievements, and good citizenship, suggested by such indicators as low crime rates and a low rate of welfare dependency. But AAPI, composed of many ethnic groups, is not a homogeneously preferred group. Due to high proportion of immigrants (about 60 percent of AAPIs in the United States were foreign born), a significant number (22.4 to 53.3%) of AAPIs cannot speak English fluently. There is also a high percentage of refugees. After the Vietnam War, more than 1.4 million Eastern Asian Indochinese refugees have been settled in the United States. As a result, the population of AAPIs is extremely heterogeneous in terms of socioeconomic status as well as ethnic origin.

Probably influenced by Eastern culture, strong kinship and family ties are the basic characteristics of the AAPI family structure. There were 2.5 million AAPI families in the United States in 1999, 80 percent of which were married-couple families. AAPI families are often large: 21 percent had five or more family members, compared with 11 percent for non-Hispanic white families. AAPI children under 18 years of age were more likely to live with both parents (84%) than non-Hispanic white children (77%). AAPI parents usually encourage their offspring toward high academic achievement, and they are more likely to direct or supervise their children’s educational activities than their white counterparts. As a result, among persons aged twenty-five and over, AAPIs had the highest proportion of bachelor’s or higher degree; at 42 percent, compared to 27.7 percent for whites and 13.4

percent for all other ethnic groups combined. However, the AAPI population also consists of more people who lack education (3.4% have an educational level below fourth grade), compared with only 1.6 percent of the total population and 0.6 percent of whites.

AAPIs had the highest median annual household income (\$46,637) among the nation’s racial groups in 1998. However, because AAPI households were larger than white households (3.15 people versus 2.47 people), the estimated income per household member was lower in the AAPI population (\$19,107 for AAPI versus \$22,633 for white). The distribution of household income also reflects AAPI’s bipolar characteristics. Compared to white households (2.6% of which had an annual income less than \$5,000; 21.3% had \$75,000 and over), AAPI households had a higher percentage of both poorest and wealthiest households (4.8% had an annual income under \$5,000; 28.1% had \$75,000 and over). Of AAPIs, 12.5 percent live under the poverty level, which is also higher than the proportion of poor non-Hispanic whites (8.2%).

Generally speaking, U.S. Census data clearly indicate that AAPIs have bipolar sociodemographic characteristics. On average, they are younger and have higher incomes and educational achievement. But on the other hand, there is a significant number of AAPIs with low income, less education, and limited English-speaking capability.

In respect to general health status, AAPIs have the longest life expectancy (80.3 years in 1992), the lowest infant-mortality rate (5.3 per 1,000 live births in 1995), and the lowest age-adjusted mortality rate (282.8 per 100,000 in 1996) among different racial groups in the United States. The three leading causes of death for AAPIs are heart disease, cancer, and stroke, which are coincident with the top leading causes of death for the general population. But, among the different racial groups, AAPIs have the lowest mortality rates from heart disease and all cancers. Stroke is one of major diseases of which the death rate among AAPIs is higher than among whites. Type II diabetes mellitus is another illness with higher prevalence and incidence in the AAPI population, compared to non-Hispanic whites.

Although overall cancer rates for AAPIs are very low, the heterogeneity of AAPIs leads to significantly different ethnic patterns for various

cancers. For example, the age-adjusted incidence rate of cervical cancer for Vietnamese women is 43 per 100,000 in 1992, which is the highest among different racial groups in the United States (5.7 times higher than the rate for non-Hispanic white women and 3.3 times higher than the rate for African-American women). Lack of knowledge and low Pap test utilization are two major areas that need great improvement for this group.

According to the National Cancer Institute, liver carcinoma is more likely to prevail among AAPIs. Compared to non-Hispanic whites (incidence of liver cancer: 3.3 per 100,000), Vietnamese men have the highest incidence of liver cancer (41.8 per 100,000), followed by Korean men (24.8 per 100,000), Chinese men (20.8 per 100,000), Filipino men (10.5 per 100,000), and Korean women (10.0 per 100,000). The most likely etiology of this high incidence of liver malignancy for AAPIs is the high viral hepatitis infection rate in this group. The prevalence rates of Hepatitis B surface antigen (HBsAg) for AAPIs range from 5 percent for Koreans to about 15 percent for Southeast Asians. High chronic HBsAg carrier rates in pregnant Asian women also contribute to high incidence rates of liver cirrhosis and primary hepatocellular carcinoma for AAPIs.

The incidence rate of nasopharynx cancer in Chinese men (10.8 per 100,000) is the highest among racial groups. Compared to non-Hispanic whites (0.6 per 100,000 for white men and 0.3 per 100,000 for white women), other AAPI groups also have high incidence of nasopharynx cancer (Vietnamese men 7.7, Chinese women and Filipino men 3.9 per 100,000). Korean men (48.9 per 100,000) and Japanese men (30.5 per 100,000) have highest incidence of stomach cancer in the United States.

Tuberculosis (TB) infections are extremely prevalent in the AAPI population (36.6 per 100,000), compared to other racial groups, including African Americans (17.8 per 100,000), Hispanics (13.6 per 100,000), and non-Hispanic whites (2.3 per 100,000). Compared with 1994, the number of reported TB cases in 1995 decreased in each gender, age, and racial group except AAPI, for whom a 2.9 percent increase was reported.

The access to health care is generally a barrier to improve health status for the poor, newly immigrated AAPIs. On one hand, a significant number

of AAPIs (21.1% in 1998) who lack health insurance coverage cannot afford health care expenses. On the other hand, the lack of availability of culturally competent health professionals in the U.S. health care system is an overwhelming, ethnicity-specific obstacle to health care access. As a result, low rates of health services utilization, high rates of emergency room use, and inadequacy of prenatal care can be often seen in the AAPI population.

Asian traditional medicine serves as a buffer to ease the unmet need of formal medical care access, especially for new immigrants and AAPI refugees and an important alternative for AAPIs in maintaining health and mitigating suffering from sickness. Asian traditional medicine, such as acupuncture, herbal medicine, and massage, consists of techniques and theories believed to be able to balance the "ying and yang" of the human body and establish a harmonious "flow of energy." The comprehensive and holistic strategies of care within Asian traditional medicine have attracted substantial attention from the general American population. However, lack of an accepted scientific basis has retarded the utilization of Asian traditional medicine by the general public. Lead poisoning is occasionally reported from Asian traditional or folk remedies.

AAPIs also have unique risk behaviors. AAPIs have a higher rate of abstinence from alcohol than do other racial groups. However, important variations among different Asian groups have also been found. Compared to whites, a significant number (30 to 50%) of Asians who are deficient in aldehyde dehydrogenase activity tend to exhibit more intense reactions to alcohol and generate higher levels of the metabolite acetaldehyde. The genetic predisposition may be the major reason that AAPIs drink less and are also less likely to be alcoholic. In addition, acculturation, social norms, attitudes toward alcohol, and expectations from drinking are also significant factors that shape the AAPIs drinking patterns.

According to the 1998 *Report of the Surgeon General*, 15.3 percent of AAPI adults (men and women combined) were current smokers in 1995, lower than the national average (22.4% in 1995) and also the lowest rate among various racial adult populations. Among smokers, AAPIs tend to smoke

fewer cigarettes per day than their white counterparts. The percentage of cigarette smoking among adult AAPI males (25.1% in 1995) is significantly higher than among adult AAPI females (5.8% in 1995). Significant variations of smoking rates can also be found among AAPI groups. Much higher smoking rates are seen among Southeast Asians (e.g., Vietnamese and Laotian) and Koreans than among other AAPI ethnic groups. Smoking prevalence among AAPI youths is the second lowest among different racial youth groups (20.6% for AAPI male adolescents and the 13.8% for AAPI female adolescents in 1994).

From a macro standpoint, Asian Americans are a “model minority” with a high household income, high education, and low mortality rate. However, as a demographic designation, Asian American also encompasses a diversity of ethnic groups. Census data and literature always illustrate their bipolar characteristics in socioeconomic status and health indices. People from lower-income AAPI groups and refugees are experiencing limited access to health care and lower health status, resulting from linguistic, cultural, financial, and systemic barriers. Cultural influences, including Asian traditional medicine and folk beliefs, also play an important role in health status. In order to promote better health for Asian Americans, a locally tailored health promotion policy and a community-based health care system are needed.

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CHIH-CHENG HSU

(SEE ALSO: *Acculturation; Chinese Traditional Medicine; Cultural Anthropology; Ethnicity and Health; Pacific Islanders, Micronesians, Melanesians; Traditional Health Beliefs, Practices*)

ASSESSMENT OF HEALTH STATUS

The health status of populations and of individuals is assessed for many reasons. Assessing needs for care helps guide the allocation of resources—diagnostic assessments guide treatment, prognostic assessments contribute to planning, and assessing changes in health status is central to evaluating the quality of health care.

Because “health” is in many ways an abstract concept, it cannot easily be assessed directly. Instead, indirect indicators such as a response to a question or a clinical observation are used. These may be combined into a numerical index, very much as economists use an index to summarize the performance of the stock market. Alternatively, health indicators may be presented in the form of a profile, in which different aspects of health are presented separately, rather as a car company might present a profile of a car’s performance, handling, fuel economy, and size.

There are several sources of public health indicators. For practical reasons, there is a strong preference toward using existing information wherever possible, although no single source is ideal. There is, for example, the anomaly that many health assessments are based on people who are not healthy. Examples include death certificates, hospital discharge information, and notifiable disease reports. These may be aggregated to provide statistics (such as mortality rates) at the community, regional, or national level. The advantage of mortality as an indicator of health is a practical one: Deaths must be recorded by law and represent a complete and accessible source of information. Other sources for public health assessment include rates of hospitalization or of disease. However, because an illness will not be recorded unless a person is receiving formal treatment, hospital statistics are at least partly based on the availability of care and may misrepresent the level of disease in a population. To overcome these limitations, indicators must be collected in other ways. Questionnaires and surveys, for example, are not limited to people who are seeking care and need not include only negative indicators. Positive indicators, such as fitness levels, the percentage of the population playing sports, or self-reported indicators of happiness, can also be assessed. The disadvantage to such methods is simply that these data are not routinely collected and are costly to gather. Health assessments may also include environmental indicators, such as water or air quality. These do not form direct health indicators, however, but generally refer to risk factors external to individuals that may play an explanatory role in analyzing health patterns.

Assessments reflect prevailing definitions of health. The World Health Organization, for example, views health as a resource for living. A healthy

population, therefore, may be defined as one that safeguards the health of its members—the health of the population may be a resource for the well-being of its members. This introduces the idea of assessing the health of a population, rather than merely health *in* a population. If a population represents more than the sum of the individuals within it, public health assessments must represent more than data based solely on individuals. With this view in mind, several categories of indicators have been proposed. These include health resources, such as the existence of immunization programs; indicators of collective justice, such as the level of disparity in individual health indicators within a society; indicators of social capital (e.g., trust in one’s neighbors, involvement in community activities); indicators of collective capacity, such as community participation and volunteering; indicators of resiliency, such as a population’s readiness and ability to cope with challenges such as natural disasters; and functional indicators, such as a society’s level of internal peace, safety, or creativity.

Approaches to assessing health are not static, but evolve in a mutual interaction with the prevailing definition of health and the health issues facing a society. From the many possible indicators of health, we tend to choose those that reflect problems of concern and for which improvement is sought. Publication of an indicator, such as the infant mortality rate, focuses attention on a particular problem, and the resulting interventions will attempt to correct it. Health assessments thus indirectly influence public health, which has the effect of reducing the value of that indicator as a marker of a current health problem. New indicators must therefore be selected, and the cycle begins again. For example, as the infant mortality rate declines, growing numbers of infants exhibit health problems associated with low birth weight or prematurity, and new assessments are needed to address these problems.

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(SEE ALSO: *Certification of Causes of Deaths; Child Mortality; Environmental Determinants of Health; Evaluation of Public Health Programs; Health Measurement Scales; Infant Mortality Rate; Life Expectancy and Life Tables; Mortality Rates; Notifiable Diseases; Observational Studies*)

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ASSESSMENT PROTOCOL FOR EXCELLENCE IN PUBLIC HEALTH

See *Mobilizing for Action through Planning and Partnerships*

ASSIMILATION

Assimilation is the process by which individuals from one cultural group merge, or “blend,” into a second group. The concept of assimilation originated in anthropology and generally refers to a group process, although assimilation can also be defined and examined at the individual level.

CONCEPTS REGARDING ASSIMILATION

The term “assimilation” describes a change in individual or group identity that results from continuous social interaction between members of two groups such that members of one group (often a minority culture group) enter into and become a part of a second group (often a majority culture group). In this process of assimilation, the minority group or culture may disappear by losing its members to the larger and more dominant cultural group. One of the more extreme forms of assimilation involves intergroup marriage (e.g., interracial marriage). Consider, for example, an immigrant Spanish-speaking Mexican woman who is Catholic marrying an English-speaking Anglo-American Protestant male. If the woman learns English, changes her maiden name and religion, and later becomes a U.S. citizen, she will have assimilated into mainstream American culture. While she does not necessarily need to change her

religion and citizenship as the result of her marriage, if she were to make these changes while abandoning her native cultural ways, then this would be a case of full assimilation. In this case, entering another cultural group via marriage has resulted in a woman relinquishing most or all important aspects of her native identity. As part of this full assimilation, this person would undergo psychological changes in her cultural orientation (i.e., beliefs, attitudes, values), and in her cultural behaviors (i.e., customs, traditions) as well as in her personal identity, to the point of losing all or most of the traditions of her original native culture. A health-related question arises as to whether such an assimilation is socially and psychologically healthy. A century ago, scholars regarded such a complete change in identity and behavior—the “melting pot” notion—as a natural and necessary aspect of immigrant adaptation to life in the United States.

Historically, the melting pot notion has not progressed in its entirety within U.S. society, due in part to the presence of structural barriers, including prejudice and discrimination, that have limited some immigrant and native-born minority persons from significant access to the resources and privileges of the dominant social group. Moreover, within the United States some ethnic people have actively chosen not to “give up” their native heritage and identity, despite their desires to participate successfully within the American economy.

The process of assimilation is facilitated by education, and by conformity to the linguistic and most prevalent cultural norms that are valued within the dominant society. Within the United States, the dominant society (the “Anglo Saxon cultural value system”) includes the values of individuality, freedom, democracy, and achievement orientation, efficiency and practicality, and science and technology. Thus, for immigrants coming to the United States, learning English is one of several adaptive changes necessary for successfully entering and participating in the social institutions of the dominant culture.

Historically, some ethnic minority groups have experienced a threat to their culture by the imposition of *forced assimilation*, resulting from governmental policies and programs that used education as a means of assimilating minority people. The

classic case of this involves American Indians. Beginning in the 1890s, American Indian children were removed from the reservation and transported to Indian boarding schools where they were forced to learn English while they were also prohibited from speaking their native language. This effort to inculcate mainstream or dominant cultural ways and to eliminate minority culture, or “Indian ways,” operated as a form of forced assimilation. Nonetheless, in the case of American Indians, this effort at “Anglo-Saxon conformity” failed to convert these American Indian children and their parents to dominant cultural norms, and subsequently these policies for the educational assimilation of Indians were discontinued. One question that arises, of course, is whether forced assimilation is detrimental to mental health.

Assimilation is to be distinguished from the related concept of acculturation. Both assimilation and acculturation refer to the process by which individuals undergo changes in their way of life through adaptation to pressures to conform to the lifeways of a new society. Acculturation, however, refers to changes in beliefs and behaviors that occur as an individual adjusts to life in a new culture. Level of acculturation has typically been measured by way of acculturation scales. Such scales typically consider: (1) the individual’s level of proficiency in language (e.g., in speaking only Spanish, only English, or both); (2) prior life experiences within his or her native country; (3) current preferences regarding friends; (4) preferences regarding television and radio programs broadcast in English or in their native language; and (5) other aspects of cultural involvement.

While both assimilation and acculturation share a common process of adaptation, assimilation constitutes a more extreme form of change compared with acculturation. In other words, while acculturation involves changes in the individual’s pattern of living in adapting to the new society, under acculturation the person often maintains some aspects of his or her original cultural ways and identity. As noted previously, with full assimilation the individual blends entirely into the new society losing most or all aspects of his or her previous cultural identity. By contrast, some immigrants develop a bilingual/bicultural identity, which involves the integration of language, beliefs, and

behaviors learned from each of two cultures. This integrated bicultural identity is seen by some as a more mature and healthy resolution to the acculturative stress that affects many immigrants.

ASSIMILATION, ACCULTURATION, AND HEALTH

Public health research has examined the relationship between acculturation and health status. The results of these studies provide a mixed picture as to whether successful acculturation, and perhaps successful assimilation, can improve or denigrate health status. Generally, many studies have shown a positive relationship between a high level of acculturation and an increased number of health-risk behaviors that are prevalent in the dominant society. In other words, racial and ethnic minority populations have often observed a greater number of health-compromising behaviors as they acculturate into U.S. society. However, as many of these studies are cross-sectional in design, rather than longitudinal, this conclusion involving the apparent ill effects of acculturation has been inferred rather than observed directly.

In one line of health research—the Hispanic Health and Nutrition Examination Survey (HHANES) survey study of health status, which was conducted from 1982 to 1984—results generally showed the aforementioned association between levels of acculturation and various health problems. The association was stronger among women, although it was also apparent among men. Among Hispanic women, higher rates of health-compromising behaviors have been observed across levels of acculturation for cigarette smoking and for alcohol use. Moreover, for both males and females, a greater level of acculturation has been associated with higher rates of illicit drug use, particularly marijuana and cocaine. However, this general trend, when examined in greater detail, shows that the relationship between assimilation or acculturation and health status is very complex. For example, via the process of acculturation, individuals also tend to improve in socioeconomic status—which means better jobs, better insurance coverage, better access to health services, and, therefore, a greater likelihood of having better health.

Research on the influences of acculturation status on mental health and substance use further demonstrates the complexity of this relationship. For example, some researchers suggest that the occurrence of deviant youth behavior and subsequent substance abuse are prompted by the occurrence of acculturation stress among the parents coupled with subsequent parent-child relationship problems. Such problems often occur because immigrant children acculturate at a faster rate than their parents. Among adult immigrants, acculturation stress occurs as the result of the pressure toward conformity to dominant cultural ways that many immigrants experience in their effort to survive within a new country.

Others have argued, however, that the strong family orientation that is characteristic of Hispanic and other minority families serves as a protective factor against delinquency and other types of anti-social behavior. A clearer interpretation of these apparently contradictory findings will require greater depth of analysis regarding the sociocultural and familial factors that may add risk or protection to the lives of immigrants as they adapt to life within a new society.

A recent study of the lifetime prevalence of psychiatric disorders among various Mexican-American migrant laborers in California revealed some important relationships between acculturation and rates of psychiatric disorder. In comparisons of migrant laborers having a low level of acculturation with those having a high level, those having the highest levels of acculturation exhibited higher rates (adjusted odds ratios) of diagnosed mood disorders (depression) and of diagnosed drug abuse or dependence (addiction to illegal drugs). In addition, those migrant laborers who lived in the United States for less than thirteen years exhibited the lowest levels of any psychiatric disorder (lifetime prevalence rates), with higher levels observed for those who had lived in the United States for over thirteen years. Moreover, the highest levels of psychiatric disorder were observed among those who were native-born Mexican Americans. These results suggest that some process involving acculturative stress and/or adjustment to the normative living conditions within the United States increases the risk of depression and of illicit drug use among Mexican-American

migrant laborers. Further developmental and longitudinal research is needed to clarify the mechanisms that may produce these effects.

From a different perspective, young immigrants who engage in deviant behaviors (including substance abuse) cannot be characterized solely as being of either high or low acculturation status, but instead can be seen as outcasts or "marginalized," because they do not "fit into" either group. Such individuals do not relate to either the dominant culture or to their native cultural group. In other words, these are persons who have failed to assimilate into the society. Such members of racial or ethnic minority groups may enter into socially deviant lifestyles in efforts to obtain coveted goals (e.g., economic rewards) that are otherwise blocked via conventionally sanctioned mechanisms (e.g., school achievement). These alienated youth may not only isolate themselves from the mainstream culture, but they may also become alienated from their native reference group. Isolated from both cultures, they may choose to become members of street gangs as a means of obtaining mainstream goals. While joining a street gang may serve as an adaptive form of survival in ghetto or *barrio* environments, it may be unhealthy in the long run, as these youth face greater risks of being victims of violence and of developing drug dependence. Similarly, minority youth who are alienated from the mainstream culture may develop a radical identity that avoids the mainstream culture but that expresses strong loyalty toward their native culture (i.e., separatists). These youth may or may not belong to a street gang, but they do exhibit strong cultural loyalty and adherence to certain traditional cultural traits such as (among Hispanic groups) family bonding (*familism*), *respeto*, and *machismo*.

As the above discussion suggests, acculturation (of which assimilation represents an extreme form) is a complex process. Many immigrants to the United States exhibit improvements in lifestyle as they acculturate and move up in socioeconomic status. However, as they do, some of these immigrants may also exhibit greater rates of unhealthful behavior, reflecting the prevailing or normative unhealthful behaviors that are prevalent within certain sectors of conventional U.S. society. These more complex patterns of change in lifestyle and

in risk for various diseases and disorders due to acculturation and assimilation require further study to clarify which life changes are indeed healthful (and why they are healthful), and which increase the risk for disease or antisocial behavior.

FELIPE GONZALEZ CASTRO
VERA LOPEZ

(SEE ALSO: *Acculturation; Cultural Factors; Ethnicity and Health; Immigrants, Immigration; Migrant Workers*)

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ASSOCIATION OF SCHOOLS OF PUBLIC HEALTH

The Association of Schools of Public Health (ASPH) is the national organization representing the deans, faculty, staff, and students of the accredited member schools of public health in the United States. Incorporated in 1959, it is the national voice of academic public health.

The ASPH mission is to improve the public's health by advancing professional and graduate education, research, and service in public health. In order to achieve this, ASPH is committed to:

- Providing a forum for communication between schools and the public health community
- Identifying and expanding funding resources to support and improve schools of public health
- Promoting public awareness and understanding of the critical roles played by education, science, and practice in meeting public health needs
- Identifying and disseminating strategies to increase diversity of faculty, students, and staff in schools of public health
- Encouraging and supporting the expansion of the number of schools of public health
- Initiating cooperative actions and helping build international, national, and local coalitions with other organizations whose mission is to improve public health

The schools have a combined faculty of over 3,000 and educate more than 15,000 students annually. Degree programs are focused on biostatistics, epidemiology, health-services administration, health-educational behavioral science, and environmental health; but they also offer various concentrations and subspecialties. Students come from throughout the United States and from most countries throughout the world. The schools graduate over 5,000 professionals each year, and offer a variety of degrees such as Master of Public Health, Master of Health Administration, Master of Health Services, and Doctor of Public Health. Schools of public health constitute a primary source of trained public health professionals and specialists, who are in short supply, to serve the federal government, the fifty states, and the private sector.

KAREN HELSING

(SEE ALSO: *Accreditation of Public Health Training Programs; Careers in Public Health; Health Administration, Career in; Training for Public Health*)

ASSOCIATION OF STATE AND TERRITORIAL DENTAL DIRECTORS

The Association of State and Territorial Dental Directors (ASTDD) is a national, nonprofit organization representing state and territorial oral-health program directors. The ASTDD provides leadership to formulate and promote sound national oral-health policy, to increase awareness of oral-health issues, and to assist in the development of initiatives for the prevention and control of oral diseases. The association builds awareness and strengthens dental public health professionals' knowledge and skills by developing position papers and policy statements on oral health issues, conducting special studies on dental public health practices, providing information on oral health to health officials and policy makers, publishing a quarterly newsletter, and conducting conferences for the dental public health community.

The association is an affiliate of the Association of State and Territorial Health Officials (ASTHO). Founded in 1948, the ASTDD is committed to maintaining a strong oral-health presence in state and territorial governments to assure optimal oral health. Full voting membership is open to the chief executive officer for dental health from the department of health or equivalent agency in each state or territory. Associate membership is open to public health agencies, voluntary organizations, tribal entities, and health professionals employed or interested in the area of dental public health programs. A seven-member executive committee serves as the administrative body for the association.

KATHLEEN A. MANGSKAU

(SEE ALSO: *Association of State and Territorial Health Officials; Oral Health*)

ASSOCIATION OF STATE AND TERRITORIAL HEALTH OFFICIALS

Headquartered in Washington, DC, the Association of State and Territorial Health Officials (ASTHO) is the national nonprofit organization

representing the official public health agencies of the fifty states, the six U.S. territories, and the District of Columbia. ASTHO's members are the chief health officials of these jurisdictions.

ASTHO provides unique state-based expertise and leadership for public health policy and practice. Calling on the knowledge and experience of its members, the senior management and program officials of its member agencies, and its alumni, ASTHO formulates and influences sound national public health policy and helps to assure excellence in state-based public health practice.

ASTHO collaborates with other national organizations to address priority public health issues. Principal among these collaborating organizations are the ASTHO Affiliates—sixteen organizationally independent entities representing the directors of programs or health professions within state health departments. A close working relationship also exists between ASTHO and the National Association of County and City Health Officials (NACCHO), representing the nation's official public health agencies at the local level. A Joint Council addresses issues of importance to both ASTHO and NACCHO.

ASTHO's origins date to 1879 when the concept of forming a national association of health officials was first raised at a meeting of the Sanitary Council of the Mississippi Valley in Nashville, Tennessee. Four years later, officers of several state boards of health met informally to consider forming their own national organization, and on May 7, 1884, representatives from nineteen states met in Washington, DC, to establish the National Conference of State Boards of Health. In 1897, the constitution of that National Conference was amended to include membership for representatives from Canada and Mexico. To reflect this expanded membership, the organization's name was changed to the Conference of State and Provincial Health Authorities of North America.

At the beginning of the twentieth century, the U.S. Surgeon General and the State and Provincial health officials began meeting in conference annually to discuss the medical and scientific aspects of controlling diseases of public health consequence prevalent at that time. At the 1908 conference, interstate quarantine regulations were discussed—the first time that a matter of such importance was

brought before the members—and addressed in the context of a “working conference.” Successive working conferences became occasions for the U.S. Public Health Service and the State and Provincial health officials to discuss administrative relationships as well as advances in disease prevention and control.

By 1935, the annual conferences had become a joint venture, meeting the needs of the Surgeon General of the U.S. Public Health Service, the Chief of the Children’s Bureau, and the State and Provincial Health Authorities. However, shortly after the passage of the Social Security Act of 1935, state health officials began expressing the need for an independent organization that could represent them on matters concerning both federal policy and funding. As a result, on March 23, 1942, the Association of State and Territorial Health Officials was established in its current form, with membership limited to the executive officers of the health departments of the U.S. states and territories.

Today, ASTHO receives its financial support from member dues, cooperative agreements with several federal agencies, and from charitable foundations. Each year ASTHO establishes its annual legislative and policy priorities. Currently, ASTHO has policy committees addressing access to health services, environmental health, infectious diseases, prevention, and public health information and infrastructure. In each of these priority areas, ASTHO considers complex, critical public health issues and publishes newsletters, surveys, resource lists and white papers that assist the states and territories in the development of public policy and the promotion of excellence in public health practice.

GEORGE E. HARDY, JR.

(SEE ALSO: *American Public Health Association*; *Association of State and Territorial Dental Directors*; *National Association of County and City Health Officials*; *Surgeon General*)

ASSOCIATION OF TEACHERS OF PREVENTIVE MEDICINE

Founded in 1948 by medical academicians and public health professionals, the Association of

Teachers of Preventive Medicine (ATPM) is the leading national professional association dedicated to advancing individual and community disease prevention and health promotion in the education of physicians and other health professionals.

Approximately 400 individual and 125 institutional members represent multiple disciplines concerned with population health and are predominantly affiliated with academic health centers. Association activities are managed by an executive director and staff, based in Washington, DC, and by standing committees and councils on education, communications, member services, academic units in medical schools, public health graduate programs, and preventive medicine residencies. Since the early 1980s, ATPM has sponsored publications of Maxcy-Rosenau-Last’s *Public Health and Preventive Medicine* and cosponsored publication of the *American Journal of Preventive Medicine*. The Association publishes a quarterly newsletter and produces a weekly electronic bulletin, “ATPM News Now.” Each year ATPM has hosted one or more national professional meetings on academic, practice, and policy currents in the field of preventive medicine, including the annual three-day Prevention meetings, co-sponsored with the American College of Preventive Medicine between 1984 and 2000.

Through cooperative agreements with such federal agencies as the Centers for Disease Control and Prevention, the Office of Disease Prevention and Health Promotion, and the Health Resources and Services Administration, ATPM and its members conduct a wide range of educational, training, and research projects, including: development of the widely used *Inventory of Skills and Knowledge Relating to Disease Prevention and Health Promotion* (CDC) and the *Teaching Immunization for Medical Education* project (CDC); a monograph on *Enhancing Teaching of Prevention in Medical Education* (HRSA); and the Luther Terry Fellowship, a prestigious two-year position as senior clinical advisor for public health and science (ODPHP).

WILLIAM H. BARKER

(SEE ALSO: *American College of Preventive Medicine*; *Centers for Disease Control and Prevention*; *Health Resources and Services Administration*)

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ASSURANCE OF LABORATORY TESTING QUALITY

Accurate laboratory testing is essential to public health. Yet no laboratory test can be guaranteed to be accurate 100 percent of the time. In order to assure that test results are acceptable and reliable, a laboratory must incorporate both quality assurance and quality control procedures into its daily laboratory routine.

Quality assurance is the ongoing process of monitoring laboratory procedures so that corrective action can be taken when established criteria are not met. A critical element is the monitoring of the sample or specimen collection procedure. This includes making sure that the appropriate sample is submitted within the timeframe required, that it is shipped or carried to the laboratory under correct conditions for accurate testing, and that it is stored and handled according to the test protocol developed within the laboratory. A vital part of quality assurance is the statistical monitoring of the specific procedures used to measure quality control within the laboratory. Quality assurance includes both qualitative and quantitative parameters beginning with the conditions under which the specimen is collected and concluding with final report and disposition of the specimen following testing. Quality control consists of only those parameters that can be measured and reported statistically.

Internal quality control procedures can include recording the temperatures of refrigerators, freezers, incubators, water baths, and rooms; inclusion of positive and negative controls with each type of test performed; and documentation of the

lot numbers and expiration dates of every reagent or medium used in testing. These procedures must be monitored routinely to alert the analyst to situations that may result in the unsatisfactory performance of a test. Corrective action can then be taken before any erroneous results are reported. External quality control, using anonymous and coded performance evaluation samples, is used to aid a laboratory in assessing its results and provide laboratory-to-laboratory comparisons.

KATHLEEN L. MECKSTROTH

(SEE ALSO: *Diagnostic Testing for Communicable Disease; Laboratory Services; Laboratory Technician; Practice Standards; Reference Laboratory*)

ASTHMA

Asthma is a common chronic lung disease characterized by a narrowing of the airways, resulting in obstruction of the flow of air and difficulty in breathing. The airflow obstruction is partially or completely reversible in most patients. Different designations of asthma include bronchial asthma, exercise-induced asthma, drug-induced asthma, occupational asthma, and cardiac asthma (airway narrowing in the setting of congestive heart failure). This discussion focuses primarily on bronchial asthma, a chronic inflammatory disorder of the airways (both the larger "bronchi" and the smaller "bronchioles"), resulting in airflow obstruction and increased sensitivity (responsiveness) of the airways to a variety of stimuli ("bronchial hyperreactivity").

About 15 million Americans, a third of whom are children, suffer from asthma, and more than 5,000 people die from it each year. The condition accounts for an estimated 100 million days of restricted activity and 470,000 hospitalizations annually in the United States. Over the last three to four decades both the prevalence and the death rate from asthma in the United States and many other developed countries have increased. In the United States, the increases in death rates have been higher in women than in men and higher in blacks than in whites.

The most important risk factor to develop bronchial asthma is atopy, an inherited predisposition to have allergies. An acute attack of asthma

may occur if an atopic individual inhales allergy-provoking substances (allergens) such as ragweed, cat dander, or house dust. A variety of cells are involved in the asthmatic inflammatory reaction in the airway walls, including neutrophils, eosinophils, lymphocytes, mast cells, and macrophages. These cells release mediators (chemicals such as “cytokines”) that provoke the inflammatory process. Asthma also occurs in people without allergies.

During an acute episode of asthma, bronchial narrowing (“bronchoconstriction”) results from the buildup of plugs of mucus and cellular debris in the lumen, contraction of smooth-muscle cells ringing the airways, and inflammation and edema of the mucosa. Permanent changes in the airway, including enlargement of the submucosal mucous glands, proliferation of mucus-secreting cells and smooth-muscle cells, and deposition of fibrous tissue in the mucosa, may occur in chronic asthma, a process known as “airway remodeling.”

The degree of airflow limitation in patients with asthma is measured by performing breathing tests (pulmonary function tests) such as spirometry and the recording of peak expiratory flow rates (PEFRs). This requires the patient to take in as deep a breath as possible and blow it out with maximum effort into a recording instrument. Obstructive dysfunction is detected if airflow rates are significantly less than predicted values. Partial or complete reversibility of the obstructive dysfunction is possible in most cases after the inhalation of a medication (e.g., albuterol) that dilates the airways. Between episodes of asthma, airflow rates may be normal. However, a patient who has had asthma for many years may display persistent and irreversible obstructive dysfunction as a result of airway remodeling. Spirometry is also employed in bronchial-provocation testing to determine if an individual with suspected asthma has bronchial hyperreactivity (an unusual degree of airway sensitivity to challenges such as exercise or the inhalation of dilute solutions of chemicals such as methacholine).

Patients with asthma suffer from shortness of breath, wheezing, chest tightness, and cough. These symptoms, which may be episodic or chronic, are often worse early in the morning and may disrupt sleep. Asthma often develops in childhood, but it may appear at any age. Episodes of asthma may be

spontaneous, but more commonly they are “triggered” by various stimuli, such as inhaling allergens or nonspecific airway irritants (e.g., dusts, smoke, fumes, cold air), upper or lower respiratory tract infections, exercise, certain medications, and exposure to chemicals and other substances in the workplace. The frequency and severity of symptoms vary greatly from patient to patient and tend to be less episodic and more persistent with increasing age.

The diagnosis of bronchial asthma depends upon a medical history of one or more asthma symptoms, evidence of airflow limitation on physical examination or pulmonary function testing, and demonstration of some degree of reversibility of airflow obstruction. Other conditions that mimic asthma must be excluded. These include acute or chronic bronchitis, emphysema, bronchiectasis, cystic fibrosis, upper airway obstruction from various causes, abnormal function of the vocal cords, aspiration, lung cancer, congestive heart failure, pulmonary thromboembolism (blood clots in the pulmonary artery), and even certain psychiatric disorders.

Asthma is classified according to the severity and frequency of its symptoms and the results of pulmonary function tests. Mild intermittent asthma is managed by treating the occasional symptoms with inhaled bronchodilators, called beta₂-agonists. Persistent asthma is treated with daily anti-inflammatory drugs, especially inhaled corticosteroids, often in combination with one or more inhaled or oral bronchodilator drugs. A newer class of drugs called leukotriene modifiers is employed to manage some patients with persistent asthma. Severe persistent asthma requires the daily use of several medications, including oral corticosteroids such as prednisone. Acute, severe asthma may require the patient to be hospitalized to manage acute respiratory failure with supplemental oxygen and even respiratory support on a mechanical ventilator.

Patient education, environmental control, smoking cessation, and avoidance of factors known to provoke attacks are the mainstays of prevention. The importance of stopping smoking cannot be overemphasized. Patients with asthma must reduce exposure to allergens (such as house dust mites and animal danders), eliminate certain medications (such as beta-blocker drugs and aspirin),

and avoid exposure to indoor and outdoor air pollutants. A diagnosis of occupational asthma requires that steps be taken to curtail workplace exposure to offending agents. Annual vaccination against influenza virus infection is recommended for patients with persistent asthma.

Fortunately, most patients with asthma respond well to appropriate medical management. Anti-inflammatory therapy for persistent asthma and immediate treatment for acute, severe attacks are essential steps to reduce morbidity and mortality from the disease. Death from bronchial asthma is considered to be preventable.

JOHN L. STAUFFER

(SEE ALSO: *Chronic Respiratory Diseases; Emphysema; Pulmonary Function*)

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ATHEROSCLEROSIS

The most common cause of death and disability in the United States is atherosclerosis, popularly known as "hardening of the arteries."

EPIDEMIOLOGY

Every year atherosclerosis causes about 500,000 deaths nationally, most of these due to heart attack or stroke. There are about 15 million people in the

United States suffering from atherosclerosis, and another 60 million are at risk. The factors that put individuals at risk of atherosclerosis include high blood levels of cholesterol and sugar, high blood pressure, and tobacco use. Another important risk factor is a family history of premature atherosclerosis (e.g., a close relative who has had a heart attack or stroke under the age of sixty). In addition to these risk factors, there is accumulating evidence that elevated plasma levels of lipoprotein (a), C-reactive peptide, asymmetric dimethylarginine, and homocysteine also accelerate atherosclerosis, as do obesity, type A personality, and sedentary lifestyle.

PATHOPHYSIOLOGY

Atherosclerosis is thought to be initiated by a "response to injury" of the endothelium (the lining of the blood vessel). Elevated blood levels of cholesterol or glucose, as well as high blood pressure and smoking, cause changes in the endothelium (normally the "teflon" coating of the vessel), which then becomes sticky. It begins to express on its surface "adhesion molecules," which are a bit like cellular velcro. It also expresses "chemokines" which are proteins that attract white blood cells into the vessel. White blood cells (specifically monocytes and T-lymphocytes) begin to stick to the lining of the vessel, and to infiltrate the vessel.

The monocytes migrate into the vessel wall, where they begin to accumulate cholesterol. They become engorged by cholesterol in the vessel wall and become foam cells. As foam cells accumulate in the vessel they distort the overlying endothelium (forming a "fatty streak" in the vessel), and they eventually may even rupture through the endothelial surface. In these areas of endothelial ulceration, platelets adhere to the vessel wall, releasing molecules that stimulate smooth-muscle migration and proliferation. Vascular smooth-muscle cells in the vessel wall proliferate and migrate into the area above the foam cells. The smooth-muscle cells may also become engorged with lipid to form foam cells, and atherosclerotic plaque begins to take form. The plaque grows with the recruitment of more cells, and with the accumulation of matrix made by the cells and cholesterol from the bloodstream. The progression of atherosclerotic plaque is also related to the growth

of microscopic vessels into the plaques. The complex plaque typically is characterized by a fibrous cap that overlies a necrotic core composed of cell debris and cholesterol. This core also contains a high concentration of tissue factor, secreted by macrophages. If the plaque ruptures, the exposed tissue factor will cause a blood clot to form, which can lead to a heart attack or stroke.

CLINICAL MANIFESTATIONS

By virtue of its bulk, the complex plaque may limit blood flow. With moderate-sized lesions (e.g., occupying 50% of the cross-sectional area of the inner bore of the vessel), not enough blood can flow through the vessel during states of higher demand. With physical exertion, the inadequate supply of blood may cause chest pain (angina) if the narrowing is in a heart artery, or leg pain (claudication) if the narrowing is in a leg artery. As the lesion becomes larger (e.g., 80 to 90% of the cross-sectional area), it may limit basal blood flow, causing pain at rest (e.g., rest angina).

The complicated plaque is the major cause of acute cardiovascular events (e.g., heart attack and stroke). Hemorrhage into the plaque (secondary to spontaneous rupture of small vessels supplying the lesion) can cause rapid expansion of the plaque. Alternatively, rupture of the plaque releases the tissue factor in the necrotic core, which causes local clot formation and even occlusion of the vessel, leading to heart attack, stroke, or gangrene of the leg, depending upon what vessels are affected. Microscopic examination of the ruptured plaque generally reveals that the plaque is inflamed. Infection of the plaque by bacteria or viruses may play a role in the inflammation and rupture of plaques.

PREVENTION OF ATHEROSCLEROSIS

The best medical strategy for this disease is prevention through aggressive modification of risk factors. Regular physical activity; reduction of cholesterol, blood sugar, and blood pressure; and cessation of tobacco use are known to modify the progression of disease and reduce morbidity and mortality. In addition to removing or reducing risk factors, recent work indicates that enhancing endothelial function can also favorably influence the course of disease.

ROLE OF THE ENDOTHELIUM

The endothelium is the lining of the blood vessel. It produces a panoply of paracrine factors that effect vessel tone and structure. Possibly the most important of these is endothelium-derived nitric oxide (NO). NO is derived from the metabolism of L-arginine to L-citrulline and NO by the enzyme NO synthase. NO is the most potent endogenous vasodilator known, and it exerts its actions in the same way as nitroglycerine, a medicine taken by people to relieve angina.

NO also inhibits clot formation, and adherence of monocytes to the vessel. It also inhibits the growth of vascular smooth-muscle cells. By exerting these effects, NO, and a similarly acting molecule, prostacyclin, may be the body's self-defense against atherosclerosis.

Risk factors, such as high cholesterol, high blood pressure, high blood glucose, and tobacco smoke, impair endothelial function and reduce NO and prostacyclin synthesis or activity, thereby contributing to the process of atherosclerosis. Restoration of normal function of the endothelium can relieve symptoms, and may even slow the progression of atherosclerosis.

JOHN P. COOKE

(SEE ALSO: *Blood Lipids; Blood Pressure; Cardiovascular Diseases; Coronary Artery Disease; Diabetes Mellitus; HDL Cholesterol; LDL Cholesterol; Stroke; Smoking Behavior; Smoking Cessation*)

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ATMOSPHERE

The earth's atmosphere is simple in some respects, and complex in others. It is relatively uniform in

composition with respect to its major mass components (oxygen and nitrogen), yet extremely variable in some minor components, such as water vapor and ozone (O_3), which play major roles in its heat and radiation fluctuations. The atmosphere has a complex structure based on temperature gradients. This structure governs its mixing characteristics and the buildup of contaminants, yet is usually invisible, except when light-scattering particles suspended in the air make it visible. The structure of the atmosphere is of major importance to the dilution and dispersion of contaminants. It is governed by the lapse rate, which is the rate of change of air temperature with height above the ground.

The lowest of the atmospheric layers is the troposphere, which contains about 75 percent of the mass of the atmosphere, and almost all of its moisture. It extends to a height that varies from about 9 kilometers at the poles to about 15 kilometers at the equator, and it has an average lapse rate of about $-6.5^\circ\text{C}/\text{km}$. The boundary between the troposphere and the next layer, the stratosphere, is known as the tropopause. The stratosphere contains essentially all of the remainder of the mass of the atmosphere; it is nearly isothermal (the temperature does not change with altitude) in the lower regions and shows a temperature increase with height in the upper regions. There is very little air exchange between the well-mixed and turbulent troposphere and the nearly stagnant stratosphere.

The major constituents of dry air at ground level are nitrogen (N_2) at 78.1 percent by volume, oxygen (O_2) at 21.0 percent, and argon (Ar) at 0.9 percent. Carbon dioxide (CO_2) is present at about 330 ppm by volume and methane (CH_4) at about 1.5 ppm by volume. About 3 percent of the total mass of the lower atmosphere is water vapor (H_2O), but the concentration is extremely variable in both space and time. In general, the warmer portions of the atmosphere contain more water vapor. The water vapor content becomes lower with increasing altitude and with increasing latitude. Water vapor plays a critical role in governing the earth's heat exchange and the motion of the atmosphere, due to its high heat capacity, absorption of infrared radiation, and heat of vaporization. Further effects attributable to atmospheric water result when air motion creates clouds (aerosols of water

droplets), in which the energy received as sunshine in one place is liberated as the latent heat of vaporization in another.

Of the incoming radiant energy, about 30 to 50 percent is scattered back toward space, reflected primarily by clouds and, to some extent, by solid particles or by the earth's surface. About 20 percent of the incident radiant energy is absorbed as it passes through the atmosphere. Stratospheric O_3 absorbs about 1 to 3 percent, primarily in the short-wave ultraviolet (UV) portion of the spectrum; this effectively limits further penetration to those wavelengths greater than 0.3 microns. In the troposphere, 17 to 19 percent of the incoming radiation is absorbed, due primarily to water vapor and secondarily to CO_2 .

The average radiation into space essentially equals that absorbed from the sun, and a substantial amount of energy must flow from the tropics toward the poles within the oceans and the troposphere. This flow of energy is accomplished primarily by systems of warm air and ocean currents that flow toward the poles and cool currents that flow toward the tropics.

The dispersion of contaminants within the atmosphere is generally referred to as diffusion. For practical purposes, the dispersion of contaminants by molecular diffusion is negligible because the extent of movements are generally infinitesimal compared to the movements of the air volumes containing them by the turbulent motions of the air (turbulent diffusion).

Atmospheric turbulence is a complicated phenomenon that has defied mathematical description. When considering contaminant dispersion, contaminant sources can be divided into three different categories: (1) point sources, such as tall industrial smokestacks; (2) line sources, such as highways; and (3) area sources, such as whole urban regions. The simplest is an elevated point source. The light-scattering properties of the aerosol in the plume from such a stack, consisting of fly ash and condensed water, enable us to observe plume dispersion with the unaided eye.

The vertical mixing of air is dependent upon the temperature profile of the atmosphere (the lapse rate). The immediate ground level concentrations of air contaminants may be reduced by

vertical mixing, since dispersal into higher regions dilutes the contaminants. Poor vertical mixing may allow concentrations released at low altitudes to remain there in relatively concentrated form. An extreme case of atmospheric stability occurs when the atmospheric lapse rate is negative (when the temperature increases with altitude). This condition is known as a temperature inversion. There is virtually no vertical air movement within inversion layers and contaminants accumulate within them.

MORTON LIPPMANN

(SEE ALSO: *Airborne Particles; Ambient Air Quality [Air Pollution]; Climate Change and Human Health*)

ATTITUDES

Most people constantly evaluate various aspects of their environment. This process is often behavioral in its focus (e.g., “I like eating fast food”; “Breast self-exam is a waste of my time”; “Condoms are a good way to prevent pregnancy”). Attitudes are formed as a result of this ongoing evaluative process. Thus, attitudes are defined as evaluations of entities, including behavior, that result in perceptions of favor or disfavor (Eagly and Chaiken, 1993). Consequently, attitudes may predispose individuals to adopt or reject specific health-related behaviors.

Substantial evidence suggests that attitudes have an important influence on the adoption of health-related behaviors such as: contraceptive and condom use; being screened for breast, cervical, or colorectal cancer; smoking cessation; and maintenance of a healthy diet. However, the relationship between attitudes and behavior is complex, and understanding how attitudes influence behavior may be enhanced by the use of a theoretical framework.

The theory of planned behavior is based on the premise that attitudes influence behavior in unison with two other factors: perceptions of social norms (e.g., “Is this something my friends think I should do?”) and beliefs about one’s personal ability to perform a specific behavior. Studies of various health behaviors have found that attitudes, perceived social norms, and perceived

ability each contribute, in varying combinations of importance, to predicting behavior and behavioral intent. Thus, it is appropriate to consider attitudes toward a behavior as one of these three broad classes of psychological determinants of health-related behavior.

One common problem encountered in studying attitudes is that attitudes may either influence behaviors or be influenced by behaviors. For example, a favorable evaluation of oral contraception may prompt a woman to rely on the pill for contraception. Alternatively, a woman who begins using the pill because it is popular (social norms) or because it is easy to use (perceived ability) may subsequently infer that she believes the pill is a good thing (an attitude). In the latter case, the behavior preceded the attitude. A. H. Eagly and S. Chaiken (1993) provide a comprehensive view of how people infer their attitudes based on their behavior.

Measurement of attitudes can also be problematic. An attitude typically involves multiple evaluations. For example, an individual’s attitude toward drinking may involve evaluations of social benefits, benefits of getting drunk (e.g., escape), risks (e.g., injuries and addiction), and other problems (e.g., alienation of family members, missed days of work). One strategy for measuring an attitude this complex is to sum the evaluations (favorable or not) for each of the beliefs contributing to the overall attitude. Thus, an attitude can be measured with questionnaire items that can be read as a scale. For example, when the Condom Attitude Scale was recently administered to a group of adolescents, favorable attitudes on this scale were associated with lower odds of the adolescents’ reporting unprotected vaginal sex during the previous thirty days.

The professional literature in the field of public health contains numerous examples of theory-based investigations that help determine the influence of attitudes on health-related behavior. For example, K. Jennings-Dozier (1999) used the theory of planned behavior to predict intentions among minority women to obtain a Pap smear (a test for cancer of the cervix). Assessed attitudes toward obtaining a Pap smear were the best predictor of this intent among African-American and Latina women. The implication of these findings is that,

assuming the services are accessible and affordable, prevention programs can promote first-time Pap testing by providing women with information that favorably influences their evaluation of the test and procedure. In fact, the content of prevention programs is often designed to highlight the benefits of an entity (e.g., high-fiber foods prevent heart disease and some forms of cancer) or a behavior (e.g., breastfeeding helps protect your child from illness).

R. Prislin and colleagues (1998) provided another example of how the study of attitudes can be applied to the field of public health. They found that six beliefs commonly held by parents about childhood immunization predicted the immunization status of their children. The findings suggest that childhood immunization rates could be increased by facilitating parental beliefs in the efficacy and safety of vaccines and dispelling the belief that it is better to acquire immunity by getting sick than by receiving a vaccine. These beliefs contribute to parents' overall evaluation (their attitude) toward having their children immunized. Given that parents have access to affordable vaccination services, a more favorable attitude is likely to influence greater compliance with recommended immunizations.

RALPH J. DiCLEMENTE
RICHARD A. CROSBY

(SEE ALSO: *Behavior Change; Behavior, Health-Related; Health Belief Model; Predisposing Factors; Psychology, Health; Theories of Health and Illness; Theory of Planned Behavior*)

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AUDIOTAPES AND VIDEOTAPES

Audiotapes have been used by health professionals primarily as a tool in patient education. The growing importance of stress management has led to the use of audiotapes to provide patients with guided imagery and progressive muscular relaxation to aid in stress reduction. They are also used for diabetes education, progressive muscular relaxation, and patient research.

Educational videotapes are perhaps the single most frequently used presentation tool and teaching aid in health-education settings. The advent of the video projector in the mid-1980s allowed programs to be viewed on videotape by large groups much more easily than with the now-obsolete 16mm film and projector. Optimally, educational tapes are short in duration (fifteen to twenty minutes) and focus on either the cognitive or affective domains of learning.

ROBIN G. SAWYER

(SEE ALSO: *Communication for Health; Counseling; Health Promotion and Education*)

AUTOMOTIVE EMISSIONS

Pollutant emissions from transportation sources, particularly automobiles and trucks, make up a substantial portion of national and global air pollution. They are major sources of carbon monoxide, nitrogen oxides, polycyclic organic matter, and volatile organic compounds (VOCs), such as benzene, a known cause of human leukemia and a

subject of long-term regulatory concern. Nitrogen oxides and VOCs in automotive emissions are also major precursors for the formation of tropospheric ozone, which is of particular concern because there are substantial portions of the United States that experience adverse health consequences due to summertime oxidant smog, of which ozone is the key component. Diesel fuels, primarily used by trucks, also contribute to the overall particulate load as well as to mutagenic polycyclic aromatic hydrocarbons (PAHs). Resolving the current controversy about the role of diesel exhaust in causing cancer, as well as noncancer endpoints such as asthma, is important as it will affect decisions about the future development of automotive engines. Automotive emissions are also major contributors to the production of carbon dioxide, a significant contributor to global climate change.

Many automotive emissions of concern have come from fuel additives. Recognition of the role of lead in gasoline in producing subtle effects on childhood neurological and neurobehavioral development has led to a phasing out of leaded gasoline in the United States, an approach now followed in much of the world. The blending with gasoline of methyl tertiary-butyl ether (MTBE), an oxygenated ether, is also currently being phased out in the United States due to concerns about health effects and groundwater contamination. Unfortunately, other potentially neurotoxic heavy metals, such as manganese, are still being considered as fuel additives, and there are other oxygenated ethers in use for which there is even less toxicological information than there is for MTBE.

Changes in the design and engineering of automobiles have led to significant reductions in emissions. Evaporative loss of gasoline hydrocarbons has declined; increased engine efficiency has reduced carbon monoxide emissions; and the catalytic converter has significantly limited tailpipe emissions of all pollutants, except for nitrogen oxides. However, the decreases in emissions per mile driven have barely kept up, if at all, with the marked increase in miles driven. Continuing worldwide increases in the number of automobiles powered by gasoline and diesel fuel are inevitable for at least a few decades. Developing countries routinely go through a transition to reliance on greater numbers of automobiles and trucks, usually preceded by a surge in motorcycles or mopeds powered by two-cycle engines, which are themselves

heavily polluting. There is a longer-term possibility of lesser emissions from automobiles powered by electricity or by other less-polluting sources such as hydrogen. Hybrid (gasoline and electric) automotive power sources may make inroads relatively quickly.

Land planning is also a major determinant of automotive pollution emissions. Urbanization in developing countries and urban and suburban sprawl in developed countries both have adverse implications on automotive emissions that can be avoided though proper planning.

BERNARD D. GOLDSTEIN

(SEE ALSO: *Airborne Particles; Ambient Air Quality [Air Pollution]; Atmosphere; Benzene; Carbon Monoxide; Climate Change and Human Health; Fuel Additives; Land Use; Urban Health; Urban Sprawl; Urban Transport*)

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AUTONOMY

The core idea of personal autonomy is to have personal rule of the self while remaining free from controlling interference by others. The autonomous person acts in accordance with a freely self-chosen and informed plan. A person of diminished autonomy, by contrast, is in at least some respects controlled by others or is incapable of deliberating or acting on the basis of his or her own plans. For example, institutionalized persons, such as prisoners or the mentally retarded, may have diminished autonomy.

In public health, the concept of autonomous decision making is related to informed consent. Virtually all medical and research codes of ethics

now hold that physicians and researchers must obtain the informed consent of patients and research subjects before undertaking procedures. These consent measures have been designed to enable autonomous choice by patients and subjects, but they serve other purposes as well, including the protection of patients and subjects against harm and the encouragement of medical professionals to act responsibly in their interaction with patients and subjects.

There is growing international appreciation of the importance of ethical review of research involving human subjects. Ethical review committees carry the primary responsibility for ensuring that research is scientifically sound, and that informed consent is obtained from research subjects in ways that respect their autonomy and ensure an appropriate balance of risks and benefits.

While informed consent can be obtained in more advanced societies in ways that can be assessed by ethical review committees in terms of subjects being well informed and the consent being understood and responded to by the subject

without coercion or intimidation, the situation may be different in developing countries. The informed consent process could be very different in a cultural situation in which the subject is illiterate and the process of seeking consent involves obtaining overall permission from community leadership in addition to individual consent from research subjects. In such situations the challenge is to respect local culture and its processes, while at the same time respecting the autonomous rights of each research subject.

JOHN H. BRYANT

(SEE ALSO: *Cultural Appropriateness; Epidemiology; Informed Consent; Paternalism*)

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B

BABY BOTTLE TOOTH DECAY

Baby bottle tooth decay (BBTD) is a type of early childhood caries (ECC) that affects primary teeth. BBTD is attributed to prolonged bottle feeding, usually during sleep, of cariogenic liquids, such as milk. It occurs in young children who have inadequate dental plaque removal. Some reports suggest that good oral hygiene can delay or prevent BBTD, even when prolonged feeding occurs. BBTD is alternatively called nursing bottle mouth, baby bottle caries, or baby bottle syndrome.

While the etiology of BBTD is still controversial, animal models suggest that milk alone is not causative. Other liquids such as juices, carbonated drinks, and fruit-flavored drinks can support a pattern of decay identical to BBTD. Most experts would attribute BBTD to the combined precipitating factors of a cariogenic liquid containing sugar, susceptible dentition, and the presence of cariogenic microorganisms such as *Streptococcus mutans*. Identical caries patterns have been reported to occur with prolonged or frequent breastfeeding or feeding with a transitional container such as a “sippy cup.”

BBTD has a characteristic clinical pattern, but a strict definition is not agreed upon. The following are indicators of BBTD:

1. Decay in two or more of the maxillary primary incisors (top front teeth).
2. The mandibular incisors (bottom front teeth) are generally not affected.

3. Other primary teeth, may also show decay.
4. Dental caries on tooth surfaces usually considered resistant to decay, such as the facial and/or lingual surfaces of the teeth.
5. Rapid and early occurrence of dental caries in the life of the primary teeth.

The prevalence of BBTD varies among different populations. It ranges from about 5 percent in the general population to well over 50 percent in selected groups such as Native Americans and some immigrant groups. Within low-income groups, prevalence is about 20 percent, according to some studies. Risk factors that predict BBTD are inadequate plaque removal, a diet rich in cariogenic liquids, and prolonged or frequent feedings with cariogenic liquids. Secondly, studies have implicated parental lifestyles and ignorance of the condition, child behavioral and sleep problems, a need for frequent feedings, and virulent microflora as additional risk factors.

Prevention of BBTD aims to eliminate risk factors and includes education of parents about causality; the use of alternative liquids such as water for night feeding; substituting another object for the bottle, such as a pacifier or toy; weaning a child from the bottle; and daily plaque removal. Secondary prevention involves the use of home-applied topical fluoride in dentifrice or gel form or office-applied fluoride varnish to halt the decalcification of incipient carious lesions, and, if needed, restoration of early lesions with a material such as a dental cement or composite resin. These

often have a fluoride-release capability. Once affected with BBTD, a child remains more susceptible to recurrent dental caries throughout the primary dentition. Several studies suggest that even intensive use of existing preventive therapies will not alter a child's susceptibility to recurrent dental caries after having experienced BBTD.

PAUL S. CASAMASSIMO

(SEE ALSO: *Caries Prevention; Maternal and Child Health; Oral Health*)

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BAREFOOT DOCTORS

In the People's Republic of China, the "cultural revolution" was the tumultuous period from 1965 to 1975 when young people reacted violently against the policies of the communist government that had been in power since 1949. The reforms that followed gave rise to widespread training of peasants in basic principles of environmental sanitation, communicable disease control, health education (on nutrition, safety, etc.), and treatment of minor ailments. The peasants were trained for three to six months at rural health centers of rural hospitals. Initially, these health workers were called "barefoot doctors." After the death of Chairman Mao Zedong in 1976, their training became more rigorous, they were required to pass examinations, and they were upgraded to "village doctors."

MILTON I. ROEMER

(SEE ALSO: *International Development of Public Health; International Health*)

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BARRIER NURSING

The term "barrier nursing" is given to a method of nursing care that has been used for over one hundred years when caring for a patient known or thought to be suffering from a contagious disease such as open pulmonary tuberculosis. It is sometimes called "bedside isolation." As the name implies, the aim is to erect a barrier to the passage of infectious pathogenic organisms between the contagious patient and other patients and staff in the hospital, and thence to the outside world. Preferably, all contagious patients are isolated in separate rooms, but when such patients must be nursed in a ward with others, screens are placed around the bed or beds they occupy. The nurses wear gowns, masks, and sometimes rubber gloves, and they observe strict rules that minimize the risk of passing on infectious agents. All equipment and utensils used to care for the patient are immediately placed in a bowl of sterilizing solution, and attending nurses observe surgical standards of cleanliness in hand washing after they have been attending the patient. Bedding is carefully moved in order to minimize the transmission of airborne particles, such as dust or droplets that could carry contagious material, and is cleansed in special facilities that include the use of steam heat for sterilization.

Barrier nursing often failed its objective, especially in hospital wards of the traditional "Nightingale" pattern, with rows of beds lined up on two or more sides of a large room. Airborne and droplet infection all too frequently penetrated the imperfect barrier, and sometimes even fecal-oral infectious agents found ways to invade the imperfect protective measures intended to block their passage. Late in the twentieth century, barrier nursing was superseded by more effective and more rigorous universal precautions.

JOHN M. LAST

(SEE ALSO: *Cordon Sanitaire; Public Health Nursing; Universal Precautions*)

BATTERED CHILD

See Domestic Violence

BATTERED SPOUSE

See Domestic Violence

BAYES, THOMAS

An English country clergyman, amateur mathematician, and inveterate gambler, Thomas Bayes (1702–1761) is remembered for his development of ideas and concepts in the theory of probability. These are described in his *Essay Towards Solving a Problem in the Doctrine of Chances*, published posthumously in 1763. Bayes was interested in the chances of drawing a winning hand in card games, throwing the right combination of numbers with a pair of dice, and picking the winner in a horse race. He expounded on the chance of events occurring on the basis of preexisting circumstances and after the occurrence of particular events, which he termed “prior odds” (or probability) and “posterior odds.” His *Essay* was rediscovered in the twentieth century and was put to service in Bayesian statistics, a branch of stochastic mathematics that does not use statistical significance tests. It has proved very useful in decision analysis, clinical epidemiology, health-services research, and other applications of probability theory.

JOHN M. LAST

(SEE ALSO *Bayes' Theorem; Probability Model; Statistics for Public Health*)

BAYES' THEOREM

Bayes' theorem deals with the role of new information in revising probability estimates. The theorem assumes that the probability of a hypothesis (the posterior probability) is a function of new evidence (the likelihood) and previous knowledge (prior probability). The theorem is named after Thomas Bayes (1702–1761), a nonconformist minister who had an interest in mathematics. The basis of the theorem is contained in an essay published in the *Philosophical Transactions* of the Royal Society of London in 1763.

Bayes' theorem is a logical consequence of the product rule of probability, which is the probability (P) of two events (A and B) happening— $P(A,B)$ —is equal to the conditional probability of

one event occurring given that the other has already occurred— $P(A|B)$ —multiplied by the probability of the other event happening— $P(B)$. The derivation of the theorem is as follows: $P(A,B) = P(A|B) \times P(B) = P(B|A) \times P(A)$

Thus: $P(A|B) = P(B|A) \times P(A) / P(B)$.

Bayes' theorem has been frequently used in the areas of diagnostic testing and in the determination of genetic predisposition. For example, if one wants to know the probability that a person with a particular genetic profile (B) will develop a particular tumour type (A)—that is, $P(A|B)$. Previous knowledge leads to the assumption that the probability that any individual will develop the specific tumour ($P(A)$) is 0.1 and the probability that an individual has the particular genetic profile ($P(B)$) is 0.2. New evidence establishes that the probability that an individual with the tumour— $P(B|A)$ —has the genetic profile of interest is 0.5.

Thus: $P(A|B) = 0.1 \times 0.5 / 0.2 = 0.25$

The adoption of Bayes' theorem has led to the development of Bayesian methods for data analysis. Bayesian methods have been defined as “the explicit use of external evidence in the design, monitoring, analysis, interpretation and reporting” of studies (Spiegelhalter, 1999). The Bayesian approach to data analysis allows consideration of all possible sources of evidence in the determination of the posterior probability of an event. It is argued that this approach has more relevance to decision making than classical statistical inference, as it focuses on the transformation from initial knowledge to final opinion rather than on providing the “correct” inference.

In addition to its practical use in probability analysis, Bayes' theorem can be used as a normative model to assess how well people use empirical information to update the probability that a hypothesis is true.

GEORGE WELLS

(SEE ALSO: *Bayes, Thomas; Probability Model; Statistics for Public Health*)

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BEHAVIOR, HEALTH-RELATED

Health-related behavior is one of the most important elements in people's health and well-being. Its importance has grown as sanitation has improved and medicine has advanced. Diseases that were once incurable or fatal can now be prevented or successfully treated, and health-related behavior has become an important component of public health. The improvement of health-related behaviors is, therefore, central to public health activities.

Behavioral factors play a role in each of the twelve leading causes of death, including chronic diseases such as heart disease, cancer, and stroke, which are the major causes of death in the United States and other developed countries. The most common behavioral contributors to mortality, or death, in 1990 included the use of alcohol, tobacco, firearms, and motor vehicles; diet and activity patterns; sexual behavior; and illicit use of drugs. Behaviors such as these are thought to contribute to almost half of the deaths in the United States, and, according to J. McGinnis and W. Foege (1993), they were responsible for nearly 1 million deaths in the United States in the year of 1992 alone. The social and economic costs related to these behaviors can all be greatly reduced by changes in individuals' behaviors.

The last two decades of the twentieth century saw a rising interest in preventing disability and death through changes in health-related behaviors, particularly changes in lifestyle habits and participation in screening programs. Much of this interest was stimulated by the change in disease patterns from infectious to chronic diseases as leading causes of death, combined with the aging of the population, rapidly escalating health care costs, and data linking individual behaviors to increased risk of morbidity and mortality. The AIDS (acquired immunodeficiency syndrome) epidemic also contributed.

Although there is more information about what constitutes healthy behavior and risk factors than ever before, this information has not always

led to healthier behaviors. There have been some positive changes, however. Between 1988 and 1994, the average daily intake of dietary fat in the United States dropped from 36 percent to 34 percent of total calories; seat belt use increased from 42 percent to 67 percent; and the number of women over the age of forty who had breast exams and mammograms doubled. Cigarette smoking has decreased among men by as much as 50 percent in some countries. Unfortunately, during this same period, the number of obese adults rose, sexual activity among adolescents increased, more teenage girls began smoking, and the incidence of HIV (human immunodeficiency virus)/AIDS reached epidemic proportions.

DEFINITIONS OF HEALTH BEHAVIOR

There are many questions about health-related behavior, or health behavior, that are not yet well understood. Therefore, both public health workers and scientific researchers continue to attempt to understand the nature and causes of many different health behaviors. Health behavior encompasses a large field of study that cuts across various fields, including psychology, education, sociology, public health, epidemiology, and anthropology.

In the broadest sense, health behavior refers to the actions of individuals, groups, and organizations, as well as the determinants, correlates, and consequences, of these actions—which include social change, policy development and implementation, improved coping skills, and enhanced quality of life. This is similar to the working definition of health behavior that David Gochman proposed, which includes not only observable, overt actions but also the mental events and emotional states that can be reported and measured. Gochman defined health behavior as "those personal attributes such as beliefs, expectations, motives, values, perceptions, and other cognitive elements; personality characteristics, including affective and emotional states and traits; and overt behavior patterns, actions, and habits that relate to health maintenance, to health restoration, and to health improvement." Interestingly, this definition emphasizes the actions and the health of individuals. A public health perspective, in contrast, is concerned with individuals as part of a larger community. These perspectives are interrelated, as the

behaviors of individuals determine many of the social conditions that affect all people's health.

Gochman's definition is consistent with the definitions of specific categories of overt health behavior proposed by S. Kasl and S. Cobb. In two seminal 1966 articles, Kasl and Cobb define three categories of health behavior:

- *Preventive health behavior* involves any activity undertaken by individuals who believe themselves to be healthy for the purpose of preventing or detecting illness in a asymptomatic state. This can include self-protective behavior, which is an action intended to confer protection from potential harm, such as wearing a helmet when riding a bicycle, using seat belts, or wearing a condom during sexual activity. Self-protective behavior is also known as cautious behavior.
- *Illness behavior* is any activity undertaken by individuals who perceive themselves to be ill for the purpose of defining their state of health, and discovering a suitable remedy.
- *Sick-role behavior* involves any activity undertaken by those who consider themselves to be ill for the purpose of getting well. It includes receiving treatment from medical providers, generally involves a whole range of dependent behaviors, and leads to some degree of exemption from one's usual responsibilities.

These classic definitions have stood the test of time, and continue to be used by students and public health workers alike. However, the lines between these three categories have blurred somewhat over time, and there are also several categories of behavior that warrant specific definitions.

Behavior versus Lifestyle. Health behavior can be something that is done once, or something that is done periodically—like getting immunizations or a flu shot. It can also be something that one does only to oneself, such as putting on sunscreen, or a behavior that affects others, like putting up a shade cover so that children at a playground are protected from the sun. Other health behaviors are actions that are performed

over a long period of time, such as eating a healthful diet, getting regular physical activity, and avoiding tobacco use. It is these latter types of behaviors, which are sustained patterns of complex behavior, that are called "lifestyle" behaviors. A composite of various healthful behaviors is often referred to as "healthy lifestyle." However, most people do not practice either healthful or risky behaviors with complete consistency—someone might get regular, health-promoting exercise several times a week but be a cigarette smoker who seldom brushes his or her teeth; or someone might quit smoking, only to begin eating chocolate as a substitute. In the ideal, the person who practices a variety of behaviors in a health-enhancing manner can be described as living a healthy lifestyle. More realistically, though, many people practice some, but not all, lifestyle behaviors in a consistently healthful manner.

Health-Related and Health-Directed Behavior. Health-related behavior is any action that is related to disease prevention, health maintenance, health improvement, or the restoration of health. This type of behavior can be either voluntary or involuntary, and can be undertaken explicitly for health purposes, as a matter of habit, or to comply with a law or requirement. For example, a child who runs 800 meters in a physical education class is performing a health-related behavior, but only because the teacher requires it to get a passing grade. In contrast, an adult who exercises to reduce the risk of heart disease is engaging in that behavior for the express purpose of restoring, maintaining, or improving his or her health. This type of action is called "health-directed behavior." Sometimes these two types of health behavior coexist—a toddler buckled into a safety seat is participating in health-related behavior, but for the parent this is a health-directed behavior.

Self-Care Behavior. Self-care behavior involves taking actions to improve or preserve one's health. Self-care is often thought of in terms as prevention or self-treatment of definable health problems or conditions, but it can also include primary prevention in the absence of any symptoms. Self-care includes the actions taken to treat symptoms before (or instead of) seeking professional medical attention, such as eating chicken soup, drinking liquids, or taking over-the-counter medications for cold or flu-like symptoms. It also includes treating minor injuries such as bruises, scrapes, and twisted

ankles when a person does not think a health care professional is needed. Self-care is also a continuum whereby a patient may complete home treatments such as changing a bandage or wound dressing, doing rehabilitation exercises, or avoiding foods that inflame an allergic reaction. The use of alternative and complementary medical treatments, without medical supervision, is also self-care behavior. An important feature of self-care behavior is that it involves active participation in the health care process.

Health Care Utilization Behavior. Health care utilization is the use of health services, whether it be clinical public health services or the services of medical care professionals. Health care utilization behavior is a continuum that ranges from using preventive services, such as getting immunizations or early detection and screening tests, to elective surgery or involuntary hospitalization after an injury. Health care utilization is influenced by many different factors, and therefore the study of utilization behavior includes examining who uses medical services, when and why they use these services, and how satisfied they are with the services. Because health care utilization behaviors, like lifestyle behaviors, are quite complex, various factors need to be examined to understand them. A framework for understanding these factors that has been widely used is the model devised by R. Andersen and L. A. Aday. According to their model, among the factors influencing health care utilization are: characteristics of individuals and populations at risk, the availability and quality of availability services, economic factors such health insurance, and additional access factors such as the location of health services and the availability of transportation. In addition, the level of "health need" is very important in terms of motivation and/or choice about using medical care. This approach provides an important and robust model for studying health care utilization behavior.

Dietary Behavior. Dietary behavior refers to eating patterns that people engage in, as well as behaviors related to consuming foods, such as shopping, eating out, or portion size. Dietary behavior differs from some other types of health behavior in that it is, in its basic forms, essential for life. Of course, some dietary behaviors, such as drinking alcoholic beverages or smoking cigarettes, are not necessary to sustain life. It is recognized that dietary behaviors influence the development

of many chronic diseases, including coronary heart disease, some cancers (e.g. breast, colon, prostate, stomach, and cancers of the head and neck), type II diabetes mellitus, and osteoporosis. Recommendations for healthful dietary behavior include limiting consumption of high-fat foods, having a high intake of fruit and vegetables, increasing fiber, and controlling caloric intake to prevent obesity. Although most Americans know about the health consequences of unhealthful diets, many of the public health goals for dietary behavior have not been met. The prevalence of obesity and type II diabetes mellitus increased markedly in the United States and Canada during the last decade of the twentieth century.

Dietary behaviors play a role in preventing or managing disease when they are sustained over the long term. Behavioral considerations are key to any attempts to promote healthful dietary behavior. Several core issues about dietary behavior have been recognized. First, most diet-related risk factors are asymptomatic and do not present immediate or dramatic symptoms. Second, health-enhancing dietary changes require qualitative change, not just changes in the amount of food consumed. Third, both the act of making changes and self-monitoring dietary behaviors require knowledge about foods. Thus, information acquisition and processing may be more complex for dietary change than for changes in some other health behaviors, such as smoking and exercise.

Substance-Use Behavior. Substance-use behavior focuses on the use of both licit and illicit mood-altering substances. This category of substances, typically referred to collectively as "drugs," includes tobacco, alcohol, caffeine, marijuana, cocaine, heroin, "designer drugs," and prescription medications taken improperly. These substances are ingested for various reasons, but they are similar in that they are all taken without the advice of a physician. Substance abuse, which occurs when substance use behavior is at an extreme and unsafe level, is sometimes associated with addiction, which makes it difficult to stop using the substance. Substance use and abuse are responsible for many social and health problems, and for an enormous burden of avoidable injuries in the United States each year.

Sexual Behavior. Sexual behavior may or may not involve sexual intercourse. Sexual behaviors

have health implications that range from reproduction and childbearing to sexually transmitted diseases and, the most serious of these, HIV/AIDS. Taking precautions or avoiding sexual contact with multiple partners can help prevent sexually transmitted diseases (STDs) and prevent unwanted pregnancies. Sexual freedom due to social changes, a broadening of women's participation in society, and the availability of effective birth control has increased the prevalence of sexual behavior in the United States, bringing with it significant health and social problems. Attention toward this area of health behavior has increased greatly over the last two decades of the twentieth century, especially due to the AIDS epidemic.

Reckless Behavior. Reckless behavior involves individuals putting themselves in situations not normally required in daily living that substantially increase their chances of illness, injury, or death. It is often used synonymously with the terms "risk-taking behavior" and "risky behavior." Reckless or risky behavior is observed in adolescents and young adults, especially young males, more often than in other demographic groups. Examples of behaviors considered risky or reckless include drinking and driving, drag racing, substance use, carrying a concealed weapon, engaging in unprotected sex, and playing extreme sports. Reckless behaviors have been shown to be strongly related to an individuals' tendency toward impulsivity and sensation-seeking.

UNDERSTANDING AND IMPROVING HEALTH BEHAVIOR

The best way to design programs to achieve positive changes in health behavior is to have an understanding of why people behave as they do and what might motivate them to change. Theories and models of health behavior have been developed for this purpose. A theory is a set of interrelated concepts, definitions, and propositions that present a systematic view of events or situations by specifying relations among variables in order to explain and predict the events or situations. Theories can be useful during the various stages of planning, implementing, and evaluating interventions. They can, for example, be used to guide an exploration of why people are or are not consuming a healthful diet or adhering to a therapeutic dietary regimen. Theories can guide the search to

understand why people do or do not follow medical advice; to help identify what information is needed to design an effective intervention strategy; and to provide insight into how to design an educational program so it is successful. Thus, theories help to explain behavior, as well as suggest how to develop more effective ways to influence and change behavior. A theory about why a person chooses the foods he or she eats is one step toward successful nutrition management, but some type of change model will also be needed to guide the person toward a healthful diet.

The most widely accepted theories about health behavior have been tested in research and found to be helpful in understanding or predicting health behaviors. Health behavior is, however, far too complex to be explained by a single, unified theory, and some professionals have devised models that draw on a number of theories to help understand a specific problem in a particular setting or context.

THEORETICAL MODELS OF HEALTH BEHAVIOR

No single theory or model dominates research or practice in health-related behavior. Four of the most frequently mentioned theories of health behavior in the late 1990s were the health belief model; social cognitive theory; the stages of change/trans-theoretical model; and community organization. These theories focus on a range of factors influencing behavior determinants, including factors within an individual (such as thoughts, feelings, and beliefs), factors in groups or relationships, and factors that exist in organizations, communities, and governments (such as structures, regulations, policies, and laws).

The health belief model was originally developed to explain why people did or did not take advantage of preventive services such as disease screening and immunizations. Its central thesis is that health behavior is determined by two interrelated factors: a person's perception both of the threat of a health problem and of his or her accompanying appraisal of a recommended behavior for preventing or managing the problem. The model works well, especially for early detection or for some conditions, such as infectious

diseases, that people might find frightening, especially if they are uncertain about the effects of treatment methods.

The stages of change model concerns an individual's readiness to change, or to try to change, unhealthful behaviors. Its basic premise is that behavior change is a process and not an event, and that individuals are at varying levels of motivation, or readiness, to change. This means that people at different points in the process of change can benefit from different programs for change, and the programs work best if matched to their stage of readiness.

Social cognitive theory (SCT) is very complex. From this theory's perspective, people and their environments are thought to interact continuously. A basic premise of social cognitive theory is that people learn not only through their experiences, but also by watching the way other people act and the results they achieve. SCT also takes the view that, while people are influenced by the world around them, they can also actively change that world. SCT provides a foundation for several strategies for behavior change, for example the use of role models who carry out a behavior and achieve good results. Another way SCT applies to behavior change is by emphasizing that individuals change their situations by changing their own behavior.

Community organization articulates the process by which community groups identify problems or goals, mobilize resources, and develop ways to reach their goals. It includes several ways of bringing about change, including developing resources and skills; getting specialized help from outside experts; and social action, which involves people joining together for a cause, especially one that involves a particular group that is being greatly affected by a particular problem. Examples of this are AIDS activists, women's health activists working for more research on breast cancer prevention and treatment, and youths developing coalitions to fight the tobacco companies' efforts to attract customers among teenagers.

IMPORTANT CROSS-CUTTING ISSUES AND CONSTRUCTS

The various theories of health-related behavior often overlap. Not surprisingly, these explanations

for behavior and models for change share several constructs and common issues.

Behavior Change as a Process. One central idea that has gained wide acceptance is the simple notion that behavior change is a process, not an event, which is the major tenet of the stages of change model. It is important to think of the change process as one that occurs in stages. It is not a question of someone deciding one day to stop smoking and the next day becoming a nonsmoker for life. Likewise, most people won't be able to dramatically change their eating patterns all at once. The idea that behavior change occurs in a number of steps is not particularly new. In fact, various multistage theories of behavior change date back to the 1940s. This theory gained wider recognition toward the end of the twentieth century, however. One example is the diffusion of innovations theory, which distinguishes the diffusion or spread of new behaviors from their adaptation or use by increasing numbers of people.

Changing Behaviors versus Maintaining Behavior Change. Even where there is good initial compliance to a health-related behavior change, a relapse to previous behavior patterns is very common. Undertaking a behavior change and maintaining the change, therefore, require different types of programs and self-management strategies. For example, someone could quit smoking by going "cold turkey," but he or she will probably be tempted again, perhaps at a party where friends are smoking. Maintaining cessation involves developing self-management and coping strategies, as well as establishing new behavior patterns that emphasize perceived control, environmental management, and improved confidence in one's ability to avoid temptation. A model called the relapse prevention model focuses very specifically on this issue.

Barriers to Actions and Decisional Balance. The concept of barriers to action, or perceived obstacles, is often mentioned in theories of health behavior. An extension of this concept involves what is known as "decisional balance." This idea is called the "net benefits of action" in the health belief model and "pros minus cons" in the stages of change model. These terms all reflect the idea that individuals engage in a relative weighing of the pros and cons of a prospective behavior change. This notion is basic to models of rational decision

making, in which people intellectually think about the advantages and disadvantages of engaging in a particular action.

IMPLICATIONS FOR PUBLIC HEALTH

Understanding and improving health-related behavior is critical to the future of public health and to the well-being of individuals, and has become central to public health activities. While policies, laws, and regulations can affect health behaviors, there are also many individual factors that must be considered in these public health efforts.

Change is incremental. Many people have practiced a lifetime of less than optimal health behaviors of one sort or another. It is unreasonable to expect that significant and lasting changes will occur during a short period of time. Public health programs need to identify and maximize the benefits of positive change, pull participants along the continuum of change, and consider changes in educational programs and environmental supports to help people maintain changes over the long term.

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(SEE ALSO: *Alcohol Use and Abuse; Behavioral Change; Behavioral Determinants; Behavioral Strategies for Reducing Traffic Crashes; Community Organization; Family Planning Behavior; Health Belief Model; Illness and Sick-Role Behavior; Preventive Health Behavior; Smoking Behavior; Social Cognitive Theory; Transtheoretical Model of Stages of Change*)

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BEHAVIORAL CHANGE

Many behaviors are related to health and health risks. Unprotected sexual intercourse, for example, is a behavior that puts one at risk for HIV (human immunodeficiency virus) and other sexually transmitted infections. Similarly, maintaining an unhealthful diet is a behavior that puts one at risk for cardiovascular disease. Many health promotion interventions seek to turn people away from risky behaviors and toward healthful behaviors, such as using condoms when having sexual intercourse and following a diet rich in fruits and vegetables.

Behavior change is a complex process. Positive health-related changes come about when people learn about risks and ways of enhancing health, and when they develop positive attitudes, social support, self-efficacy, and behavioral skills. Health-promoting behaviors are most usefully defined as performance objectives. For example, safe sexual practices are enhanced by practical objectives: purchasing condoms, carrying condoms, negotiating condoms, correctly applying condoms, and maintaining condom use.

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(SEE ALSO: *Attitudes; Behavior, Health-Related; Behavioral Determinants; Psychology, Health; Social Determinants; Social Networks and Social Support*)

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BEHAVIORAL DETERMINANTS

It is almost universally accepted that each case of disease arises as the result of a chain of events. The origin can usually be traced back to underlying

"determinants" such as economic, social, or environmental conditions; war; or famine. At the other end of the chain is the individual case: the malnourished child, the case of cholera, or the accident victim. Somewhere among the intermediate links in the causal chain lie human behaviors, commonly termed "health behaviors" to illustrate their relevance to disease. The metaphor of a chain does not do justice to the complexity, however, for there are mutually reinforcing relationships among each of these causal stages that can be very hard to alter. Behavior, for example, is influenced by social environment and culture, but also contributes to sustaining that culture. Likewise, behavior influences the risk of disease, but is in turn influenced by disease or the fear of disease. For example, the death of a friend from heart disease may stimulate a person to have his or her blood pressure checked, and to join an exercise program.

Nonetheless, behaviors directly influence the risk of disease and are among the few modifiable risk factors that exist for some diseases. Tobacco smoking, drug use, lack of physical exercise, excess alcohol consumption, inappropriate nutrition, failure to use safety equipment including automobile seat belts, and failure to follow preventive guidelines are all associated with elevated risk of disease or death. The relationship is sufficiently convincing that the question is not one of whether public health programs should seek to modify behavior, but how.

Health behaviors rarely occur in isolation, but cluster in patterns that in combination influence a person's risk of disease. Thus the "sedentary lifestyle" of some people in industrial societies connotes a loose pattern of mutually influencing behaviors such as taking little exercise, eating foods of poor nutritional value, consuming calorific drinks, and perhaps also smoking cigarettes. While these factors do not determine disease in an inevitable sense, they place the person at elevated risk of obesity, high blood pressure, and subsequently of cardiovascular disease. Other unhealthful behavioral patterns include the connections among smoking, undernutrition, and drug taking, and those among alcohol consumption, aggression, and violence. Each of these patterns is reinforced by membership in a social milieu that brings similar people together, as well as by individual personality traits. Each pattern also tends to correspond

to personal values and beliefs, which form the connection between behavior and culture. While all human behavior is learned, it quickly becomes habitual and less accessible to modification.

Because of the importance and yet the difficulty of modifying behavior, great attention has been paid to conceptual approaches to understanding health behavior. Theories include the Health Belief Model (Becker, 1980), the Theory of Reasoned Action (Ajzen, 1980), and many others, most of which focus on the forces that maintain behavior and how these may be changed. Several models propose stages of changing health behaviors, generally beginning with a period of precontemplation in which the person is not interested in change; interventions such as a smoking-cessation program would be premature and wasted (Prochaska, 1983). In the contemplation stage, preparatory cognitive changes are occurring and interventions can support the person's decision-making process. The actual behavior is not altered until the stage of initiating change, and during this fragile phase there may be frequent relapses. There follows a long-term phase of maintenance of the change, during which the new behavior must be reinforced until it is finally incorporated into the person's normal behavior pattern. Such theories underscore the long-term nature of the process of altering health behaviors, and of the need to make a detailed behavioral diagnosis for each person and to tailor interventions to match his or her current stage of readiness to change.

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(SEE ALSO: *Behavioral Change; Customs; Illness and Sick-Role Behavior; Lay Concepts of Health and Illness; Medical Sociology; Multifactorial Diseases; Self-Care Behavior; Smoking Behavior; Smoking Cessation*)

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BEHAVIORAL RISK FACTOR SURVEILLANCE SYSTEM

With 200,000 interviews annually, the Behavioral Risk Factor Surveillance System (BRFSS) is the world's largest telephone survey. Sponsored by the Centers for Disease Control and Prevention, these ongoing surveys of health risks of the American public are conducted in all fifty states, the District of Columbia, and three U.S. territories (Guam, Puerto Rico, U.S. Virgin Islands). The availability of data from the states (and frequently from major cities) on behavioral health risk factors and use of preventive services has been an invaluable tool for health promotion. Data have helped to establish baselines; track trends; assess geographic, age, race, and gender differences; benchmark programs; set priorities and plan interventions; evaluate the impact of programs; support legislative and budgetary actions; and raise public awareness about important health issues. Data are available at www.cdc.gov/nccdphp.brfss.

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(SEE ALSO: *Behavior, Health-Related; Centers for Disease Control and Prevention; Health Promotion and Education; Risk Assessment, Risk Management; Surveys*)

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BEHAVIORAL STRATEGIES FOR REDUCING TRAFFIC CRASHES

The World Health Organization predicts that by 2020 road trauma will be the world's third leading cause of death and disability, after heart disease and mental depression. These facts make motor-vehicle-injury prevention one of the most formidable public health challenges of the future.

Motor-vehicle crashes are the leading cause of injury-related deaths in the United States, and the leading cause of death from all causes for Americans aged one to thirty-four. In 1997, nearly 42,000 people died on the nation's roads and highways, and another 3.5 million suffered nonfatal injuries. Road trauma results in about 500,000 hospitalizations and 4 million emergency department visits annually. These deaths and injuries cost the United States more than \$150 billion annually, including \$52.1 billion in property damage, \$42.4 billion in lost productivity, and \$17 billion in medical expenses.

The reduction in motor-vehicle-related deaths attributable to crashes in the United States also represents one of the great public health achievements of the twentieth century. Despite the ten-fold increase in motor-vehicle travel between 1925 and 2000, the annual death rate declined during this period from 18 per 100 million vehicle-miles traveled in 1925 to 1.7 in 1997—a 90 percent decrease. A significant decline in traffic deaths per 100,000 population also occurred during this period. These reductions have come about by reciprocal changes in the design of vehicles, changes in the behavior of road users, and structural changes that make roads and environments safer.

BEHAVIORAL APPROACHES

While structural approaches to preventing road trauma, such as changes to the vehicle and the road, have led to many positive safety advantages, driver behavior still remains a key impediment to further progress. Unlike most diseases that have been prevented with vaccines, most traffic injuries cannot be controlled quickly by introducing a vaccine-like technology, as the technology must be proven safe, adopted by people, and used properly in order to be effective. Behavior-based strategies have succeeded in reducing both injury-risk behaviors and injury outcomes. The most successful strategies have been planned and implemented with a theoretical framework such as behavior modification or applied behavior analysis.

APPLIED BEHAVIOR ANALYSIS

Perhaps the most widespread use of behavioral technologies to modify road-use behaviors has

been applied behavior analysis. This framework uses contingency management through various forms of rewards and incentives, behavioral shaping, and modifying environmental cues and conditions to affect driver, occupant, and pedestrian behaviors. At the societal level, laws and enforcement strategies that discourage or punish risky behaviors are a form of contingency management.

For example, in studying drinking and driving behavior, behaviorists are interested in identifying antecedents (A) to the behavior, such as legal requirements, cues in the environment, and “happy hour” inducements; studying the behavior itself (B), such as frequency and speed of drinking, and the drinking and driving environment; and consequences (C) that follow the behavior, such as social attention, or punishment in the form of DWI (driving while intoxicated) arrests. Understanding the ABCs of a behavior chain can help the behaviorist shape the individual and the environment to yield change. Reminders, prompts, incentives, and cues in the environment can be used to modify antecedents. Behavioral modeling, demonstration, and skill building can be used to modify the risk behavior. Social support, feedback, reinforcement, and punishment (or perception of punishment) can be used to modify the consequences of the behavior. Application of these strategies, and others that rely on legislative and enforcement strategies to change behaviors, has been found effective. Behavioral road safety intervention research has been used to modify safety belt use, drinking and driving, use of child restraints, speeding, and other risky road safety practices.

THEORETICAL AND INTEGRATED APPROACHES

Application of a theoretical approach to changing traffic-related behavior holds the greatest promise for future success. Using the theory of planned behavior, the theory of reasoned action, social learning theory, subjective norm development, protection motivation, the health belief model, stages of change, and risk perception approaches, researchers have sought to apply models of behavior change to modify individual behaviors and social norms that enhance traffic safety. While early motor-vehicle safety resulted from vehicle and highway engineering, future success will require an integrated approach, using what we have

learned from health promotion, health education, behavioral and social science, and law together with structural approaches like engineering and environmental science to produce long-term positive outcomes. This approach can also prove effective on those who make laws, design roads, and build cars in ways that protect whole populations. The rigorous scientific application of behavioral science principles to injury prevention is an important strategy that is necessary to further reduce traffic crashes and motor-vehicle injuries.

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(SEE ALSO: *Health Belief Model; Psychology, Health; Reckless Driving; Social and Behavioral Sciences; Theory of Planned Behavior; Theory of Reasoned Action*)

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BENEFICENCE

In public health, the governing ethical theory is utilitarianism, meaning "doing the greatest good for the largest number of people." Beneficence is strongly tied to the utilitarian theory of ethics. It is one of four principles considered in medicine and public health under the principle-based approach to ethical analysis. The other three principles are: respect for autonomy, nonmaleficence, and distributive justice. Beneficence is the professional duty to do or produce good. By "good" is meant the performance of acts of kindness and charity. "Doing good" is considered virtuous conduct. Ultimately, beneficence is the duty to do more good than harm through public health actions because, in practice, no action in public health will have exclusively beneficial effects. For example, if a public health agency becomes aware of a person infected with a bacterium that could be spread through the air, then, there is, on the one hand, a duty to respect the person's right to confidentiality and freedom of movement. But, on the other hand, there is a greater duty to prevent the spread of the bacterium to other people. Thus, more good would be achieved by protecting the public health, which can be accomplished only by breaching the duty to maintain the infected person's confidentiality and freedom of movement. Such breaches would occur only to reduce the risk associated with permitting the infectious person to put others at risk of infection (e.g., through quarantine or confinement, with a consequent

loss of privacy in terms of the diagnosis). The ethical dilemma for decision makers in public health lies in weighing the pros and cons between at least two conflicting options: protecting the individual's rights or protecting the public health. Such breaches of an individual's rights are rare in public health and are undertaken only with maximum discretion.

COLIN L. SOSKOLNE

(SEE ALSO: *Autonomy; Ethics of Public Health; Nonmaleficence; Paternalism*)

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BENEFIT-COST ANALYSIS

Benefit-cost analysis is a technique for assessing the desirability of government projects and policies. The basic idea is simple: Consider alternative policies and identify the one that yields the greatest net gain to society. Benefit-cost analysis has been widely used to compare the positive and negative aspects—measured in terms of reduced mortality, morbidity, property damage, and losses to the natural environment—of policies that affect public health and the environment.

Benefit-cost analysis has been widely used in the design of environmental policies and to help resolve disputes under the U.S. legal system. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; commonly called the “Superfund” law) governments (local, state, or federal) can seek financial compensation from responsible parties for natural resources that are damaged by releases of hazardous wastes. Benefit-cost analysis can be helpful in putting a price tag on the damaged resources.

Determining the benefits of pollution reduction generally requires assessing the magnitude of the damage caused by that pollution. This involves four key steps: (1) identification of the key types of damage; (2) establishing the physical relationship between the pollutant emissions and the extent of

damages caused (dose-response curve); (3) identification of the responses by affected parties to mitigate some (or all) of the damage; and (4) placing a monetary value on the physical damage, including the damage to human health.

All four of these steps can involve difficult technical issues, especially when both scientific and ethical concerns limit the ability to obtain empirical information on the effect of pollution on humans. Expertise in various natural and social science disciplines is required. The focus of economics is on the fourth step of the process (ascertaining the monetary value of the physical damages, including the damage to human health) and on integrating the results of all the steps.

Some have argued, on both moral and technical grounds, that benefit-cost analysis is a flawed environmental management tool. Others have suggested that it is inevitable, since if it is not done explicitly, with a careful consideration of alternative options, it will occur implicitly. In that case, decision making will be driven by public fears, special-interest lobbying, and bureaucratic preferences.

Three major functions of economic analysis in the regulation of health, safety, and the environment have been identified: (1) arraying information about the benefits of proposed regulations; (2) revealing potentially cost-effective alternatives; and (3) showing how benefits and costs are distributed (e.g., geographically, temporally, and among income and racial groups). However, the same economists also argue that “in many cases, benefit-cost analysis cannot be used to prove that the economic benefits of a decision will exceed or fall short of the costs . . . [but] . . . it can provide illuminating evidence for a decision, even if precision cannot be achieved” (Arrow et al., 1996).

RICHARD D. MORGENSTERN

(SEE ALSO: *Acceptable Risks; Benefits, Ethics, and Risks; Cost-Effectiveness; Environmental Impact Statement; Risk Assessment, Risk Management*)

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BENEFITS, ETHICS, AND RISKS

Morality requires that people not only treat each other autonomously and refrain from harming one another, but also that people contribute to each other's welfare. These beneficial actions fall under the principle of "beneficence." It is appropriate to distinguish two further principles under the general principle of beneficence—the "provision" of benefits, and the "balancing" of benefits and harms.

Questions commonly arise in biomedicine about the comparison of, and relative weights of, costs, risks, and benefits. Questions about medical treatment are routinely decided by reference to the probable benefits and harms, and questions about the justification of research involving human subjects are resolved in part by determining whether or not the risks to subjects outweigh the benefits. Risk-benefit relations are best conceived in terms of a ratio between the probability and magnitude of an anticipated benefit and the probability of an anticipated harm.

Questions of risks and benefits can be faced in two contrasting situations. In one, the research to be done offers benefits for the patient as well as for the society; testing the effectiveness of a new medicine is an example. In the other, the research offers promise of benefits for society but negligible benefits, and even some risks, for research subjects; this might involve evaluating the safety (but not the effectiveness) of a new medication.

For example, in submitting a research protocol (e.g., for testing the effectiveness of a new medication) involving human subjects to an institutional review board (IRB) for approval, an investigator is expected to array the risks to subjects and the benefits to both subjects and society, and then to explain why the probable benefits outweigh the risks. The IRB then offers its own assessment. If the research is approved, the investigator is expected to describe the risks and benefits to potential subjects so they can make an informed decision about their participation in the research. This

application of the principle of beneficence to research can, with only slight reformulation, be extended to the treatment of patients and the delivery of health services.

JOHN H. BRYANT

(SEE ALSO: *Autonomy; Beneficence; Benefit-Cost Analysis; Ethics of Public Health*)

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BENZENE

Benzene is a ubiquitous component of the petrochemical era. Present in crude petroleum, benzene is produced from the combustion of fossil fuels. It has been known to cause toxicity to human bone marrow since the late nineteenth century, at high levels destroying the bone marrow machinery responsible for the production of mature red blood cells, white blood cells, and platelets. When severe, this is a frequently fatal condition known as aplastic anemia. Lesser levels of benzene exposure result in sufficient bone marrow destruction to cause partial decrements in the levels of circulating blood cells, a condition known as pancytopenia.

Benzene is also a known cause of acute myelogenous leukemia, the adult form of acute leukemia, and a more than probable cause of other forms of blood and bone marrow cancers, including non-Hodgkin's lymphoma, multiple myeloma, and acute lymphatic leukemia, the childhood form of acute leukemia. There are recent indications that subpopulations vary in their susceptibility to benzene toxicity based upon their metabolic capabilities.

In the latter half of the twentieth century there was a dramatic decline in the allowable levels of

benzene at the workplace. To protect workers from this known human carcinogen, the United States permissible standard progressively decreased from 100 parts per million (ppm) to 1 ppm on an eight-hour time-weighted average. There was a corresponding fall in shorter term exposure limits, and an increase in requirements for industrial hygiene monitoring and in the use of respirators and other personal protective equipment. Even more stringent standards have been proposed.

At high concentrations, well above 100 ppm, benzene is also a central nervous system anesthetic-like agent. This effect is due to its solubility in lipids and its other physicochemical characteristics, and it is predictable based upon what is known about analogous compounds such as toluene and xylenes. In contrast, the bone marrow toxicity of benzene is a result of its metabolism and this toxicity does not occur with toluene, xylenes, and other related compounds that are metabolized differently. In fact, at high concentrations toluene is known to protect against the bone marrow toxicity of benzene because it occupies the metabolic machinery that otherwise would produce toxic benzene metabolites. However, concentrations in the general environment are too low to produce this result. For benzene, outdoor environmental exposure is usually in the 1 to 5 parts per billion (ppb) range in the United States. Benzene levels from natural sources are negligible in comparison.

For most nonsmoking individuals in the general population, it is indoor exposure that is the most dominant source of benzene, often reflecting the storage of gasoline or of benzene-containing consumer products within the home. Gasoline in the United States contains about 1 to 2 percent benzene, and higher levels are present elsewhere. Cigarette smokers inhale benzene directly in tobacco smoke, causing contamination of indoor air with benzene that is then inhaled by nonsmokers. Drinking water supplies are sometimes contaminated with benzene, most frequently from leaking underground petroleum storage tanks. This can also lead to inhalation of benzene through offgassing from contaminated water during cooking or showering. Skin absorption can occur in those working with products that contain benzene, as well as during the refueling of automobiles with gasoline.

As with other cancer-causing agents, it is unclear what level of exposure, if any, can be considered completely safe, or what level might be certain to cause cancer. As benzene is a component of gasoline, a useful solvent, and an organic building block in many chemical reactions, it cannot simply be banned. However, there have been many actions taken to decrease the extent to which the general population is exposed to benzene from gasoline and from industrial effluents.

BERNARD D. GOLDSTEIN

(SEE ALSO: *Cancer; Carcinogen; Carcinogenesis; Environmental Tobacco Smoke; Fuel Additives; Groundwater Contamination; Hazardous Air Pollutants; One-Hit Model*)

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BEREAVEMENT

Bereavement is defined as the objective state of having experienced the loss of a loved one. Grief, in contrast, is the psychological and emotional reaction to bereavement. Grief is a healthy, normal, and appropriate response to loss. It is a process of adaptation, with a number of signs or manifestations that are part of the experience. Grief may also precede a loss, in which case it is termed "anticipatory" grief. In this case, grief is the process of slowly coming to terms with the potential loss of a significant person, such as may be seen in a caregiver of a person with a progressive illness.

The duration and expression of "normal" bereavement vary considerably among both individuals and cultural groups. For some individuals, bereavement becomes overwhelming, and grief leads to pathological or complicated mourning, with negative implications for functioning or physical health. Complicated grief entails a failure to

return to pre-loss levels of performance or states of emotional well-being within eighteen months after a death, and is manifested by poorer global functioning, depressed mood, poorer sleep quality, and lower self-esteem.

Bereavement is a stressful process that affects morbidity and mortality. The recently bereaved report increased depression, deteriorating physical health, and increased consumption of tobacco, alcohol, and tranquilizers. Studies have found a 40 percent increase in mortality rates among widowers in the first six months after the loss of their spouse. Severe psychological stress secondary to bereavement has been associated with abnormalities in immune function. Between 20 and 25 percent of bereaved persons remain depressed one year after a death, and up to 26 percent of bereaved persons exhibit depressive symptoms after two years.

The experience of grief is described as occurring in phases, with one phase gradually following the next. The process of uncomplicated grief can be thought of as an interwoven pattern of changing emotional states, somatic symptoms, and motivational stages. These phases overlap, as do each of the components within the phases.

The first phase is one of shock. This phase begins immediately after a loss and it generally lasts two weeks or less. During this period the survivor is often in a state of numbed disbelief. Somatic symptoms include crying, dysphagia, chest tightness, nausea, and a sensation of abdominal emptiness. Individuals may feel lost, dazed, stunned, helpless, and disorganized. The shock phase is often more pronounced if the death is sudden or unexpected. Similar experiences may occur after an individual learns of a grave diagnosis, even if death is not imminent.

Phase two consists of preoccupation with the deceased. This phase is marked by a sense of unreality and decrease in the feeling of disbelief. Emotional numbness gives way to fully experiencing the painful sadness of the loss. Crying spells persist. Symptoms include insomnia, fatigue, and loss of appetite. Most characteristic of this period is an intense, almost obsessive, preoccupation with the memory of the deceased, and past grievances, anger, guilt, and other unresolved conflicts are reexamined. Dreams of the dead may be intensely vivid. Transient hallucinatory episodes may occur

in which the deceased's voice is heard or strangers may be mistakenly identified as the deceased. A period of social withdrawal and introversion is also typical. This phase is usually well developed by three months and may persist for six months or longer. Recurrences of these symptoms may occur on birthdays, anniversaries, or other special dates that remind the survivor of the deceased.

Phase three is a period of resolution, heralded by the bereaved's being able to recall events with sentimental pleasure and regaining an interest in activities. New social contacts are gradually made and life is reorganized around new activities and interests. Crying spells, feelings of emptiness, and longing for the dead still occur, but begin to diminish in intensity and duration. Somatic symptoms and preoccupation with memories begin to wane. Getting over a death does not mean that sad and empty feelings are never evoked by the memory of the loved one, but rather that the survivor does not remain preoccupied with the deceased and is not restricted socially and psychologically as a result of the death. Bereaved individuals should not expect to, nor be expected to, recover within a specified period of time.

Bereaved individuals may benefit from support services, including bereavement counselors, psychologists, and support groups. Most hospices provide bereavement services, informational materials, and support groups, even if the deceased did not receive hospice services. Local funeral homes are a good source for informational materials about grief and bereavement. AARP offers a number of resources through its web site. Compassionate Friends is a national nonprofit, self-help support group for families who are grieving the death of a child. The National Funeral Directors Association and the National Hospice and Palliative Care Organization offer a variety of resources on bereavement issues.

JEAN S. KUTNER

(SEE ALSO: *AARP; Crisis Counseling; Family Health; Widowhood*)

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Although compromises had to be made to the original blueprint, mainly to placate powerful medical lobby groups, the NHS, as originally established, was a good model for comprehensive, state-supported universal health care services. In its first fifty years the NHS evolved and underwent several reorganizations (some reflecting the changing demographics and advances in medical knowledge, others at the whim of political ideologues) but at the end of the twentieth century it remained an impressive monument to Beveridge's original vision.

JOHN M. LAST

(SEE ALSO: *National Health Systems; Social Medicine*)

BEVERIDGE, WILLIAM

An Indian-born British economist, administrator, and social reformer, William Henry Beveridge (1879-1963) is remembered mainly for two principal accomplishments. The first was his reshaping of British social services during World War II, when he established a system of services that set out to meet social needs rather than papering over cracks in the fabric of society. This led directly to his second great achievement, accomplished during the darkest days of the war. In November 1942, the Beveridge Report on Social Insurance and Allied Services was published by the Inter-Departmental Committee on Social Insurance and Allied Services, of which Beveridge was chairman. The report was a blueprint for a complete and total national network of health and social services that would meet the needs of the British people for hospital-based and communitywide medical care, including personal care by family doctors, public health and preventative services organized by local authorities, social support of the elderly and the handicapped, and a children's allowance to ensure adequate food and clothing, all to be financed by a national system of comprehensive social insurance. In the midst of the war, and with a right-wing conservative government in office, nothing was done about Beveridge's recommendations at that time; but with the election of a Labour government after the Germans surrendered in 1945, the political landscape changed.

Most of the recommendations in the Beveridge Report were implemented by 1948, when the British National Health Service (NHS) was established.

BIAS

The validity or capacity of scientific or medical studies to generalize is often put at risk through the introduction of bias. Such bias results from systematic, nonrandom effects that, even in a large study, produce an incorrect answer or result by weakening, distorting, or spuriously creating a relation between a risk factor or intervention and the observed outcome. It might be caused by a reference population different from the intended group. Therefore, bias has the potential to jeopardize study validity. Researchers must recognize this potential, and reduce its effects through study design, analysis, and interpretation. Controlled laboratory experiments and randomized clinical trials are less prone to bias than are observational studies such as cohort or case-control studies, but this protection is only available for a limited set of conclusions, and bias must be addressed in all studies.

There are many types of bias, which can be intentional or unintentional, and events or features that bias one study may have no biasing effect on another. Biases can result from selection effects (e.g., the sampling plan leaves out a subgroup, overrepresents a subgroup, or has more complete follow-up for a subgroup [the healthy worker effect]); differential measurement (e.g., cancer cases provide a more accurate family history or exposure history than do controls), measurement error (e.g., the recorded and actual exposures to cigarette smoke differ), and a host of other factors.

Bias is a loaded term in that not all bias is bad. For example, in small studies use of a statistically biased estimate (an estimate that on average does not equal the population value) can have substantially lower variance than the unbiased estimate and thus be preferred. Regression techniques rely on this trade-off between variance and bias to decide on the value of entering additional explanatory variables.

Additional examples of bias include the following:

- *Conscious selection:* A randomized clinical trial requires participants to have the disease of interest, but not be too ill. The treatment comparison is internally valid, but generalizing findings to all diseased individuals may introduce a bias.
- *Regression dilution:* Reducing elevated blood pressure is known to reduce the risk of a myocardial infarction. However, blood pressure is measured with error, and regression dilution produces an attenuated (biased) relation between the intervention and risk.
- *Drop out bias:* For an interesting example of bias consider a study of the effects of coaching on SAT scores, reporting that students completing the coaching program averaged a fifty-point-higher score on their next SAT exam than those who dropped out. This result is unbiased in comparing completers with noncompleters; however, the result is positively biased in assessing the effect of a coaching program on all who start the program, irrespective of whether they complete it.

Other types of bias typically encountered in epidemiologic research, particularly those employing observational designs, include recall and observer bias. Recall bias arises if one group systematically over- or underreports information about an exposure or risk factor in comparison to the other group. Observer bias occurs if one group is systematically “observed” and reported to behave in a manner that is different from the other group.

Careful design and conduct of studies and careful interpretation of results are necessary to

reduce or eliminate bias. Minimizing bias in design and conduct is preferable to relying on post hoc statistical “cures” such as covariance of adjustment and causal modeling. These powerful techniques are absolutely necessary in analyzing observational studies and can be used to “mop up” some bias in designed experiments, but their effectiveness depends on model validity and expert tuning to the specific study.

GERMAINE M. BUCK
THOMAS A. LOUIS

(SEE ALSO *Case-Control Study; Causality, Causes, and Causal Inference; Cohort Studies; Observational Studies*)

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BICULTURALISM

Biculturalism implies the existence of two distinct cultural groups, usually of unequal status and power, within a society united by one economic and political structure. Research indicates that biculturalism and acculturation can influence intergenerational differences in health beliefs and behaviors for certain U.S. ethnic groups. Unlike acculturated individuals, bicultural individuals identify with core elements of their culture of origin as well as the dominant culture. Bicultural individuals successfully integrate into and participate in important aspects of both cultures, values, and belief systems. Such people are especially valuable in program planning, outreach, and implementation.

JUNE GUTIERREZ ENGLISH

(SEE ALSO: *Acculturation; Asian Americans; Assimilation; Cross-Cultural Communication, Competence; Cultural Anthropology; Cultural Identity; Cultural Norms; Customs; Folk Medicine; Hispanic Cultures*)

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BILLINGS, JOHN SHAW

John Shaw Billings (1838-1913) was one of the towering figures of American medicine—indeed, of American civilization. As a young man, Billings was a surgeon, serving as medical inspector of the Army of the Potomac in the Civil War. The latter post was focused on public health rather than management of wounds and surgical care of soldiers. After the war ended, he assumed direction of the Surgeon General's library in Washington, DC. He was a bibliophile, and set about cataloging and enlarging this collection. He devoted some years to the task of developing a comprehensive *Index Catalogue*. This became the *Index Medicus*, which had taken on its main features under Billings' leadership by 1879.

Billings held office as the librarian in the Surgeon General's department from 1864 to 1895. During this time he oversaw the establishment of the National Library of Medicine as it grew into the most comprehensive collection of medical books and journals in the world. In 1889 he supervised compiling of the *National Medical Dictionary*, a scholarly dictionary of medical terminology with much information on provenance of terms, eponyms, and procedures.

Billings also supervised the national censuses of 1880 and 1890. He helped design the Johns Hopkins Hospital in Baltimore, and also select the

outstanding physicians (Welch, Halstead, Osler, and others) who established its reputation as one of the best medical schools in the world. Among his most important nonmedical achievements was his key role in starting the New York Public Library, with the aid of a grant from Andrew Carnegie.

JOHN M. LAST

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BILLS OF MORTALITY

In English parishes, beginning in 1538, every burial required completion of a document that was the precursor of the modern death certificate. This made the burial legal and allowed the deceased's estate to be legally disposed of. The number of deaths were compiled on a weekly and an annual basis. These compilations were known as bills of mortality. In many parishes they were rough accounts of the causes of death, and over the years this information became more precise, though it was not necessarily consistent from one parish to another. The procedure was made more formal and systematic throughout England in 1603, and continued until it was superceded by the Births and Deaths Registration Act of 1836. From 1728 onward, the age of death was also recorded in the bills.

In the years following the foundation of the Royal Society in 1660, several scholars found these documents to be a fruitful source of information about the lives and deaths of the English people. The first of these was John Graunt, a London haberdasher and amateur scientist who was interested in the impact of epidemic outbreaks of plague, the impact of death and its cases on men and women, and the relative merits of living either in a city such as London or in the country. Graunt published his analyses in *Natural and Political Observations . . . on the Bills of Mortality* (1662), a work that became the founding classic of the modern sciences of vital statistics and epidemiology. Graunt's contemporary Sir William Petty adopted a similar approach in his analyses, published in

Political Arithmetic (1682) and other works that made Petty a founding father of economics.

JOHN M. LAST

(SEE ALSO: *Certification of Causes of Deaths; Graunt, John; Mortality Rates*)

BINOMIAL DISTRIBUTION

A *binomial distribution* can be used to describe the number of times an event will occur in a group of patients, a series of clinical trials, or any other sequence of observations. This event is a binary variable: It either occurs or it doesn't. For example, when patients are treated with a new drug they are either cured or not; when a coin is flipped, the result is either a head or tail. The binary outcome associated with each event is typically referred to as either a "success" or a "failure." In general, a binomial distribution is used to characterize the number of successes over a series of observations (or trials), where each observation is referred to as a "Bernoulli trial."

In a series of n Bernoulli trials, the binomial distribution can be used to calculate the probability of obtaining k successful outcomes. If the variable X represents the total number of successes in n trials, it can only take on a value from 0 to n . The binomial distribution can be used to calculate the probability of obtaining k successes in n trials is calculated as follows:

$$P(X = k) = \frac{n!}{k!(n-k)!} p^k(1-p)^{n-k}$$

where 0 less than or equal to p less than or equal to 1 is the probability of success, and $n! = 1 \times 2 \times 3 \dots (n-2) \times (n-1) \times n$.

The above formula assumes that the experiment consists of n identical trials that are independent from one another, and that there are only two possible outcomes for each trial (success or failure). The probability of success (p) is also assumed to be the same in each of the trials.

To further illustrate the application of the above formula, if a drug was developed that cured 30 percent of all patients, and it was administered to ten patients, the probability that exactly four patients would be cured is:

$$P(X = 4) = \frac{10!}{4!(10-4)!} (0.3)^4(0.7)^{10-4} = 0.20$$

Like other distributions, the binomial distribution can be described in terms of a mean and the spread, or variance, of values. The mean value of a binomial random variable X (i.e., the average number of successes in n trials) can be obtained by multiplying the number of trials by p (np). In the above example, the average number of persons cured in any group of 10 patients would thus be 3. The variance of a binomial distribution is $np \times (1-p)$. The variance is largest for $p = 0.5$, while it decreases as p approaches 0 or 1. Intuitively, this makes sense, since when p is very large or small nearly all the outcomes take on the same value. Returning to the example, a drug that cured every patient p would equal one, while for a drug that cured no one, p would equal zero. In contrast, if the drug was effective in curing only half of the population ($p = 0.5$) it would be more difficult to predict the outcome in any particular patient, and in this case the variability is relatively large.

In studies of public health, the binomial distribution is used when a researcher is interested in the occurrence of an event rather than in its magnitude. For instance, smoking cessation interventions may choose to focus on whether a smoker quit smoking altogether, rather than evaluate daily reductions in the number of cigarettes smoked. The binomial distribution plays an important role in statistics, as it is likely the most frequently used distribution to describe discrete data.

PAUL J. VILLENEUVE

(SEE ALSO: *Statistics for Public Health*)

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BIOAVAILABILITY

Bioavailability refers to the difference between the amount of a substance, such as a drug, herb, or

chemical, to which a person is exposed and the actual dose of the substance the body receives. Bioavailability accounts for the difference between exposure and dose. A drug's therapeutic action or a chemical's toxicity is determined by the dose received at the target site in the body. The dose at the target site is determined by the amount of the substance absorbed by the body, which depends on its bioavailability. If a substance is ingested, for example, its bioavailability is determined by the amount that is absorbed by the intestinal tract. If a substance is inhaled, its bioavailability is determined by the amount that is absorbed by the lungs. Understanding bioavailability is critical to determining the amount of a drug to administer or the level of chemical exposure that is likely to produce toxicity.

The bioavailability of drugs depends on their formulation, which determines the rate at which they dissolve in the gastrointestinal tract. Although not legally considered to be drugs, the bioavailability of vitamin, mineral, and herbal supplements obey the same principles. For example, calcium (calcium bound to an organic acid such as citrate) is more easily absorbed by the gastrointestinal tract than calcium carbonate. Similarly, the bioavailability of chemical contaminants in the environment depends on the nature of the medium in which they are found. For example, the soil at locations of former manufactured gas plants can be very contaminated with chemicals (such as polycyclic aromatic hydrocarbons) that were produced by burning fuels, although very little of those chemicals is bioavailable because they are bound very tightly to the soil itself. The toxicity level of the chemicals in the soil, if measured in the laboratory, would be much greater than the toxicity level that would be experienced by someone exposed to the soil itself.

Questions of bioavailability are sometimes at the root of disagreements about what are the appropriate actions to take to protect public health and the environment from environmental contaminants. For example, sediment at the bottom of the Hudson River is contaminated with polychlorinated biphenyls (PCBs) due to past industrial disposal practices. Some argue that the PCBs in the sediment pose an unacceptable risk to the health of humans, fish, and other wildlife, and should be removed. Others argue that the PCBs are not a health hazard because of their low

bioavailability in the sediment, and thus should be left in place because disturbing the sediment might make them more bioavailable. The bioavailability of chemical contaminants is often poorly understood, so it is sometimes not taken into account when the health risks from chemical exposures are assessed.

GAIL CHARNLEY

(SEE ALSO: *Environmental Determinants of Health; Toxic Substances Control Act*)

BIODIVERSITY

The continued health of human societies depends upon a natural environment that is productive and contains a wide diversity of plant, animal, and microbe species. Life on the earth comprises at least 10 million species of plants, animals, and microbes, while in the United States there are an estimated 750,000 species, of which small organisms such as arthropods and microbes comprise 95 percent.

The sustainability of the forest ecosystems and other natural ecosystems are in danger from the expanding world population, which now totals more than 6 billion. With an estimated growth rate of 1.4 percent per year, it is projected to reach 12 billion by the year 2050. Further, due in large part to the growing human population and diverse human activities (supported in large part by fossil fuels), the current extinction rate of species ranges from approximately 1,000 to 10,000 times higher than natural extinction rates. This is alarming for several reasons. Foremost, biodiversity is essential for the sustainable functioning of agricultural, forest, and natural ecosystems upon which human survival and health depends. The loss of a key species (e.g., loss of a predator) creates an imbalance among the remaining species, and can sometimes result in the collapse of the entire ecosystem. Altering a habitat may also improve the environment for an infectious disease, like dengue.

Species diversity affects the quantity and quality of human food supply. For example, conserving pollinators and natural enemies of pests is essential for successful grain, fruit, and vegetable production. Improving food production decreases

malnutrition. Yet, at present, the rapidly expanding human population is intensifying the need for increased food supplies. In the year 2000, more than 3 billion people were suffering from malnutrition—the largest number and proportion of people to date. Each year, between 6 million and 14 million people die from the effects of malnutrition.

In many parts of the world, especially in developing countries (e.g., in the Sahelian region of Africa), severe shortages of vitamin A are causing blindness and even death. Worldwide, approximately 250 million children are vitamin A deficient, and each year vitamin A deficiency causes approximately 2 million deaths and 3 million serious eye problems, including blindness.

Similarly, iron intake per person has been declining, especially in sub-Saharan Africa, South Asia, the People's Republic of China, and South America, because overall shortages of food result in inadequate nutrition. In 1998 more than 2 billion persons were sufficiently iron deficient to cause anemia in 1.2 billion people. An estimated 20 percent of the malnutrition deaths are attributed to severe anemia.

Malnutrition is also associated with parasitic infections that are found in areas where conditions of poverty and inadequate sanitation also exist. The health of malnourished individuals, especially children, is seriously affected by parasitic infections, because their presence reduces the availability of nutrients. Parasitic infections diminish appetites while increasing the loss of nutrients by causing diarrhea and dysentery. Hookworms, for instance, can suck as much as 30 milliliters of blood from an infected individual each day, lowering his or her resistance to other diseases. Because an estimated 5 to 20 percent of an individual's daily food intake is used by the body to offset the effects of parasitic illnesses, the overall nutritional status of a parasite-infected person is greatly diminished over time.

As a human population continues to expand and biodiversity declines, waste grows and its disposal becomes a major environmental problem. Each year the total quantity of waste produced by humans, livestock, and crops weighs about 38 billion tons worldwide. Numerous invertebrate animals and microbes function to degrade and

recycle wastes. Their preservation in ecosystems is essential to maintain a healthy and productive environment.

Worldwide chemical waste and pollution are also major environmental problems. In the twenty-first century in the United States, 80,000 different chemicals are used and released into the soil, water, and air; worldwide, an estimated 100,000 chemicals are used. In the United States, more than 1,100 kilograms of chemicals per person are used each year; nearly 10 percent of these are known carcinogens. Each year nearly 3 billion kilograms of pesticides are applied worldwide. These toxic chemicals cause 26 million human poisonings annually, with about 220,000 deaths, and affect approximately 750,000 people with chronic diseases like cancer.

Approximately 75 percent by weight of the chemicals released into the environment can be degraded by biological organisms. Thus, species biodiversity helps provide continuous cleanup of contaminated sites (such as residue of pesticides in agriculture), and has a significant advantage over other techniques. Conserving beneficial natural enemies not only controls crop pests but also helps reduce the amount of pesticides applied.

In addition to degrading chemicals, some invertebrate and microbe species also degrade and recycle biological pollutants in water resources. Again, the biological pollution problem is particularly serious in developing nations. About 1.2 billion people in the world lack clean, safe water because most household and industrial wastes are dumped directly into rivers and lakes without treatment. This pollution contributes to the rapidly increasing incidence of diseases in humans. Waterborne infections account for 80 percent of all infectious diseases worldwide and 90 percent of all infectious diseases found in developing countries. A lack of sanitary conditions contributes to about 2 billion human infections of diarrhea, resulting in about 4 million deaths, per year, mostly among infants and young children.

Sometimes altering a natural habitat inadvertently leads to the spread of an infectious disease. Diseases like schistosomiasis that are associated with contaminated fresh water are expanding worldwide. In 1999 it was estimated that schistosomiasis

caused 1 million deaths per year. The escalation of the incidence of this disease followed an increase in suitable habitats for the snail that serves as the intermediate host of the causative agent, *Schistosoma mansoni*. Thus, construction in 1968 of the Aswan High Dam in Egypt and its related irrigation systems was followed by an explosion in the prevalence of *Schistosoma mansoni*, which increased in the human population from 5 percent in 1968 to 77 percent in 1993.

Considered together, the natural biodiversity of plants, animals, and microbes functions in many ways to enhance the health and quality of life enjoyed by human society. In view of the likely continued growth in human population, and the resultant alteration of the earth's fragile natural ecosystem, greater efforts must be made to conserve biodiversity as a natural and essential treasure.

DAVID PIMENTEL

(SEE ALSO: *Climate Change and Human Health; Demographic Trap, Drinking Water; Ecosystems; Endangered Species Act; Environmental Determinants of Health; Famine; Groundwater Contamination; Land Use; Municipal Solid Waste; Nutrition; Ocean Dumping; Pesticides; Pollution; Population Density; Population Growth; Sanitation; Species Extinction; Sustainable Development; Wastewater Treatment; Water Quality*)

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BIOLOGICAL DETERMINANTS

Biological factors that determine health may be classified as either endogenous or exogenous. Endogenous biological determinants include genetic heritage and immunity that is passively acquired from maternal antibodies passed across the placenta or transmitted in maternal milk. Genetic heritage is determined largely by responses to biological and physical environmental challenges to which human ancestors were exposed. These influence skin pigmentation and DNA composition that determines blood group, tendency to develop errors of metabolism, abnormalities of red blood cells (e.g., sickle cell trait), certain kinds of cancer, allergies, and many other conditions.

Exogenous biological determinants of health are the other living things with which humans interact. The most important are microorganisms; also significant are larger organisms that carry them. It is important to emphasize that humans could not live without microorganisms—they outweigh all other forms of life on earth a hundred-fold in biomass and are essential components in the web of life that makes up the global ecosystem. Many microorganisms are commensal or symbiotic with humans. The human body could not assimilate foods such as cheese if they had not been partially prepared before ingestion by bacterial fermentation, and it could not digest food without the help of bacteria that break down complex chemicals into simpler ingredients in our intestines. To maintain good health, people rely on relationships with innumerable microorganisms. Good bacteria are far more common than bad bacteria.

Only a small proportion of microorganisms are harmful. They are called pathogens because they cause pathological processes or diseases, and they cause most of the misery and suffering in the world. Encounters with harmful bacteria provoke defensive reactions; the immune system makes antibodies that confer partial or complete immunity. A person's immunologic defenses are influenced by his or her prior state of health, including nutritional status. Poorly nourished, protein-starved, and vitamin-deprived individuals are unable to mount effective immune defense mechanisms and are therefore more vulnerable to serious infection by invading pathogenic organisms. The potency or virulence of the organisms and their sheer numbers also affect their impact.

The European conquest of the Americas owes much to the fact that the Europeans had been exposed for generations to the pathogens that cause measles, smallpox, and tuberculosis; they therefore had some inherent immunity to infection. But the aboriginal populations had not, and so were devastated in epidemics that had extremely high mortality rates. In some respects, these aboriginal populations may not yet have fully adapted biologically to their changed circumstances. Before the European invasions, most had been hunter-gatherers, adapted by their evolution over hundreds of generations to a roving existence and a frugal diet. They were metabolically unprepared for a rapid dietary transformation, which helps account for their proneness to obesity and diabetes. The same phenomenon is observed in some Pacific Island populations.

The epidemic of coronary heart disease in the Western industrial nations in the 1940s that began to subside after the 1960s may have similarly been related to a failure of adaptation, that is, it may have had an evolutionary basis. The surge in coronary heart disease mortality and morbidity in Eastern Europe and the Indian subcontinent since the 1980s offers some support for this hypothesis, although other explanations, including a possible role for pathogenic organisms, have been suggested.

JOHN M. LAST

(SEE ALSO: *Cultural Factors; Ecosystems; Genetics and Health*)

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BIOLOGICAL OXYGEN DEMAND

Biological Oxygen Demand (BOD) is one of the most common measures of pollutant organic material in water. BOD indicates the amount of putrescible organic matter present in water. Therefore, a low BOD is an indicator of good quality water, while a high BOD indicates polluted water. Dissolved oxygen (DO) is consumed by bacteria when large amounts of organic matter from sewage or other discharges are present in the water. DO is the actual amount of oxygen available in dissolved form in the water. When the DO drops below a certain level, the life forms in that water are unable to continue at a normal rate. The decrease in the oxygen supply in the water has a negative effect on the fish and other aquatic life. Fish kills and an invasion and growth of certain types of weeds can cause dramatic changes in a stream or other body of water. Energy is derived from the oxidation process. BOD specifies the strength of sewage. In sewage treatment, to say that the BOD has been reduced from 500 to 50 indicates that there has been a 90 percent reduction.

The BOD test serves an important function in stream pollution-control activities. It is a bioassay procedure that measures the amount of oxygen consumed by living organisms while they are utilizing the organic matter present in waste, under conditions similar in nature. The other traditional tests or indicators for water quality are chemical oxygen demand (COD) and pH.

For results of the BOD test to be accurate, much care must be taken in the actual process. For example, additional air cannot be introduced. Temperature must be 20°C, which is the usual temperature of bodies of water in nature. A five-day BOD test is used in environmental monitoring. This test is utilized as a means of stating what level of contamination from pollutants is entering a body of water. In other words, this test measures

the oxygen requirements of the bacteria and other organisms as they feed upon and bring about the decomposition of organic matter. Time and temperature, as well as plant life in the water, will have an effect on the test. High BOD burdens or loads are added to wastewater by food processing plants, dairy plants, canneries, distilleries and similar operations, and they are discharged into streams and other bodies of water.

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(SEE ALSO: *Ambient Water Quality*; *Dissolved Oxygen*; *Ecosystems*; *Water Quality*)

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BIOLOGICAL WARFARE

Biological warfare is defined as the international use of biological agents or their by-products to harm human populations. Using biological agents to create mass casualties requires more than having the biological agents in hand—the agents must also be disseminated. Technology has made it easier to obtain and distribute harmful microorganisms. Since starting the Bioterrorism Preparedness and Response Program in 1999, the Centers for Disease Control and Prevention and its partners have developed laboratory protocols for the identification of threat agents and have begun to address the needs of public health in responding to an event.

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(SEE ALSO: *Anthrax*; *Antisocial Behavior*; *Arms Control*; *Contagion*; *Terrorism*; *War*)

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BIostatISTICS

Biostatistics in the public health context consists primarily of developing descriptive statistics describing the overall health and well being of a population. These statistics include such measures as birth, death, and infant death rates; disease incidence and prevalence; and trends of this data over time. Proper adjustment of these rates so as to allow for correct interpretation of and comparison among populations also falls within the purview of the public health biostatistician. The biostatistician works closely with other public health disciplines to develop outcome measures to ascertain the effectiveness of programmatic activities and to develop the means to collect such measures, which may include surveys, lab reports, and hospital discharge data.

NEIL CASEY

(SEE ALSO: *Birth Certificates*; *Data Sources and Collection Methods*; *Statistics for Public Health*; *Vital Statistics*)

BIRTH CERTIFICATES

There are many reasons for the nations of the world to keep an accurate count of their citizens, and for individuals to have a formal record of their own existence. Birth certificates serve the needs of both nations and individuals. The United States, like many nations, uses birth certification as the basic ingredient in national vital statistics. Linked to census data and death certification, birth certification is the foundation for fundamental indicators of the nation's health, including life tables and life expectancy. Individuals need a birth certificate for purposes such as obtaining official documents like a passport; applying for a Social Security number; and for many other official, statutory, and private reasons ranging from education to life insurance. Parents also need a record of the birth of their children in order to obtain child benefits, tax credits, and numerous other purposes.

Birth certification evolved out of older systems of recording vital statistics in parish registers, which maintained records of baptisms and burials beginning in the Middle Ages in England and most European nations. The first formal statutory certification of births in the English-speaking world began in Britain with the passage of the Registration of Births and Deaths Act in 1836. (William Farr, the first compiler of abstracts in the Office of the Registrar General, demonstrated how valuable these birth certificates could be in assessing the nation's health by using them to construct life tables.)

Modern birth certificates contain much valuable information, including personal identifying data; data about the mother and, if possible, the father; the date, place, and manner of birth; and the birthweight. If the infant is not named at the time of birth, this information can be added later. The infant's position in birth order among his or her siblings, and information about other biological facts, such as race or ethnicity, is recorded in some jurisdictions. Births are registered locally, and birth certificates are usually issued locally as well. The information is transmitted to a regional center and then to a national center where the statistics are compiled—and where individuals can obtain a copy of their birth certificate when they need it later in life for various statutory purposes.

Live births are of greatest interest, but stillbirth is also certified and recorded. Perinatal mortality rates, a very useful measure of maternal and infant health, are calculated by adding numbers of stillbirths to the numbers of infants who die before their twenty-eighth day of life, and dividing this total by the number of live births in a year.

The facts in birth certificates are the basis for a national identification system in some countries. The sequence of digits derived from birth date, sex (1 for a male, 2 for a female), and a code for birthplace is the basis for a unique numbering system that is used in the Nordic nations (Norway, Sweden, Denmark, Finland, Estonia, and Latvia) to identify each individual. This national identifying number is used in all official medical, educational, and legal records, thus providing a valuable national dossier available to every person, as well as to social and medical scientists who seek to obtain longitudinal data for research purposes.

Other nations that link medical and social records also often use birth certificate data as a basis, though they usually rely on other kinds of information to complete the alpha-numeric sequence.

JOHN M. LAST

(SEE ALSO: *Birthrate; Census; Farr, William; Life Expectancy and Life Tables; Record Linkage; Vital Statistics*)

BIRTH CONTROL

See Contraception

BIRTHRATE

A population of a country, or other defined territory, grows as people are born or migrate into it, and it lessens as people die or migrate out. The birthrate, which is most often called the crude birthrate because it is a simple measure, is the rate at which the population grows due to births over a reference period. Conventionally, it is the number of infants born alive in a calendar year per 1,000 population at midyear. The rate is accurately calculated using live birth counts from a universal system of registration of births, deaths, and marriages, and population counts from a census. Otherwise, it may be satisfactorily estimated by application of specialized demographic techniques. If the death rate and migration rates are known, together with the birthrate, the population growth rate can be calculated accurately.

The birthrate alone may still be used as a proxy for population growth, because it is usually the largest component of population growth. As there exist better, noncrude measures of births—known as fertility rates—that take account of the age distribution, relative group size, and mortality of potential mothers, the principal use of the birthrate is as a summary indicator of population growth. Typically, a birthrate of 10 to 20 per 1,000 is low, and a rate of 40 to 50 per 1,000 is high. In the absence of other information, a high birthrate is assumed to be a general indication of health impairments and low life expectancy, low living

standards, low status of women, and low levels of education. In the process of economic development and accompanying social change, the birth-rate and population growth rate decline as conditions improve, and potential parents choose to have fewer children by practicing contraception, which may be made available by family planning programs. Accordingly, the birthrate is anticipated to respond to development and to the provision of family planning services and is monitored as evidence of their achievement.

The world birthrate is estimated to have been around 37 per 1,000 in the early 1950s, and it is estimated at 21 per 1,000 in 2000. Since the 1950s, the birthrate for all Europe is estimated to have fallen from 21 to 10 per 1,000 (in the United Kingdom, the birth rate fell from 16 to 11 per 1,000); in the United States from 24 to 14, Canada 28 to 11, Australia 23 to 13, and New Zealand 26 to 15 per 1,000; in Latin America to have dropped from 42 to 22 per 1,000; in Asia to have halved from 43 to 21 per 1,000 (in the People's Republic of China alone, the birth rate fell from 44 to 16 per 1,000); and in sub-Saharan Africa to have declined from 48 to 41 per 1,000. A well-conceived public health strategy is likely to include provision of a range of contraceptive and other family planning services as part of broadbased health interventions designed to attain sustainable economic as well as social improvements.

ODILE FRANK

(SEE ALSO: *Birth Certificates; Demography; Mortality Rates; Vital Statistics*)

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BLACK DEATH

This name is given to the pandemic bubonic and pneumonic plague that swept across the Middle

East, the Mediterranean region, and Europe in the fourteenth century. Great epidemics had occurred before, but never with the ferocity of the Black Death. It seems to have begun in Asia Minor in 1345 or 1346 (although there may have been earlier outbreaks farther east in what is now Iran, and there were a large epidemic around this time in China). The incessant wars and failed harvests of those times encouraged turbulent population movement, and food shortages bordering on famine sapped resistance to contagious disease, thus aggravating the severity of the epidemic. It was the first great pandemic of recorded history, with death rates reaching and in places exceeding 70 percent. The plague spread along trade routes as well as in battle fields. In 1347 it reached Naples and Genoa, and from there it rapidly spread across western Europe, striking heavily populated cities, such as Vienna and Paris, and isolated rural villages alike. The Black Death caused large painful swellings to appear in the groins and armpits and black blotches on the skin due to blood leaking from the veins. Fever, delirium, and death followed in short order. The dramatic and sudden onset, rapid course, and terrible aspect evoked horror and fear, leading many who came in contact with it to flee—and as they were contagious contacts, they aggravated the further spread of the disease. The terrifying onslaught of the Black Death in an era of superstition was explained as the wrath of God or relief was sought by seeking scapegoats. Jews, witches, and others were burned at the stake.

There has been considerable debate about the nature of the Black Death. Was it due only to the plague bacillus, *Yersinia pestis*, to this and other conditions such as overwhelming streptococcal and/or staphylococcal infections that coexisted, or could it have been due to anthrax? There are reliable clinical descriptions, though there is much folklore from which inferences can be made. The ecology of plague is complex: *Yersinia pestis* may be transmitted by direct contact or a droplet spread from infected to susceptible persons, but bubonic plague typically is a zoonosis, a disease of rodents, especially rats, transmitted by the rat flea. It spreads from rats to humans in rat-infested dwellings. There is good historical evidence on the prevalence in those days of black rats, *Rattus rattus*, which prefer indoor habitat and nesting sites close to where people live. Over the next one hundred

to two hundred years, black rats were supplanted by brown rats, *Rattus norvegicus*, whose preferred habitat is outdoors, removing them and their fleas to a slightly safer distance from people.

The Black Death waned slowly, and smaller localized epidemics broke out over the centuries that followed. The waning of the pandemic was due to several factors: extermination of susceptibles, leaving resistant survivors alive (blood group frequencies and other genetic markers are evidence of this); displacement of black rats by brown; and ecosystem changes (the use of brick and stone reduced indoor nesting sites for rats).

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(SEE ALSO: *Epidemics; Plague*)

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BLACK LUNG DISEASE

See Occupational Lung Disease

BLACK MAGIC AND EVIL EYE

Magic has probably been practiced since the beginning of recorded history. It evolved out of a need to explain and control an environment that was often hostile and deadly. The world, the sky, the stars and planets, birth, illness, and death were but a few of the many things that puzzled early humans. These must have seemed mysterious and controlled by unknown, powerful forces. Efforts to explain the world's mysteries, and to find ways to control at least some of them, gave rise to many magical practices and rituals to manipulate the weather, the movement of animals, fertility, illness, death, and other seemingly uncontrollable forces. In the process of exploring and explaining their world, people began to evolve a primitive science, which would eventually lead to a greater understanding of astronomy, medicine, chemistry, and other natural sciences.

Over the thousands of years that magic has been evolving it has taken on many different forms, including shamanistic magic, which involves leaving the body and communing with otherworldly spirits and teachers; tribal magic, which is practiced by more primitive cultures to influence spirits associated with the tribal group and to counter evil sorcery directed at them; voodoo, a mix of West African religions, Christianity, and local beliefs present in the West Indies at the time of the slave trade; witchcraft, originated as a synthesis of various folk religious practices and mythologies from the Middle Ages; and Satanism, the worship of the devil.

Magic is practiced in many different forms including thaumaturgy, sympathetic magic, and divination. Thaumaturgy is associated with miracle working that rises above the laws governing the physical nature of reality and is most notably found in such practices as giving blessings, performing magical healing, and in curses designed to bring harm to another. Sympathetic magic is based on the principle of "like producing like." For instance, in voodoo this would take the form of a voodoo doll representing someone whom the user wishes to harm by placing pins into the doll with the expectation of causing pain and/or death to that person. It may also be used to drive away evil by creating a representation of that evil and then doing something to it to destroy or send it away. Divination is yet another form of magical practice in which one seeks to look into the future. Diviners, those who seek to foresee or foretell the future, may use a variety of methods including cards, bones, the entrails of animals, runes, or other devices. Reading one's horoscope is a form of divination that relies on the movement of the stars and planets to guide one's intuition and behaviors in daily life.

Black magic is a type of magic that is often used to bring harm to another person. It is strongly associated with the devil and was thought to be practiced by witches who had made pacts with the devil during the Salem witch trials of 1692. It is used to call forth the powers of darkness and evil in an attempt to control natural forces through the use of spells, incantations, and other means. White magic is the opposite of black magic, and is not thought to cause harm to others. It can be hard to

distinguish between the two, however, as both seek to control natural forces and both are thought to have the potential to bring harm, even when the harm is unintended (as in the use of a love charm to control another's feelings). While many people do not believe in black magic, there are also many who do. For believers, either practicing the magic or being the recipient of an evil spell, hex, or other form of harm is very real.

Witchcraft has seen a resurgence in the twentieth century with neo-pagan, Wiccan, and Dianic traditions spreading throughout the United States, Europe, South America, and Australia. Black magic is also still practiced in many traditional cultural groups around the world including the United States, where it may be seen among voodoo practitioners, brujos, and others who practice the black arts. Evil Eye is an old and fairly widespread superstition found in the Mediterranean and Aegean areas as well as among Hispanic population groups in the United States, Mexico, Central, and South America. It goes by many names including *mal occhia* in Italy, *ayin harsha* in Arabic cultures, and *mal de ojo* in Hispanic cultures. It is also known as bad eye, narrow eye, the look, and the wounding eye. A person with this power can cause another person harm merely by looking at them. This belief is felt in some cultures to be tied directly to the heart, and a person with the evil eye is often covetous or jealous of something that belongs to another. It is believed that anyone can have this power, though it is often ascribed more to elderly women. The possessor of the evil eye may not be aware that he or she possesses it, and any harm that is inflicted is usually unintentional. For those who use it intentionally, the evil eye is linked to witchcraft, sorcery, and black magic.

Among Hispanic cultures, *mal de ojo* is a folk illness caused by evil eye that can cause a child's blood to heat up and can lead to a variety of physical problems, including diarrhea, upset stomach, fever, vomiting, and inconsolable crying. Treatment requires the services of a traditional health practitioner, who may use prayer or other approaches to resolve the illness. Evil eye can be counteracted using a variety of methods and devices, including amulets worn around the neck and certain magical practices and prayers. As with black magic, belief in the evil eye is a problem

that is sometimes encountered by modern health practitioners. In such instances the practitioner needs to recognize the patient's beliefs, and possibly include elements of traditional remedies along with modern medical approaches to treat the symptoms. Often, however, belief in such powers can keep people from seeking needed medical attention.

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(SEE ALSO: *Cultural Appropriateness; Ethnicity and Health; Faith Healers; Shamanic Healing*)

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BLACKS

See African Americans

BLINDNESS

See Vision Disorders

BLOCK GRANTS FOR PUBLIC HEALTH

The Reagan administration proposed in 1981 the creation of several grants to replace categorical

grant programs to the states. The idea behind this proposal was to transfer authority and responsibility to the states, thereby reducing the role of the federal government as a funder, relieving states of some federal regulatory burden and saving money by reducing administrative costs. Congress acted on this proposal in the summer of 1981 and consolidated fifty-seven categorical programs into several block grants. The two most significant block grants for state public health systems were the Maternal and Child Health Block Grant (MCHBG) and the Preventive Health and Health Services Block Grant (PHHSBG).

In Federal Fiscal Year (FFY) 1999, the core PHHSBG was funded nationally at \$150 million. Additional funds earmarked specifically for rape prevention education were subsequently added to this core amount and distributed via a formula to all states. The primary areas of activity for the core PHHSBG included chronic disease prevention and control, emergency medical services in rural areas, and community health education efforts. States are required to develop plans, report activities, and target these activities to identify high-need populations. Flexibility inherent in this block grant allows states to address health problems specific to their state, as long as these activities also address the national health objectives for the nation contained in *Healthy People 2010*. Funded program areas included cardiovascular disease prevention, injury prevention, increasing good nutrition choices and physical activity, and prevention of tobacco use by youth.

The Maternal and Child Health program was authorized under Title V of the Social Security Act of 1935. The actions taken by Congress in 1981 created block grant amendments for Federal Fiscal Year (FFY) 1982 (October 1, 1981–September 30, 1982). These amendments increased states' roles in determining activities and added programs under Title V to create the MCHBG.

The MCHBG is focused on improving and protecting the health of all mothers and children. States have the ability to determine their needs within prescribed categories of activities. These planned activities must be consistent with national health objectives established by the Secretary of the U.S. Department of Health and Human Services (e.g., *Healthy People 2010*). Programs have

been developed to address several areas, which include preventing deaths, illnesses, and disabilities; assuring access to quality health care; and providing community-based health services to children with special needs. It is estimated that over 20 million women, children, and youth received services under the MCHBG in FFY 1999. Programs funded by the MCHBG include prenatal care, services for children with special health care needs, newborn screening for metabolic errors, childhood lead-poisoning prevention, and sudden infant death syndrome prevention.

FRANK S. BRIGHT

(SEE ALSO: *Maternal and Child Health Block Grant; Newborn Screening; Prevention Block Grant; Sudden Infant Death Syndrome [SIDS]*)

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BLOOD LEAD

Blood lead is a biomarker used for monitoring occupational and environmental lead exposure. The Occupational Safety and Health Administration (OSHA) has established the following blood lead screening guidelines and actions for workplace exposure: over 60 micrograms per deciliter (>60 mcg/dL): removal from workplace; >50 mcg/dL in three consecutive months: removal of individual from workplace; >40 mcg/dL: medical evaluation only; a goal of the ABLES program of the Centers for Disease Control and Prevention is a guideline of <25 mcg/dL. The Centers for Disease Control and Prevention (CDC) has established the following blood lead screening guidelines and actions for childhood environmental lead exposure: <9 mcg/dL: acceptable background

lead exposure; 10 to 19 mcg/dL: more frequent rescreening and nutritional/educational interventions; 20 to 44 mcg/dL: consider pharmacologic therapy; 45 to 69 mcg/dL: pharmacologic therapy; >70 mcg/dL: medical emergency.

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LAWRENCE S. QUANG

(SEE ALSO: *Centers for Disease Control and Prevention; Environmental Determinants of Health; Lead; Occupational Safety and Health Administration; Screening*)

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BLOOD LIPIDS

Lipids are fatty organic compounds or particles in the body that are poorly soluble in water and generally feel greasy to the touch. The most important lipids in the blood are fatty acids, cholesterol, cholesterol esters (cholesterol attached to a fatty acid), triglycerides (three fatty acids attached to a three-carbon glycerol), and phospholipids, such as lecithin.

Cholesterol esters and triglycerides are hydrophobic and do not dissolve in water. They are thus carried through the bloodstream in particles called lipoproteins—complex particles with the less water-soluble cholesterol esters and triglycerides on the inside and the more water-soluble free cholesterol, phospholipids, and apoproteins on the surface.

Lipoproteins are clinically named by their location in a density gradient, which is discerned by placing them in a ultracentrifuge for twenty-four hours. In order of increasing density, lipoproteins include: chylomicrons, very low-density lipoprotein (VLDL), intermediate-density lipoprotein (IDL), low-density lipoprotein (LDL), and high-density lipoprotein (HDL; see Figure 1). The least dense particles—the chylomicrons, VLDL, and IDL particles—mostly contain triglycerides, and

when severely elevated they can make the plasma look milky. The more dense particles—LDL and HDL—contain more water-soluble cholesterol esters, and no triglycerine, and thus, when elevated, they are visually undetectable in the plasma.

Through long-term studies of large populations, the particles associated with increasing atherosclerosis (a buildup of fatty cholesterol-filled plaques in the arteries that can lead to heart attacks, strokes, and gangrene) are LDL, IDL, and small breakdown remnants of VLDL and chylomicrons. Large amounts of HDL are associated with protection from atherosclerosis, thus the designation of cholesterol in these particles as healthy, or "good," cholesterol. The cholesterol in LDL particles, because of its strong association with atherosclerosis, has been designated as lousy or "bad" cholesterol and has been targeted as the most important lipid for people to lower. Since two-thirds of the total cholesterol in the blood stream is LDL cholesterol, high levels of total cholesterol, which thus generally reflect this LDL cholesterol, are associated with an increased risk of atherosclerosis.

A lipid profile is the clinical blood test which measures total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides. The most common way lipid risk for atherosclerosis is interpreted on a lipid profile is the total cholesterol/HDL cholesterol ratio. For heart attack prevention the TC/HDLC ratio should be less than 4.5 to 1 (ideally less than 4.0).

Each lipoprotein has proteins on its surface called apoproteins (or apolipoproteins). These are designated by letters and numbers; for example, there is predominantly apoprotein apo AI on HDL; apo B100 on LDL, VLDL, and IDL; and apo B48 on chylomicrons. Thus, apo B100 represents particles associated with risk for atherosclerosis and Apo AI with particles associated with protection. The apo B/apo AI ratio has been used to determine atherosclerotic risk, though it seems to be no better in predicting risk than the TC/HDLC ratio. Lipoprotein "little a," written as lipoprotein (a) or Lp(a), is an LDL particle with an apoprotein (a) attached; in some populations increased Lp(a) increases risk for atherosclerosis in persons with increased LDL cholesterol levels.

Extreme elevations of LDL cholesterol usually occurs in families for genetic reasons, but can be

Figure 1

Lipoproteins				
Name	Relative size	Main ingredients	Function	Risk for CHD
Chylomicrons	Very large	Triglycerides	Carry dietary fatty acids from intestine to liver, muscle, and fat cells	Low
Very low-density lipoproteins (VLDL)	Large	Triglycerides	Carry fatty acids from liver to muscle for energy, and to fat for storage	Medium
Low density lipoproteins (LDL)	Medium	Cholesterol	Carry cholesterol throughout body, including to glands for making steroid hormones	High
High density lipoproteins (HDL)	Small	Cholesterol	Carries cholesterol from inside body to liver for excretion in bile	Protective

SOURCE: Courtesy of author.

increased in individuals and populations by diet as well. LDL cholesterol levels may be elevated by consumption of saturated fatty acids (found in animal fats, dairy fats, and palm oil); partially hydrogenated fats such as vegetable shortening (found in fried fast-food products, pastries, and certain snacks such as potato chips); and cholesterol in the diet from too many egg yolks, meats, liver, or a high intake of squid or shrimp. Hypothyroidism or certain types of kidney failure may also elevate LDL cholesterol. Medications that reduce LDL cholesterol include statins (HMG CoA reductase inhibitors), a popular group of medications that inhibit an important enzyme in cholesterol synthesis; bile acid binders, which waste bile salts in stools, forcing the liver to make new bile salts from cholesterol; and niacin (vitamin B3).

Triglycerides, elevation of which has been associated with increased coronary heart disease, are increased mostly by genetic factors, but also by excess abdominal fat; excess simple sugar intake as found in table sugar, fruit juices, cold drinks; estrogens; glucocorticoids (cortisone-like agents); excess alcohol intake; and insulin resistance and diabetes. Triglycerides may be lowered by weight loss; increased exercise; reduction of simple sugars and excess carbohydrates in the diet; control of blood glucose in persons with diabetes; fibric acid medications (gemfibrozil, fenofibrate); niacin; and fish oils (in high doses).

Low HDL cholesterol, which increases risk for coronary heart disease, is most often caused by genetic factors, but can also be lowered by smoking; abdominal obesity; inactivity; insulin resistance and diabetes; and androgen (male hormone)

ingestion. HDL cholesterol may be raised by smoking cessation; substantial increases in physical activity; maintained weight loss; mild to moderate alcohol consumption; reducing elevated triglyceride levels; postmenopausal estrogen usage; moderate to high doses of niacin; fibric acid medications; statins; and bile acid binders.

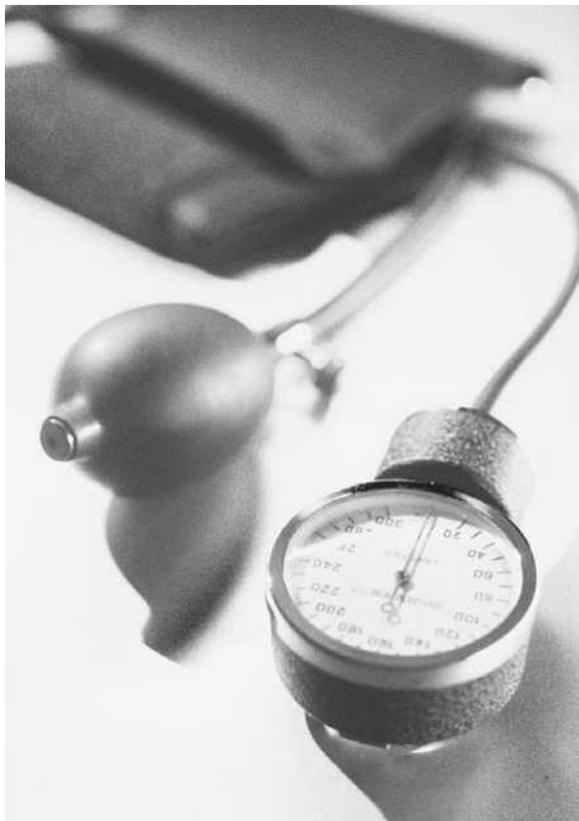
DONALD A. SMITH

(SEE ALSO: *Atherosclerosis; Cholesterol Test; Fats; Foods and Diets; Genetics and Health; HDL Cholesterol; Hyperlipidemia; LDL Cholesterol; Lipoproteins; Nutrition; Triglycerides; VLDL Cholesterol*)

BLOOD PRESSURE

Blood pressure is a physiological variable—like body temperature, respiratory rate, or heart rate. Blood pressure is not constant throughout the day; each time the heart squeezes and relaxes, there is a new blood pressure. It increases before awakening and declines with sleep. The level of blood pressure is regulated by the kidneys, brain, heart, endocrine glands, and blood vessels. In the United States, the actual level of blood pressure gradually increases from birth to adulthood. Due to difference in diet and activity levels in nonindustrialized countries, however, blood pressure does not increase beyond the age of eighteen.

Whereas temperature is measured with a thermometer, blood pressure is measured with a sphygmomanometer, preferably a mercury sphygmomanometer, though aneroid and electronic devices are sometimes used.



A sphygmomanometer is used to measure blood pressure.
 (© John Wilkes/Corbis)

Blood pressure should be measured after a five-minute period of rest, with the back supported and the legs uncrossed. Constrictive clothing should be removed from around the upper arm, which must be resting on a table at heart level. The blood pressure cuff is evenly and snugly applied around the upper arm above the elbow, and a stethoscope is placed over the crease of the elbow. The cuff is inflated to 15 millimeters of mercury (mmHg) above the point where radial artery pulse (the artery above the thumb at the wrist) disappears. The pressure in the cuff is then slowly released at 2 mmHg per second. The first of two consecutive sounds as cuff pressure decreases is called the systolic blood pressure—the pressure to open the artery occluded with the cuff. The diastolic blood pressure is recorded at the absence of sounds with continued deflation of the blood pressure cuff. Blood pressure is generally recorded to the nearest 2 mmHg. For example, a blood pressure of 142/86 mmHg indicates a systolic

blood pressure of 142 mmHg and a diastolic blood pressure of 86 mmHg. Pain and emotional disturbance, as well as caffeine, tobacco, and alcohol, can elevate systolic blood pressure.

HYPERTENSION

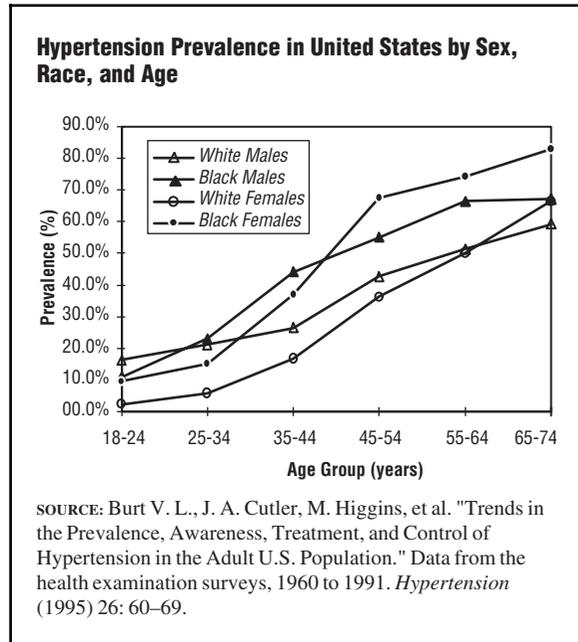
An abnormal blood pressure requires confirmation on two subsequent days. An optimal blood pressure is less than 120/80 mmHg. High blood pressure, or hypertension, is defined as either a systolic blood pressure greater than 140 mmHg or a diastolic blood pressure greater than 90 mmHg. Systolic blood pressure is a more powerful predictor of cardiovascular events than diastolic blood pressure. With increasing age, the diastolic blood pressure may actually decrease while systolic blood pressure increases; this indicates increased stiffening of the arteries throughout the body.

Hypertension is not a nervous disorder or an anxiety state, but rather a disease of the blood vessels that increases blood vessel constriction of the small arteries. It particularly damages the blood vessels inside the brain, heart, kidneys, eyes, and the largest artery, the aorta. Damaged arteries may rupture, thicken, or harden and narrow—resulting in strokes, heart attacks, kidney failure, visual impairment, or tearing or rupture of the aorta. Also, the left heart chamber thickens as a consequence of increased blood pressure. When the heart can no longer thicken or enlarge to overcome the increased pressure in the blood vessels, the squeezing function of the heart decreases, resulting in congestive heart failure.

CAUSES OF HYPERTENSION

Fifty million Americans (about one-fifth of the U.S. population) have hypertension (see Figure 1). Over 90 percent of the causes of hypertension remain unknown. Four groups are predisposed to developing hypertension: the obese, the elderly, diabetics, and African Americans. Certain drugs are known to elevate blood pressure, including most arthritis medications (except acetaminophen and aspirin), many cold remedies, nose sprays, weight-reducing pills, and alcohol. Increased heart rate, anemia, excessive thyroid hormone, or stiff

Figure 1



(nondistensible) arteries can increase systolic blood pressure. Blocked arteries to the kidney, kidney failure, and decreased production of thyroid hormone are common causes of hypertension. Other rare causes include tumors of the adrenal gland.

TREATMENT OF HYPERTENSION

Nondrug treatment of hypertension should include weight loss, salt restriction, smoking cessation, and alcohol restriction. A reduced saturated- and total-fat diet that is rich in fruits, vegetables, and low-fat dairy products lowers blood pressure in some individuals, avoiding the need for drug treatment. The treatment goal for uncomplicated hypertensives is below 140/90 mmHg. To achieve that goal consistently, most individuals will need to be treated with more than one drug. Treatment has been proven to decrease heart attacks, strokes, and heart failure, and is usually required throughout life.

L. MICHAEL PRISANT

(SEE ALSO: *Atherosclerosis; Cardiovascular Diseases; Coronary Artery Disease; Foods and Diets; Lifestyle; Nutrition*)

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BLOOD-BORNE DISEASES

The blood-borne diseases include a broad spectrum of infectious conditions that reach their target tissue through the circulation of blood. For the purposes of this discussion, a blood-borne disease is one that is transmitted from one person's blood to another's (often by an insect vector) and that manifests itself prominently in the blood elements.

Depending upon the nature of the causative agents, blood-borne diseases fall into four categories of which parasites and viruses are far more prevalent than are bacteria and prions. Malaria is one of the most common blood-borne diseases on earth, infecting nearly a half-billion people, primarily in the tropics. Of the four forms of human malaria (numerous animal pathogens exist) *Plasmodium falciparum* is the most deadly. The malaria parasite lives and grows in circulating red blood cells during one phase of its life cycle (liver involvement occurs during another stage). Mosquitoes are the primary vectors for malaria, disseminating the parasite as they take blood meals from different people. The advent and spread of malaria parasites that are immune to common treatments, such as chloroquine, makes malaria one of the world's major public health challenges. Intense efforts are aimed at developing vaccine treatments to complement drug therapy regimens.

The human immunodeficiency virus (HIV) is the most deadly blood-borne condition of viral etiology. The virus has infected hundreds of millions of people, most of whom live in sub-Saharan Africa, India, and Southeast Asia. HIV is, in fact, primarily a sexually transmitted disease in which blood transmission (often by transfusion) is much less frequent than sexual transmission. The pathological manifestations of HIV reflect the fact that it destroys a category of blood cells called lymphocytes that are vital to normal immune function. Infection due to impaired immune activity is the leading cause of death in people affected with the

HIV virus. Through 2001, effective therapies were far too expensive for people in the developing world, though this situation is changing due to pressure on drug companies and the manufacture of generic versions of copyrighted drugs in some countries. The magnitude of the problem hits home with the prediction that the population of sub-Saharan Africa will decline over the next ten years due to the HIV epidemic.

The Epstein-Barr virus (EBV) is a herpes virus that is transmitted primarily by saliva and less commonly by blood transfusion. Manifestations of EBV infection are variable, but infectious mononucleosis is the most common. Like HIV, EBV infects lymphocytes in the blood. Unlike HIV, which destroys lymphocytes, EBV only disrupts their function. Although EBV infections are life-long, most people develop an immune balance so that their lymphocyte function returns to normal.

Blood-borne bacterial infections are uncommon in people with normal immune function. Insect bites often seed the blood with bacteria. The body's bactericidal response is so powerful that a small number of bacteria entering the bloodstream are quickly cleared. However, bacteria that contaminate blood or blood products can multiply to the point that transfusion introduces an overwhelming number of organisms. Chills, high fever, shock, and death can occur quickly following transfusion of a contaminated blood product. The bacterium *Yersina enterocolitica* is a common culprit in this scenario. Only scrupulous sterility during blood collection, processing, and storage can eliminate this potentially deadly problem.

Prions are a category of pathogen differing from any previously discussed. Most cells, including parasites, viruses, and bacteria, require nucleic acid for replication (deoxyribonucleic acid [DNA] or ribonucleic acid [RNA]). Prions consist solely of protein. These protein molecules somehow commandeer the control machinery of cells, producing disease. Creutzfeldt-Jakob disease in humans results from a prion that can be transmitted by blood transfusion. The condition produces brain deterioration and death. "Mad cow disease" results from a similar prion-induced disorder in cows. Whether the bovine condition can be transmitted to humans is a point of controversy. In the United States, people who may have been exposed

to the bovine prion currently are exempted from the blood donor pool.

KENNETH R. BRIDGES

(SEE ALSO: *Bovine Spongiform Encephalopathy; Communicable Disease Control; HIV/AIDS; Malaria; Prions; Vector-Borne Diseases*)

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BLOT, WESTERN

The blot test is a method used to detect and identify DNA or RNA samples, using absorbent paper electrophoresis. The original test in this group was developed by British biologist M. E. Southern in 1975, and is named the Southern blot test. As related tests using the same general method were developed, they were named for the points of the compass. The Western blot test is a specific test that uses paper electrophoresis to detect HIV (human immunodeficiency virus), and it is widely used in screening for HIV infection.

JOHN M. LAST

(SEE ALSO: *HIV/AIDS; Laboratory Services; Screening*)

BOARDS OF HEALTH

Citizen boards of health were first formed in the late 1700s to control epidemics and poor sanitary conditions. By the end of the twentieth century, there were approximately 3,200 local boards of health in the United States.

There are two types:

- *Advisory*: Usually appointed by a health officer or an elected body to provide a community voice on public health issues.

- *Governing*: Generally mandated by state statutes. Members are appointed by an elected body or are directly elected. Their responsibilities include local health department governance, employment of the health officer, establishing public health policy, regulations, and fiscal oversight.

A balanced board of health represents the diversity of the community.

NED E. BAKER

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BONE DENSITOMETRY

See Osteoporosis

BOTULISM

Botulism is a rare disease that occurs in four forms: food-borne botulism (the most common form); infant botulism (sometimes associated with honey); an adult form of infant botulism; and wound infection botulism. Botulism is caused by botulinum neurotoxin, which blocks acetylcholine release at neuromuscular junctions, resulting in paralysis. The toxin is produced under anaerobic conditions by *Clostridium botulinum*, a bacterium found widely in the environment.

In food-borne botulism, the preformed toxin is ingested. There are two main bacterial strains: Group I strains are proteolytic, have spores that are highly resistant to heat, and cannot grow below 10°C. Group II strains are nonproteolytic, are less likely to survive thermal processing or grow in acid or salty products, and grow at refrigeration temperatures. The canning industry has developed retort conditions to prevent the survival of all spores.

Symptoms of food-borne botulism include double vision, inability to speak or swallow, labored breathing, and death. Food-borne botulism can be caused by improperly processed or stored foods,

including vegetables, meat, fish, and cheese. The annual incidence of botulism is highest in Russia, Poland, and Hungary with 0.2 to 0.3 cases per 100,000 persons (due to contaminated home-preserved foods); and in the Inuit populations of Canada and Alaska (60 cases per 100,000 persons in northern Quebec), where it is usually associated with toxins in putrefied whale, seal, or fish products.

Symptoms of infant botulism include constipation, weakness, and respiratory arrests, but rarely death.

EWEN TODD

(SEE ALSO: *Food-Borne Diseases*)

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BOVINE SPONGIFORM ENCEPHALOPATHY

Few more challenging food safety issues exist today than that of bovine spongiform encephalopathy (BSE) and the human form of the disease, variant Creutzfeldt-Jakob disease (vCJD). While vCJD remains rare at this time, the lack of a screening diagnostic test, uncertainty about the extent of exposure to the agent among humans and animals, the long incubation period, and the resulting devastating and inevitably fatal disease combine to create a situation of extreme difficulty for those responsible for public-policy development. The true extent of the unfolding epidemic is unknown, and since the largest exposures to BSE occurred before the relationship to a human disease was recognized, the full impact on human health may not be known for many years to come. This makes it difficult to determine appropriate actions to take to protect the consumer.

THE EPIDEMIC OF BSE

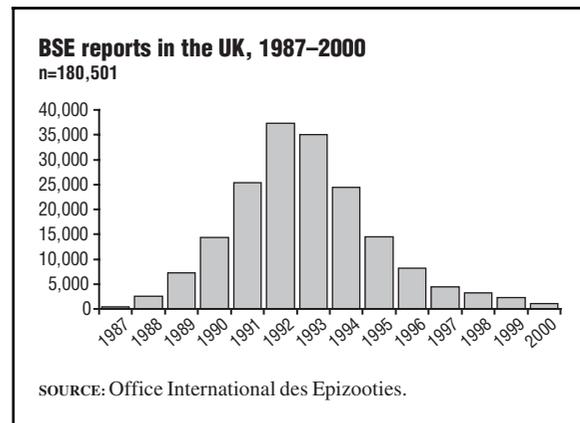
BSE appeared as a completely novel disease of cattle in the United Kingdom (UK), the first known case being diagnosed retrospectively in 1985. By 1986, BSE was recognized as a transmissible spongiform encephalopathy (TSE) of cattle and considered to be analogous to scrapie, a disease of sheep that is not known to cause human disease. Regardless, investigations were conducted to determine how it was being transmitted among cattle. These studies determined that protein supplement feeds made with meat and bone meal (MBM) were the most likely source of the disease. MBM is extracted from cattle and sheep carcasses through a long cooking process called rendering. Rendering is an established practice, used since the turn of the twentieth century. Through rendering, any tissue remaining on animal carcasses after removal of principle tissues is converted into a cake-like material that is used in multiple industries, including the production of protein supplements for animal feeding. Recycling of the agent through rendering led to the rapid and diffuse spreading of BSE throughout most of the United Kingdom (see Figure 1).

Cattle feed sold in the European market spread the disease further. The first cases outside of the UK appeared in 1989 in the Republic of Ireland. By 1990, two other countries (Portugal and Switzerland) were affected, and France reported its first case in 1992. As of December 2000, eleven European countries outside of the UK had reports of BSE in their national herds (Republic of Ireland, Switzerland, Portugal, France, Belgium, Luxembourg, Netherlands, Liechtenstein; and in 2000, Denmark, Spain, and Germany). Three other countries (Canada, Oman, and Maldives Islands) have reported cases, but only in imported cattle. The UK reported approximately 180,000 cases (as of December 2000), with just over 1,300 BSE cases reported elsewhere.

BSE IN HUMANS

In April 1996, Dr. Robert Will of the United Kingdom Edinburgh CJD Surveillance Unit announced that ten persons had been identified with a novel form of Creutzfeldt-Jakob disease (CJD), and that these cases were sufficiently alike and sufficiently distinguishable from sporadic CJD that they could be considered a new variant of CJD

Figure 1



(vCJD). Surveillance for vCJD is conducted throughout the European Union (EU), and in some non-EU countries including the United States, Canada, and Australia. As of April 4, 2001, the number of vCJD cases reported in the UK was ninety-seven, with three cases reported in France and once in the Republic of Ireland.

Clinically, the illness begins with behavioral changes, but its progression is inevitable and unrelenting. The course is relatively prolonged (two years or more) with both mental and physical deterioration. The patient is eventually left in a vegetative state, unable to speak or move, and death is inevitable, as there is no treatment apart from supportive nursing. The average age of onset is 29 years (cases have ranged from 14 to 74 years of age). Diagnosis is made by magnetic resonance imaging, tonsillar biopsy, and cerebro-spinal fluid testing, and must be confirmed by neuropathology. EEG, used for the diagnosis of sporadic CJD, is not helpful. Brain biopsy is not recommended unless a treatable differential diagnosis is sought.

It is now widely considered that the same agent causes both BSE and vCJD. A number of causes have been proposed—including organophosphates, vaccines, and other novel agents—however, scientific support for these theories has been weak. The route of exposure for humans is unclear, but it seems reasonable to suspect cattle-based food.

Discussion of the potential health impact for humans began early, and by 2001 a wide variety of measures had been implemented, including the

removal of animals known to have BSE from the human food chain and the removal during slaughter of known high-risk tissues from animal carcasses regardless of their BSE status (certain tissues of sheep and goats are also removed because of fears raised that sheep and goats may be harboring BSE without developing disease). These tissues included initially the brain, eyes, spinal cord and terminal ileum, but the list was later expanded to include the whole head (excluding tongue), spinal column, thymus, intestine, and dorsal root ganglion. In addition, reflecting current knowledge about the spread of infectivity, animals over certain ages (from 6 to 30 months of age depending on the level of safety required) are not consumed. Also to be considered is the possible contamination of skeletal muscle meat due to certain slaughter techniques that embolize brain tissue throughout the body, or which cause surface contamination of edible parts of the carcass.

CONTROL OF BSE

To stop the continued spread of BSE, three principle strategies are used: surveillance, preventing the exposure of ruminants (cattle, sheep, and goats) to feed made from ruminant protein, and slaughter of diseased animals. Because of the long incubation period for BSE (four to five years), cases have continued to be reported after the implementation of these measures. The peak of the epidemic was seen in 1992, at which point the UK was reporting over 30,000 cases of BSE per year.

Cases of BSE reported after the feed ban was implemented are known as "born-after-ban" (BAB) cases, and investigation of them revealed important holes in safety measures. BAB cases appear to be the result of an incomplete application of the feed ban and an incomplete understanding of the importance of even a small amount of contamination—a piece of brain tissue the size of a peppercorn is sufficient to infect a bovine animal. In the UK, feed bans had to be extended (in 1994) to include all mammalian protein in ruminant feeds, with a further extension in 1996 to prevent the use of mammalian MBM in all animal feed. Cross-contamination of tissues in slaughterhouses, feed mills, and other sites also required management. Furthermore, inspection, animal tracing systems, financial incentives, and fines were implemented to ensure that all risk materials were

removed from carcasses and that animals with disease were reported and destroyed.

The European Union did not introduce its feed ban legislation (a simple ruminant-to-ruminant feed ban) until 1994, by which point it was too late to prevent the introduction of the disease. When the first human cases of vCJD occurred in 1996, the UK was prohibited from exporting bovine meat, cattle, and bovine-based products. As recently as November 2000, with the recognition of more than expected numbers of cases of BSE, it became clear to the EU that their interventions had been both inadequate and inadequately enforced. Measures to prohibit all animal protein feed to farm animals were to be introduced in the EU within 2001. However, the extent of spread of the epidemic among national herds will not be visible for a number of years.

At the international level, a question exists regarding non-European countries who also imported implicated MBM from the UK and Europe. Few non-EU countries have surveillance system for BSE, yet many nations imported and used implicated MBM, and many also imported live cattle. The risk that the disease has been imported into these countries without the financial capacity to enact the required interventions could result in a new foci of distribution of this devastating disease. International guidelines, such as those promulgated by the Office International des Epizooties, the Food and Agriculture Organization, and the World Health Organization are only partial solutions. It is clear that risk analysis must be conducted in each country in order to assess the risk that BSE was imported and whether the conditions exist for its further propagation.

MAURA N. RICKETTS

(SEE ALSO: *Transmissible Spongiform Encephalopathy; Veterinary Public Health; Zoonoses*)

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WEB SITES OF INTEREST

For information about BSE reports: <http://www.OIE.int>.

For WHO consultations and opinions: <http://www.who.int/emc/diseases/bse/index.html>.

For information concerning EU decisions: http://europa.eu.int/comm/food/index_en.html.

Web site of the CJD Surveillance Unit (with connections to UK ministries and international surveillance systems sites): <http://www.cjd.ed.ac.uk/index.htm>.

BREAST CANCER

Breast cancer is the most common malignancy in American women, accounting for approximately 30 percent of their new cancer cases. It is the second leading cause of cancer death in women, following lung cancer. In the year 2000, it was estimated that there were more than 180,000 new cases of breast cancer diagnosed, and over 41,000 breast cancer deaths in the United States. Breast cancer incidence rates were steady through the 1990s, although the number of breast cancer deaths declined, decreasing an average of 1.8 percent per year between 1990 and 1996.

Breast cancer can be divided into invasive and noninvasive forms. Noninvasive breast cancer is almost always cured through local control measures (surgery and radiation therapy). Tamoxifen (a selective estrogen-receptor modulator), is used to reduce the risk of a local recurrence in patients treated with breast conservation. Early-stage invasive disease is limited to the breast and axillary lymph

nodes, while metastatic disease includes tumors that have spread outside the breast and local lymph nodes. Early-stage invasive breast cancer is curable, although less so than noninvasive disease.

The first step in the management of early-stage breast cancer is surgical removal of the tumor. This can be accomplished by lumpectomy (removal of the tumor and a margin of surrounding normal breast tissue) or mastectomy (removal of the entire affected breast). Following lumpectomy, patients should receive radiation to the remaining breast tissue to decrease the risk of recurrence. Studies have shown that patients with small tumors who are treated with breast conservation therapy (lumpectomy and radiation) have equivalent survival rates to patients treated with mastectomy. Ipsilateral axillary lymph nodes are removed in order to determine whether the tumor has spread via the lymphatic drainage. Involvement of the ipsilateral lymph nodes is a marker for increased risk of later distant spread of the tumor.

Once the tumor is removed, the size of the tumor, hormonal status (estrogen and progesterone receptor), and lymph node involvement is considered in aggregate to determine the overall risk of distant spread of disease. Patients at high risk for recurrent disease can be given systemic therapy in order to decrease the odds of relapse. Systematic therapy circulates throughout the entire body in order to kill microscopic tumor cells. Conventionally this therapy can consist of chemotherapy, hormonal therapy (if the tumor is estrogen- or progesterone-receptor positive), or both. Chemotherapy is typically given to patients with invasive tumors greater than 1 centimeter in largest diameter or with involved (positive) lymph nodes. Patients with hormone receptor-positive tumors or tumors in which the receptor status is unknown benefit from treatment with tamoxifen for five years. Both of these interventions have been shown to decrease both the patient's annual risk of recurrence and the risk of mortality from breast cancer. Tamoxifen also decreases the risk of a second primary breast cancer in the preserved contralateral breast.

Breast cancer can metastasize to other organs in the body. Once breast cancer has been detected in distant sites, it is no longer curable. At that stage, the goal of the treatment is to prolong survival while maintaining quality of life. Patients

with hormone receptor–positive tumors who are minimally symptomatic and who have predominantly bone disease can frequently be treated with hormonal therapy. This treatment is taken orally and is generally well tolerated. Patients who have hormone receptor–negative tumors, those who have failed hormone therapy, and those who have symptomatic or rapidly progressive disease are frequently treated with chemotherapy. The specific decisions regarding hormone therapy, chemotherapy, and supportive measures require skill, compassion, and a detailed understanding of the numerous treatment options.

Established risk factors for breast cancer include older age (women over fifty have a 6.5 times higher risk of developing breast cancer than younger women), a family history of breast cancer (especially the presence of a documented genetic abnormality), early age of menarche (less than 12 versus equal to or greater than 14), late age of menopause (equal to or greater than 55 versus less than 55), age at first live birth (greater than 30 versus less than 20), history of benign breast disease, and a history of hormone replacement use. Some studies also suggest an increased breast-cancer risk associated with increased alcohol and dietary fat intake, excess body weight, and limited exercise. Further studies are needed to establish the benefit of lifestyle modification in the prevention of breast cancer.

Randomized trials have shown the benefit of chemoprevention in reducing the risk of breast cancer for women at increased risk. The National Surgical Adjuvant Breast and Bowel Project Tamoxifen Prevention Trial (NSABP-1) evaluated the benefits of tamoxifen in the prevention of breast cancer. More than three thousand women at increased risk for breast cancer (defined as a five-year risk of breast cancer of 1.66 percent or more) were followed for approximately four years. Treatment with tamoxifen reduced the overall odds of developing both invasive and noninvasive breast cancer by approximately 50 percent. This decrease in breast cancer risk was seen across all age groups. Side effects of tamoxifen include hot flashes, an increased risk of thromboembolic events, and increased risk of endometrial cancer.

Newer antiestrogens, such as raloxifene, may have fewer side effects than tamoxifen. The MORE (Multiple Outcomes of Raloxifene Evaluation) trial

was a trial of 7,705 postmenopausal women who received raloxifene for the treatment of osteoporosis. Raloxifene was found to reduce the risk of invasive breast cancer by 76 percent, with no increased risk of endometrial cancer. Raloxifene is being compared directly to tamoxifen for prevention in high-risk patients in the STAR (Study of Tamoxifen and Raloxifene) trial.

CLIFFORD HUDIS
ARTI HURRIA

(SEE ALSO: *Breast Cancer Screening; Breast Self-Examination; Cancer; Clinical Breast Examination; Gender and Health; Mammography; Tamoxifen*)

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BREAST CANCER SCREENING

The three most common modalities for breast cancer screening are mammogram, clinical breast

examination, and breast self-examination. The goal of these screening examinations is to detect occult breast cancer at an early stage—before it is clinically evident—and thereby increase the probability of cure. A screening mammogram is an X-ray examination of the breast. The breast tissue is compressed, so that two views of the breast can be taken: a mediolateral (MLO) view and a craniocaudal (CC) view. If abnormalities are seen, then further images of the abnormality are taken, called magnification, or spot compression, views.

Mammogram screening is ideally performed in conjunction with a physical examination of the breast. These two examinations are complementary to one another—mammographic screening is able to detect some cancers that are not palpable, while some cancers are palpable, but not detectable on mammogram. Therefore, and of inestimable importance, a palpable abnormality needs to be evaluated further, even if the mammogram is normal.

Physical examination of the breast is performed in both the upright and supine positions. The patient is disrobed from the waist up for a complete examination. The breasts are inspected in the upright position with the arms relaxed, with the arms raised, and with the pectoral muscles contracted. The clinician is looking for differences in the breast size, alteration in the breast shape, or areas of skin retraction. The skin of the breast and the nipples are inspected. The regional lymph nodes are examined, including the axillary and supraclavicular lymph nodes. The breasts are subsequently palpated in the upright position and in the supine position, with the ipsilateral arm raised above the head. If a dominant mass is palpated, then further evaluation by a physician is warranted.

The first randomized controlled trial demonstrating the benefit of the screening mammogram and clinical breast exam in decreasing mortality was performed in 1963 by the Health Insurance Plan breast screening project. Sixty-two thousand women were randomized to either the intervention group, consisting of screening mammogram and clinical exam, or to a control group. At ten years of follow-up, the intervention group had a 30 percent reduction in breast cancer mortality.

Subsequent randomized trials of the screening mammogram also demonstrated a benefit to

screening mammography. A meta-analysis of mammogram screening trials (9 randomized controlled trials and 4 case-control studies) was published in 1995. Data from the randomized controlled trials demonstrated that women between 40 to 74 years of age who underwent screening mammography had a relative risk of breast cancer of 0.79 (95% CI [confidence interval] 0.71–0.87) in comparison to unscreened patients. Women aged 50 to 74 (relative risk 0.77; 95% CI 0.69–0.87) benefited from screening mammogram more than women aged 40 to 49 (relative risk 0.92; 95% CI 0.75–1.13). The relative risk decreased to 0.83 (CI 0.65–1.06) after 10 to 12 years of follow-up. Based on these studies, screening mammography has been shown to decrease breast cancer mortality by approximately 30 percent.

The breast self-examination is a monthly examination of the breast performed by the patient. The goal of this examination is for the patient to notice any changes in her breasts that should subsequently be brought to the attention of a physician for further evaluation. It is estimated that patients discover approximately 65 percent of palpable breast abnormalities. For premenopausal women, the best time to perform the examination is one week after the start of menstruation. Postmenopausal women can perform the examination during any part of the month.

In performing the breast self-examination, the patient inspects her breasts in front of a mirror, with arms at her side and then with arms raised above her head. The nipples are gently squeezed to evaluate for discharge. The patient subsequently lies down and places the right arm above her head. The left hand is used to palpate the right breast. The breasts are examined in a circular motion with the fingers flat. All of the breast tissue and the axilla should be palpated. The opposite breast should be examined in a similar manner. The breasts should subsequently be examined in the shower. With one arm raised above the breast, the contralateral (opposite) hand is used to palpate the breast. The breasts are examined in a circular motion with the fingers flat. The patient is looking for breast lumps, changes in the breast shape, size, or contour, or for skin changes, puckering, or dimpling. Any of these abnormalities would warrant further evaluation by a physician.

The efficacy of breast self-examination in reducing mortality from breast cancer has not been established. Despite this, the exam is easily performed and of low cost. It should therefore be recommended to all women in the absence of better alternatives.

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ARTI HURRIA

(SEE ALSO: *Breast Cancer; Breast Self-Examination; Clinical Breast Examination; Mammography; Tamoxifen*)

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BREAST SELF-EXAMINATION

The breast self-examination is an examination of the breasts, performed by a woman, ideally one time per month. The goal of the breast self-examination is for a woman to notice changes in the breast that should be brought to the attention of a physician for further evaluation. These include breast lumps, changes in the breast shape, size, or contour, or skin changes. Randomized trials have shown no decrease in breast cancer

mortality among women performing monthly breast self-examination. Despite this, the American Cancer Society recommends monthly breast self-examination for women over the age of twenty.

CLIFFORD HUDIS
ARTI HURRIA

(SEE ALSO: *Breast Cancer; Breast Cancer Screening; Clinical Breast Examination*)

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BRONCHITIS

The term "bronchitis" refers to the inflammation of medium-sized and large airways in the lung (bronchi). Bronchitis is distinguished from bronchiolitis (inflammation of small airways that lack cartilage and mucus-secreting glands in their walls) and from bronchiectasis (permanent dilation and destruction of bronchi associated with chronic cough productive of purulent sputum). Although bronchial asthma is a chronic inflammatory airway disease, it is not considered under the heading of bronchitis.

Acute bronchitis is usually an infectious disease caused by viruses (influenza A and B, parainfluenza, the common cold viruses [rhinovirus and coronavirus], adenovirus, and respiratory syncytial virus). Infrequently, acute bronchitis is caused by inhalation of toxic gases and products of combustion or by aspiration of foreign material. Acute infectious bronchitis is a self-limited illness characterized by cough, sputum production, and, in most cases, symptoms of an upper respiratory tract infection (sore throat, and nose and sinus congestion). Inflammation of the trachea usually occurs together with inflammation of the bronchi, so the term "tracheobronchitis" is sometimes used. The majority of cases occur during the winter. In most cases, symptoms clear spontaneously within one week. In about 10 percent of cases, acute bronchitis can be traced to infection by nonviral agents including *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, and *Bordetella pertussis*. Diagnostic

tests to determine the specific organism responsible for acute bronchitis are impractical, so therapy is usually empiric.

Treatment of acute bronchitis consists of symptomatic relief with cough suppressant medication (antitussives), pain relief with nonsteroidal anti-inflammatory drugs, and decongestants if nasal and sinus congestion is present. Antibiotics against bacterial organisms are not indicated in the treatment of acute bronchitis. If acute bronchitis occurs during a community outbreak of influenza A or B infection, influenza is likely and may be managed with new antiviral drugs that shorten the duration of illness. This therapy is effective, however, only if begun within two days of the onset of symptoms. Expense and limitation of the symptomatic benefit to one to two days render such antiviral therapy controversial.

A few patients with acute bronchitis suffer from persistent cough beyond seven to ten days, requiring management with inhaled bronchodilators such as albuterol. Persistent cough along with sore throat (pharyngitis) may suggest infection from *Mycoplasma pneumoniae* or *Chlamydia pneumoniae*, prompting treatment with an antibiotic (doxycycline, erythromycin, clarithromycin, or azithromycin). A persistent, violent, barking cough may be a clue to infection from *Bordetella pertussis*. This fairly common problem may respond to a one- or two-week course of antibiotic treatment with erythromycin. A cough that persists for more than three weeks is termed "chronic cough." Occasionally chronic cough follows an episode of acute bronchitis. More likely, however, chronic cough is caused by some type of underlying chronic lung disease, bronchial asthma, postnasal drip, or gastroesophageal reflux disease.

It is important to distinguish acute bronchitis from pneumonia. Patients with pneumonia usually have fever, chills, and a more severe illness than is seen with acute bronchitis, and the chest X-ray reveals a shadow (lung infiltrate) that is lacking in acute bronchitis. Acute bronchitis should also be distinguished from an attack of bronchial asthma and from acute exacerbation of chronic obstructive pulmonary disease (COPD).

Chronic bronchitis is characterized by chronic or recurrent excess bronchial mucus secretion. About 12.5 million Americans are thought to suffer from chronic bronchitis, and the morbidity,

mortality, and economic impact of this condition (and of emphysema) are immense. Chronic bronchial inflammation results in a persistent cough, which by definition occurs most days for at least three months of the year for at least two successive years. The cough is typically productive of varying amounts and appearance of phlegm (sputum). Other diseases that are associated with excessive mucus secretion, such as chronic sinusitis with post-nasal drip, asthma, lung cancer, tuberculosis, and bronchiectasis, must not be confused with chronic bronchitis. Patients with "simple chronic bronchitis" lack airflow obstruction on pulmonary function tests (spirometry), whereas those with "chronic obstructive bronchitis" have reduced airflow rates. Both types of chronic bronchitis are closely linked to cigarette smoking.

Chronic obstructive bronchitis is one of two types of COPD, the other being emphysema. Some, but not all, patients with simple chronic bronchitis progress to the chronic obstructive form. Most patients with chronic obstructive bronchitis also have emphysema. Chronic asthmatic bronchitis is an overlap condition with features of both chronic bronchitis and bronchial asthma. Industrial bronchitis is a type of chronic bronchitis associated with occupational exposure to dusts.

Patients with chronic obstructive bronchitis usually have a daily cough, sputum production, shortness of breath (dyspnea), and sometimes wheezing. These symptoms typically appear in the age range from forty-five to sixty and gradually progress, particularly if cigarette smoking continues. In advanced cases, chronic respiratory failure may occur. Acute exacerbations of chronic bronchitis are intermittent episodes of increasing cough with discolored sputum, shortness of breath, and wheezing that typically occur one or two times each year. Viral or bacterial infection is a common cause of these episodes.

Medical management of chronic bronchitis includes general measures such as patient education, smoking cessation, improved nutrition, exercise, and immunization against infection by influenza virus and *Streptococcus pneumoniae*. Complete elimination of cigarette smoking is essential and has been proven to slow the rate of decline in pulmonary function that occurs over time. Patients with chronic obstructive bronchitis are treated with bronchodilator drugs such as inhaled

ipratropium bromide and albuterol and occasionally with oral theophylline. Supplemental oxygen is prescribed for patients with low arterial blood-oxygen levels (hypoxemia), and antibiotics are often given for significant acute exacerbations. Other management strategies that are recommended for emphysema are also appropriate for chronic obstructive bronchitis because of the overlap of these two conditions.

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(SEE ALSO: *Acute Respiratory Diseases; Asthma; Influenza*)

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BROWNFIELDS

Located in industrial zones in cities, or along railroad lines in suburbs and rural communities, brownfields are those sites where the factories, train yards, and commercial structures that were the economic lifeblood of the American economy were located. Now, the estimated 100,000 to 500,000 brownfields in the United States are abandoned or underutilized, and many are contaminated, or perceived to be so. Physical deterioration of the brownfields and crime are major causes of decline in many neighborhoods. The U.S. Environmental Protection Agency began a brownfields redevelopment program during the mid-1990s, giving \$200,000 grants to 300 cities and other jurisdictions. More than a dozen U.S. government

agencies have begun providing coordinated assistance and funding in support of brownfields redevelopment.

The extent of risk to the public posed by environmental contamination of brownfields is a major concern. Depending upon the amount and type of contamination, soil may be removed, a concrete or other impermeable layer placed on top of the land, and restrictions placed on future use of the land. Many brownfield sites are located in poverty-stricken minority neighborhoods, and brownfields redevelopment is an important issue in relation to environmental justice policies. Brownfields contrast with greenfields, which are fields and lots that were never developed, or only lightly developed. Greenfields are generally believed, sometimes incorrectly, not to be contaminated.

MICHAEL R. GREENBERG

(SEE ALSO: *Environmental Determinants of Health; Environmental Impact Statement; Environmental Justice; Environmental Protection Agency; Hazardous Waste*)

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BRUCELLOSIS

Brucellosis, a zoonosis, is a bacterial infection, mainly of cows and goats, but with humans as alternative hosts. The causative organisms, *Brucella abortus* or *Brucella melitensis*, are small gram-negative bacilli that are difficult to cultivate, though they can be isolated from blood culture in the acute and sometimes in the chronic phase. Varieties of the causative organisms (e.g., *B. canis* and *B. suis*) occur in every part of the world where domesticated and wild cattle or goats are found. Brucellosis responds to treatment with antibiotics such as rifampin and streptomycin.

Humans are usually infected by handling or eating infected animal parts or dairy products.

Person-to-person transmission does not occur. Brucellosis is principally an occupational disease of goat and cattle farmers, veterinarians, and abattoir workers. It has always been prevalent in countries around the Mediterranean Sea—where it was formerly called undulant, Mediterranean, or Malta fever—but it can occur wherever there are herds of cattle or goats. It may have an acute or insidious onset following an incubation period of up to two months, and it frequently lingers for many months or even years—sometimes for the remainder of a person's life—with remissions and relapses of low fever, debility, depression, weight loss, joint pains and arthritis, and sometimes enlargement of the spleen and liver.

In 1859, Florence Nightingale, previously a very active woman, returned unwell to England from the Crimean War, where she had established a hospital for sick and injured soldiers. She remained a chronic invalid until her death in 1910, probably suffering from brucellosis.

Besides its debilitating and (rarely) fatal effects on human victims, brucellosis has considerable economic importance because it causes abortion in dairy cattle (hence the name of the commonest variety of the causative organism, which also carries the name of its discoverer, Sir David Bruce).

When brucellosis is diagnosed in a domestic animal herd, segregation of the herd is mandatory. Sometimes the herd is slaughtered and incinerated. Prevention of transmission depends on education of workers, scrupulous hygiene, avoidance of contact with suspected infected animal parts, especially the placenta, and the use of serologic tests to identify infected animals. Preventing infection of occupationally exposed humans also relies mainly on education, personal hygiene, and avoidance of contact with contaminated animals and their carcasses. Pasteurization of milk and dairy products protects against infection by the ingestion of such products.

JOHN M. LAST

(SEE ALSO: *Veterinary Public Health; Zoonoses*)

BUBONIC PLAGUE

See Black Death; Epidemics; Plague

BUDGET

A budget is a spending plan used to allocate resources to accomplish an organization's objectives. This management tool coordinates anticipated expenditures in an effort to maximize resources. A budget is time-specific, and it must be flexible to respond to financial and programmatic changes. A budget, in effect, serves as a financial road map for an organization.

GREGORY ERVIN

(SEE ALSO: *Economics of Health; Planning for Public Health*)

BUILT ENVIRONMENT

The average North American now spends approximately 90 percent of the time indoors, 5 percent in cars, and only 5 percent outdoors. In the developed world, four out of five people live in urban settlements, while globally, at the dawn of the twenty-first century more than half of humanity was urbanized.

As a result, the built environment (as distinct from the natural environment) is now the most significant environment for humans, especially in the developed world. The built environment includes both the buildings in which people spend their time (home, school, workplace, recreational facilities, shops and malls, etc.) and the broader built environment of human settlements (villages, towns, suburbs, and cities). It is not only a physical environment, it is also a social environment, where people gather and relate to one another. The design, construction, and operation of built environments has enormous implications for human health.

HOUSING AND HEALTH

Housing is a basic determinant of health, and many organizations, including the World Health Organization (WHO) and the American Public Health Association (APHA), have developed standards for healthy housing. The most important role of housing is to provide shelter from the elements. At its most basic level, housing needs to keep its inhabitants dry, warm (or cool), and safe.

Building codes help ensure that housing is safe, while good urban planning ensures that housing is not built in dangerous locations such as floodplains, dangerous hillsides, or next to polluting industries.

In addition to being safe and providing shelter, housing also should be hygienic. This means providing clean water, systems to remove sewage and solid waste, and hygienic food storage and preparation areas. Finally, housing needs to support mental and social well-being—it should be attractive, pleasing, and well maintained, with greenspace, play areas for children, and other elements that help promote health. These same principles also apply to other built environments, such as schools, workplaces, hospitals, government buildings, and shopping areas.

INDOOR AIR QUALITY

Since people spend so much of their time indoors, the quality of indoor air is very important. In some countries, where biomass fuels (e.g., wood, coal, peat, and animal dung) are used indoors for heating and cooking, the indoor air quality can be very poor. The World Bank estimates that 400 million to 700 million women and children are exposed to these conditions, which contribute to 4 million deaths annually from acute respiratory infections. This makes such indoor air pollution one of the four most critical global environmental problems.

In the developed world today, such severe indoor air pollution is seldom a problem. But indoor air quality remains a significant problem because of energy-efficient sealed buildings that have reduced ventilation rates. These sealed environments house a host of pollutants: volatile organic compounds (VOCs) from paints, resins, glues, fabrics, and furnishings; secondhand tobacco smoke; nitrogen oxides and carbon monoxide from fossil fuel combustion; pesticides, cleaning agents, and other toxic materials; house dust mites; animal hair from pets; and molds associated with damp housing (roughly one-third of houses in North America have a problem with dampness and mold). Complaints of “sealed building syndrome” have become commonplace. There is also considerable evidence suggesting that the approximate doubling of asthma among children in North America since the 1980s is due in no small part to this indoor air pollution.

THE URBAN ENVIRONMENT

The quality of the urban built environment is also of great importance to health. Outdoor air pollution, which results in death and disease, comes from industry, from coal-, oil-, and gas-burning electricity generating or heating plants, and from motor vehicles. Particularly in the summer months, nitrogen oxides and volatile organic carbons from these sources combine to form ground level ozone, while particulate pollutants and acid emissions contribute their share to summer smog or winter haze.

Urban settlements also contribute massively to water pollution. Human wastes, industrial wastes, urban runoff from the streets and parking lots, pesticides and herbicides from parks, lawns, and gardens—all end up in the water. Most major cities have some form of waste water treatment, but even so it is not uncommon to find that the lakes and rivers are not safe even for swimming.

Roads and traffic are another major threat to health in the urban environment. In addition to the contribution that traffic makes to air pollution, motor vehicle accidents are a major cause of death and injury, particularly among children and young adults. In addition, traffic noise is a major irritant, while large roads and highways impede access for pedestrians and isolate neighborhoods from each other.

The design of urban environments also has an important influence on crime and violence. Many women’s groups now conduct safety audits of their communities to identify streets, parks, and other areas that are dangerous and to identify ways to make them safer. It is not just the violence, but the fear of violence that is debilitating. If people do not feel safe, they will not use their community’s streets and facilities, and increasingly will wall themselves off in gated neighborhoods. This only serves to increase the isolation and the disparity between rich and poor, young and old, black and white.

Indeed, the social impacts of the urban environment are at least as important as the physical impacts. Highrise apartments, deserted streets, poor public transportation, gated communities, urban sprawl—these and other aspects of modern cities can contribute to isolation, lack of access for the disadvantaged, and alienation.

THE NEW URBANISM, SUSTAINABLE COMMUNITIES, AND HEALTH

An increasing awareness and concern about the environmental and health impacts of modern cities—especially the sprawling urban and suburban cities of North America—has resulted in a number of new but related movements, all of which are intended to improve the quality of life. One such approach is called “new urbanism.” Its focus is on improving the livability of urban communities by making them more dense, by putting home, school, workplace and other facilities closer together, and by designing streets and communities that are more traditional. In such communities, people can more easily walk and bike; there is more active street life, and—it is hoped—a greater sense of community.

The sustainable community movement includes many of these same qualities but focuses on how to reduce the ecological footprint of a community by reducing consumption of energy and other resources and by reducing air and water pollution. The safe communities movement looks at ways of reducing crime and violence (and the fear of crime and violence) and accidental injuries through better design and by involving the community through safety audits and neighborhood watch programs. Finally, the healthy communities movement combines many of these attributes, in an attempt to create healthier, safer, more sustainable and livable communities with a high quality of life. In the twenty-first century, however, health will depend to a considerable extent on how well people are able to create built environments—from individual houses to whole cities—that improve physical, mental, and social well-being.

TREVOR HANCOCK

(SEE ALSO: *Ambient Air Quality [Air Pollution]*; *Ecological Footprint*; *Healthy Communities*; *Homelessness*; *Urban Transport*)

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BUREAU OF THE CENSUS

The United States created a permanent census bureau in 1902. Early censuses of the U.S. population, which have been taken every ten years since 1790, were operated by temporary organizations. Today, the Census Bureau is the largest U.S. statistical agency. It collects a wide range of data about the U.S. population and economy—including data about families, disabilities, poverty, education, housing, and economic activity. It also conducts surveys for other federal agencies on health, alcohol-related conditions, medical care, surgery, nursing homes, and home and hospice care. Government, business, and community planners use Census Bureau data to help them make informed decisions in planning public health and other government programs.

KENNETH PREWITT

(SEE ALSO: *Census*; *Demography*; *Statistics for Public Health*)

C

CAMPYLOBACTER INFECTION

Although campylobacter was first identified in 1909 as an animal pathogen, due to better isolation methodology in recent years it is now recognized as one of the leading causes of diarrhea in humans. They are small nonsporing, gram-negative motile bacteria with spiral or S-shaped morphology and can only grow under conditions of reduced oxygen tension. Campylobacter organisms are sensitive to drying or freezing, but they can survive in the environment in cold groundwater, soil, and in refrigerated food for weeks. Campylobacters are found in the gastrointestinal tract of domestic and wild animals and can cause human infections through direct contact or through food or water vehicles. Poultry, cattle, swine, and sheep are the main reservoirs, and campylobacters can cause abortions and diarrhea in these animals.

Two main species affect humans, *C. jejuni* and *C. coli*, with most cases attributed to the former. Virulence factors include rapid motility, outer membrane protein for adherence, and possibly enterotoxin. The diarrhea caused by campylobacter is often mild, but may be marked by profuse, foul-smelling stools with blood or mucus, accompanied by abdominal cramping. Symptoms can be severe enough to mimic appendicitis, although death is rare. Sequelae such as reactive arthritis may follow, but the most serious of these is Guillain-Barré syndrome. For these reasons, the costs for campylobacteriosis are high (up to \$1.4 billion annually in the United States). Immunocompromised people are susceptible, and young adults also appear to be a high-risk group,

possibly due to inadequate understanding of food safety and undercooking of poultry. Based on routine surveillance, children under five years of age have the highest incidence.

Most campylobacteriosis cases are sporadic, peaking in the summer months. The estimated annual incidence of campylobacteriosis in the United States and United Kingdom is about the same, between 1,000 and 1,100 cases per 100,000 persons. In developing countries the rate is believed to be higher, especially in children under five. Risk factors include direct contact with farm animals, animal carcasses, or household pets—especially puppies and kittens with diarrhea. Person-to-person transmission occurs within families. Perinatal transmission is rare. Unlike Salmonella and other food-borne disease organisms, *Campylobacter* subspecies tend not to multiply in food, but they can be found in large numbers in raw sewage and fecally contaminated surface waters. Raw chicken is the food most commonly associated with campylobacteriosis. Because of the low infective dose, it is possible to transfer sufficient organisms to the mouth by direct contact with the chicken or its drip waters to cause illness.

In addition, consumption of untreated water and milk has been associated with large outbreaks—500 joggers in Switzerland became ill after drinking a raw milk beverage, and 2,500 school children aged 2 to 7 were infected by raw milk in England. In Sweden, between 1992 and 1996, six waterborne outbreaks were recorded, affecting about 6,000 persons. Water treatment, pasteurization of milk, and proper hygiene by the public are the most

important strategies for reducing incidence of the disease.

EWEN TODD

(SEE ALSO: *Food-Borne Diseases*; *Waterborne Diseases*)

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CANADIAN INTERNATIONAL DEVELOPMENT AGENCY

Canada, like other industrialized countries, provides assistance to developing countries and countries in transition (such as the formerly communist nations of Central and Eastern Europe and the former Soviet Union) in the form of goods, services, the transfer of knowledge and skills, and financial contributions. It also provides humanitarian relief to victims of emergencies and natural disasters worldwide.

The Canadian International Development Agency (CIDA) is the federal government body that oversees and funds much of this work. With public and private sector partners in Canada and in developing countries, and with international organizations and agencies, CIDA supports foreign aid projects in more than one hundred of the poorest countries of the world. The aim of Canada's Official Development Assistance (ODA) is "sustainable development that will reduce poverty and contribute to a more secure, equitable, and prosperous world."

A wide range of development partners in Canada—universities, church groups, nongovernmental organizations, cooperatives, and labor unions—along with international organizations and

the people and institutions of developing countries, play a vital role in the development of policy and in the planning and delivery of Canada's ODA. Their contribution is essential in providing the expertise, knowledge, and resources required for effective development.

CIDA's own professional and technical experts provide advice on highly specialized sectors such as food, nutrition, agriculture, rural development, cooperatives, fisheries, forestry, water management, the environment, health and population, education, energy and telecommunications, air transport, social communications, and the participation of women in development. CIDA's efforts are focused on six priority areas: basic human needs; women in development; infrastructure services; human rights, democracy, and good governance; private-sector development; and the environment. Canada commits 25 percent of its ODA to "basic human needs," which includes primary health care, basic education, family planning, nutrition, water and sanitation, and shelter. The agency focuses on work in Africa, Asia, and the Americas.

CIDA believes that developing countries should take charge of their own health development and that development of knowledge and skills and the training of health professionals within these countries is a key element in enabling national governments to assume this leadership.

Canada began its foreign aid program soon after the Second World War. It was among the founding members of the 1950 Colombo Plan for co-operative economic and social development in South and Southeast Asia. In addition to funding, Canadian aid included bringing trainees on scholarships to Canada and sending technicians and skilled workers to developing countries.

The External Aid Office was created in 1960 to coordinate work with international agencies and nongovernmental organizations, to handle assistance programs, and to manage Canadian emergency aid efforts overseas.

In 1968 the External Aid Office's name was changed to the Canadian International Development Agency. The change reflected a philosophical change in Canada's relations with developing countries, with a desire to broaden the scope of international efforts beyond financial aid.

In 1996, CIDA issued its *Strategy for Health*, which recognized “the highest attainable standard of physical, mental, and reproductive health as a human right, an essential resource for everyday life, and a crucial investment for global prosperity, security, and equitable social development.” CIDA pledged to support efforts to promote the development of sustainable national health systems, improve women’s health and reproductive health, improve children’s health, decrease malnutrition and eliminate micronutrient deficiencies, help prevent and control important and emerging pandemics, and introduce appropriate technologies and special initiatives. Top priority is given to strengthening national health systems and improving women’s health and reproductive health.

The projects CIDA funds are diverse. For example, since the mid-1970s the agency has supported major water supply projects in northern Ghana. Thanks to CIDA’s contribution of almost \$140 million, 1.4 million Ghanaians living in the poorest regions of the country now have clean drinking water. CIDA has also provided \$135 million to support HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome) prevention, education, and care programs in developing countries since 1987.

Canada, through CIDA, is also a leading provider of supplements to children with vitamin A deficiency. More than 100 million children around the world under the age of five lack sufficient vitamin A, which puts them at an increased risk of becoming blind or dying from common childhood diseases. CIDA has played a major role in developing programs that fortify foods with this essential vitamin.

Over the last two decades, CIDA has also supported global immunization programs, contributing more than \$165 million to immunization efforts in developing countries. Today, more than three-quarters of all the world’s children have been immunized against the six preventable childhood diseases.

Despite these successes, Canada has never fulfilled its 1980 pledge to raise Official Development Assistance aid to 0.5 percent of the gross national product by the middle of the 1980s and to make all best efforts to reach 0.7 percent by 1990. Major cuts to development spending during the 1990s provoked criticism from many international

development quarters. Today just 0.25 percent of Canada’s GNP is devoted to development assistance.

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(SEE ALSO: *Health Care Financing; International Health*)

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CANADIAN TASK FORCE ON PREVENTIVE HEALTH CARE

The Canadian Task Force on Preventive Health Care (the Periodic Health Examination) was established in September 1976 under the title the Canadian Task Force on Periodic Health Examination by the Conference of Deputy Ministers of Health of the ten Canadian Provinces. Its stated mandate was: “To determine how the periodic health examination might enhance and protect the health of Canadians and to recommend a plan for a lifetime program of periodic health assessments for all persons living in Canada.” Under the founding chairmanship of Dr. Walter O. Spitzer, the membership included epidemiologists, health care researchers, primary caregivers, and specialists. Dr. Spitzer chaired the task force from 1976 to 1984. From 1984 to 1994, the group was chaired by Dr. Richard B. Goldbloom. At the beginning of the twenty-first century the chair was Dr. John Feightner.

Between 1976 and 1978, the task force developed a methodology for evaluating the scientific

evidence for and against the effectiveness of any preventive intervention. The characteristic that distinguished the Canadian Task Force methodology from traditional approaches to decision making on preventive issues was that evidence took precedence over consensus. This methodology has become an international standard for evaluating preventive interventions. It included the following hierarchy for evaluating the quality of evidence for effectiveness of any preventive intervention.

QUALITY OF EVIDENCE

- I. Evidence obtained from at least one properly randomized controlled trial.
- II-1. Evidence obtained from well-designed controlled trials without randomization.
- II-2. Evidence obtained from well-designed cohort or case control analytic studies, preferably from more than one center or research group.
- II-3. Evidence obtained from comparisons between times or places with or without the intervention. Rheumatic results in uncontrolled experiments (such as the results of treatment with penicillin in the 1940s) could also be included in this category.
- III. Opinions of respected authorities based on clinical experience, descriptive studies, or reports of expert committees.

Coupled with the development of the above system for grading the strength of scientific evidence, the task force developed a bidirectional classification of its recommendations, as follows:

- A. Good evidence to support the recommendation that the condition be specifically considered in a periodic health examination.
- B. Fair evidence to support the recommendation that the condition be specifically considered in a periodic health examination.
- C. Poor evidence regarding the inclusion or exclusion of the condition in a periodic health examination but recommendations may be made on other grounds.
- D. Fair evidence to support the recommendation that the condition be excluded
- E. Good evidence to support the recommendation that the condition be excluded from consideration in a periodic health examination.

The first task force report, published in 1979, reviewed the scientific evidence for preventability of seventy-eight conditions. This report included a recommendation that the undefined "annual check-up" should be abandoned and replaced by a series of age-specific "health protection packages" that could be implemented in the course of medical visits for other purposes.

The durability of the Canadian Task Force methodology was confirmed in 1984 when the United States Preventive Services Task Force was established. The U.S. group adopted the Canadian methodology essentially unchanged. Subsequently, the Canadian and U.S. task forces worked in close collaboration over many years, each group borrowing freely from the work of the other to avoid unnecessary duplication of effort. As a result, the *Canadian Guide to Clinical Preventive Health Care*, published in 1994, contains a number of chapters prepared by members of the U.S. Task Force and adapted to the Canadian context. Likewise, the *U.S. Guide to Clinical Preventive Services* includes a similar number of chapters that originated with the Canadian Task Force.

Since its initial 1979 report, the Canadian Task Force has published forty-four additional reports in the *Canadian Medical Association Journal*, evaluating the preventability of conditions not considered previously and revising earlier reports in the light of new evidence. Following a hiatus from 1995 to 1997, the Canadian Task Force was reactivated in 1997 and meets regularly. All existing task force reviews have been converted to structured abstract format and posted to the Canadian Medical Association's Clinical Practice Guideline online database (<http://www.cma.ca/cpgs/>). The task force officially launched its worldwide web site in March 1999 (<http://www.ctfphc.org>). This web site averaged 3,835 hits per day in 1999. The feasibility of providing consumers versions of task force materials via this web site was being explored. In 1999 the name of the task force was officially changed to Canadian Task Force on Preventive Health Care. The Canadian Task Force

continues to maintain a close working liaison with the U.S. Preventive Services Task Force.

RICHARD B. GOLDBLOOM

(SEE ALSO *Prevention; Preventive Health Behavior*)

WEB SITES OF INTEREST

Information on the Canadian Task Force on Preventive Health Care is available at <http://www.ctfphc.org>.

CANCER

Cancer is the end product of a multistep process (carcinogenesis) that occurs over many years. The term "cancer" actually refers to numerous distinct diseases characterized by abnormal cell growth and differentiation. Cancers are categorized by the organ and/or cell of origin. For example, squamous cell carcinoma of the lung arises from pulmonary epithelial tissue, whereas adenocarcinoma of the breast arises from mammary duct epithelium. The natural history of a cancer is highly dependent on the organ and cell type from which it is derived. In addition, prognosis is influenced by the stage and histologic grade of the cancer. Staging is generally designated by the TNM (tumor, nodes, metastasis) staging system, which takes into account the size of the primary tumor (T), the extent to which local lymph nodes (glands) are involved (N), and whether or not distant metastases are present (M). The histologic grade, determined by microscopic examination of the biopsy specimen, provides an objective assessment of the degree of cellular differentiation.

INCIDENCE, PREVALENCE, AND MORTALITY

The worldwide burden of cancer is a major health problem, with more than 8 million new cases and 5 million deaths per year. The burden from cancer may be described in terms of incidence (number of new cases per 100,000 each year), prevalence (number of people at a given point in time with a cancer diagnosis), and mortality (number of cancer deaths). With few exceptions, cancer incidence, prevalence, and mortality rates are higher in industrialized countries (e.g., United States, European nations) than in developing countries (e.g.,

African nations, China). Incidence rates for specific cancers can be dramatically affected by the use of screening procedures to identify asymptomatic disease. This is illustrated by the dramatic increase in the incidence of prostate cancer that accompanied the introduction of prostate-specific antigen (PSA) screening in the late 1980s. Similarly, prevalence rates may be a poor index for comparing cancers, because they are dependent upon incidence, natural history, and treatment efficacy. For example, due to the relatively short life expectancy of individuals with pulmonary neoplasms, the prevalence of lung cancer is much lower than that of prostate cancer, despite the higher mortality rates associated with lung cancer. In addition to the impact of screening and natural history, prevalence rates increase as treatment improves, because therapeutic advances enable individuals to live longer following a cancer diagnosis.

Worldwide, lung cancer is the leading cause of cancer mortality, followed by stomach cancer. Smoking remains the leading preventable cause of cancer, and mortality and incidence rates of lung cancer rise and fall with smoking rates. The current trend shows a leveling off of smoking-related cancers in developed countries, possibly because of health-promotion and disease-prevention efforts. Geographical variations occur in cancer incidence and mortality, with Africa and Asia generally having lower rates than North America and Europe. However, it has been noted that differences in data collection and diagnostic practices make worldwide cancer comparisons somewhat difficult. Overall, worldwide incidence rates of breast, colon and rectum, and prostate cancers are highest in developed countries, while cancers of the cervix, mouth and pharynx, esophagus, and liver are higher in developing countries. Migration studies generally report that migrants from developing countries to developed countries adopt cancer incidence rates equivalent to those of their new country. For example, studies of Japanese and Chinese immigrants living in the United States show that their risks for prostate and breast cancers increase dramatically the longer they reside in the United States. Similar trends for increased risk are seen among African immigrants in European countries. Geographical variations in cancer incidence and mortality also exist in the United States. Each cancer site shows some variation, such as

higher prostate cancer mortality rates in the South Central and southern Atlantic states, and higher breast cancer mortality rates in the northeastern states. The *Atlas of United States Mortality*, published by the Centers for Disease Control and Prevention, provides detailed geographic information on cancer mortality rates in the United States, and is available online at <http://www.cdc.gov/nchs/data/atlasmet.pdf>.

In the United States, cancer is the second leading cause of death; although there has been a slight decline in the number of people dying from cancer since 1990, with more than one-half of those who develop cancer being cured or surviving for over five years. Because cancer is many diseases, some cancers are more common and/or more curable than others. For example, although nonmelanoma skin cancer, mainly caused by overexposure to ultraviolet (UV) radiation from the sun, is responsible for the largest number of new cancer cases each year, mortality rates associated with it are low.

Incidence, prevalence, and mortality in the United States vary by cancer site, between whites and blacks, and between men and women. By order of incidence, the three most common cancers in men are prostate, lung, and colorectal; in women the three most common cancers are breast, lung, and colorectal. These cancer sites represent more than one-half of both new cases of cancer and deaths from cancer each year. Lung cancer is the leading cause of death from cancer for men and women, accounting for almost one-third of cancer deaths.

Although cancer risk increases with age, malignant diseases are an important cause of morbidity and mortality in the pediatric population. The most frequent cancers in children are leukemias, tumors of the nervous systems, lymphomas, soft-tissue sarcomas, and kidney tumors. Other than lung cancer, which increases dramatically after age forty, three out of every four deaths from cancer occur in individuals older than sixty years of age.

CAUSES OF CANCER

Environmental and lifestyle factors such as tobacco use, diet, alcohol consumption, and exposure to sunlight play a primary role in the development of the majority of cancers. In addition,

exposure to occupational factors and to specific pathogens (e.g., viruses, bacteria), hormones, and radiation also contributes to cancer at particular sites. However, the question still remains as to why one person exposed to a given environmental or lifestyle risk factor develops cancer and another person does not. The importance of hereditary factors (gene-environment interactions) cannot be overemphasized in this regard. True “hereditary cancers,” those attributable to specific genes that are passed from one generation to another, account for only a small proportion of cancer cases, however.

Exposure to carcinogens in tobacco smoke accounts for almost one-third of cancer cases, especially cancers of the lung, respiratory tract, esophagus, bladder, pancreas, and, most likely, cancers of the stomach, liver, and kidneys. Carcinogens found in the environment and the workplace (e.g., asbestos, benzene, vinyl chloride compounds, dyes, arsenic, petroleum products) and cancers associated with exposure to these chemicals (e.g., lung and bladder) are higher in urban areas than in rural areas. Diet also influences the risk of cancer, although researchers are unsure of the mechanisms involved. In general, evidence supports an increased risk of various cancers (e.g., colon, rectum) with a high intake of red meats, and a decreased risk of various cancers (e.g., lung, colon, stomach) with a high intake of vegetables and fruits. Other food constituents, such as vitamins and minerals, are also being investigated for their ability to prevent cancer.

Other possible causes of cancer include pathogens, such as hepatitis B and C viruses in liver cancer, and the *Helicobacter pylori* bacterium in stomach cancer. Hormonal factors contributing to cancer have focused on estrogen, progesterone, and testosterone, and their role in reproductive organ cancers. These steroid hormones are being investigated because they influence the growth of cells, particularly those of the prostate, ovary and cervix, and breast. Radiation exposure, especially UV radiation from the sun, is a significant contributor to cancer of the skin, and using sunscreens has been shown to reduce skin cancer risk.

Interactions between genes and environmental exposures are of great importance in determining one’s risk of developing cancer. For instance,

genes and nutrients can interact to increase or decrease the risk of cancer depending on genetic variations known as polymorphisms—different forms of the same gene that may either increase or decrease the risk of cancer. For example, different polymorphisms in the gene that determines how vitamin D is metabolized can influence the risk of prostate cancer; one polymorphism is associated with increased risk of prostate cancer and another is associated with decreased risk. Polymorphisms in the genes that are responsible for repairing radiation damage to skin cells also play a role in increasing or decreasing cancer risk.

CANCER PREVENTION AND TREATMENT

Many cancer risk factors are avoidable. Preventing cancer by attention to diet and by quitting or never starting smoking are the most significant strategies to reduce cancer risk. Prevention of cancer is being investigated in clinical trials on dietary patterns (high intake of vegetables and fruits; low intake of saturated fats) and dietary constituents such as vitamins, minerals, and soy. Future progress may depend partly on strategies such as chemoprevention—the use of natural or synthetic substances to prevent cancer cells from forming, progressing, or recurring. For example, the anti-estrogen hormone tamoxifen has been shown to reduce the risk of developing breast cancer by 50 percent among women at high risk for this disease. It also has been shown to reduce the risk of developing a new primary breast cancer in the opposite breast among women with a history of breast cancer. Chemopreventive agents also are being investigated for prevention of colon, rectum, prostate, and lung cancers.

SCREENING AND EARLY DETECTION

Mammography has been shown to reduce breast cancer mortality among women over the age of fifty, and Pap smear screening has dramatically reduced mortality from cervical cancer. In addition, there is growing evidence that fecal occult blood testing and endoscopic screening significantly reduce mortality from colorectal cancer. Identification of mutations is becoming an important tool for identifying individuals at high risk of various cancers. For instance, DNA repair-gene

mutations (e.g., MSH2, PMS1) have been associated with a higher risk of colon cancer, as have mutations in the tumor suppressor genes BRCA1 and BRCA2 in breast cancer. Although it is believed that inherited risk for cancer accounts for a small proportion of total cancer cases each year, identifying this risk may help researchers determine how cancer develops and progresses, and may provide a tool for targeting prevention or treatment strategies.

Prognosis is dependent on the type of cancer diagnosed, the stage of the disease at the time of diagnosis, and the effectiveness of currently available therapy. Surgery, radiation, chemotherapy, hormonal therapy, and immunologic therapy form the basis of modern cancer treatment. Surgery is generally the treatment of choice for localized tumors, although radiation often is an appropriate alternative. Lasers are being used for small noninvasive tumors of the skin, cervix, and throat. Radiation therapy is often recommended as primary therapy (e.g., for Hodgkin's disease and early stage tumors of the head and neck), and is an important adjunct to lumpectomy for the treatment of breast cancer. Radiation therapy also plays an important role in the symptomatic management of patients with advanced cancer (e.g., bone or brain metastases). In contrast to surgery and radiation, chemotherapy is a systemic, rather than local, therapy, because the drugs are distributed throughout the body. Chemotherapy generally is required to treat advanced cancers that are not amenable to surgical removal or radiation therapy. Chemotherapy is often used after surgery (adjuvant therapy) to reduce the risk of relapse. The most common indication for adjuvant chemotherapy is following surgery for localized breast or colorectal cancer.

Hormone therapy represents a very important category of cancer treatment for breast cancer (tamoxifen and raloxifene) and prostate (androgen blockers) cancer. In addition, immunotherapy (also called biologic therapy) is being used to boost the immune system to fight cancer cells. Monoclonal antibodies are one type of immunotherapy that can be used to fight specific cancer cells or to carry chemotherapeutic agents to a tumor. Interferon is another immunotherapy that has shown promise in slowing the growth of tumors. Each of these treatments has advantages and disadvantages, and should be discussed with a physician.

CANCER IN DEVELOPING COUNTRIES

Cancer trends are of great concern to the public health community. As developing countries become more industrialized, incidence and mortality rates for cancers of the breast, colon, rectum, and prostate begin to rise. Also, smoking is increasing worldwide—along with lung cancer incidence and mortality rates. Liver cancer shows the same trends as lung cancer, but for a different reason. Infection with the hepatitis B or C viruses is a major risk factor for liver cancer. In some countries, where a vaccine for hepatitis B is widely used to vaccinate infants, liver cancer incidence in later life has declined; however, incidence rates in developing countries, where vaccination is not widely available, appear to be increasing. Another virus, the human papillomavirus (HPV), is an important risk factor for cervical cancer. Cervical cancer and HPV are more common in equatorial countries (e.g., in Latin America, sub-Saharan Africa, and Southeast Asia) and less common in countries in northern latitudes. Screening and treatment for early stages of cervical cancer have made significant inroads for reducing the incidence and mortality of this disease.

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(SEE ALSO: *Breast Cancer; Carcinogen; Cervical Cancer; Colorectal Cancer; Environmental Determinants of Health; Environmental Tobacco Smoke; Genetics and Health; Geography of Disease; Geriatrics; Incidence and Prevalence; Lung Cancer; Melanoma; Mortality Rates; Nutrition; Occupational Safety and Health; Oral Cancer; Ovarian Cancer; Prevention; Preventive Health Behavior; Prostate Cancer; Screening; Skin Cancer*)

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CANCER REGISTRIES

See Registries

CANDIDIASIS

Candidiasis (thrush, monilia infection) is caused by a fungus that most commonly infects the mouth (usually of infants or persons with weakened immune systems), or the vagina (yeast infection). Another form of candidiasis causes painful inflammation under the fingernails (paronychia). It also occurs as an opportunistic infection in the late stages of HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome), as a nosocomial infection after catheterization; and it

can invade the spinal canal and meninges, where it is obviously much more serious.

Candidiasis is transmitted by close contact of an infected with an uninfected mucous membrane. Infants acquire it as they pass through the birth canal. Topical application of antifungal paint or ointment can usually eliminate the infection and thus prevent transmission. Management is more difficult in debilitated and immunocompromised patients, in whom the condition can be very stubborn.

JOHN M. LAST

(SEE ALSO: *Fungal Infections; Fungicides*)

CARBON DIOXIDE

See Pollution

CARBON MONOXIDE

Carbon monoxide (CO) is a clear, colorless, odorless, and insidious poison that is responsible for hundreds of inadvertent and preventable deaths in the United States each year. The major environmental source of CO is incomplete combustion of carbonaceous fossil fuels. The reason for its toxicity is that it combines with the oxygen-carrying site of hemoglobin, the red protein within red blood cells that is responsible for delivering oxygen from the lung to body tissues. CO has a more than two-hundredfold greater affinity for this oxygen-carrying site than does oxygen. This means that, at sea level, exposure to 1,000 parts per million (ppm) CO in 20 percent oxygen (200,000 ppm) would lead, at equilibrium, to about 50 percent of hemoglobin sites being combined with CO rather than oxygen. Fortunately, it requires eight to twelve hours for maximum blood levels to be achieved when the body encounters a new CO concentration, otherwise mainstream cigarette smoke, which contains even higher levels of CO, might be instantaneously lethal. When CO combines with hemoglobin, the resulting chemical is called carboxy hemoglobin (COHb).

The negative effect of CO on the delivery of oxygen to the tissues extends beyond just the simple blockage of oxygen-combining sites. Each

hemoglobin molecule contains four oxygen-carrying sites. Once the first oxygen molecule is released at the tissue level the second, third, and fourth come off even more rapidly. Oxygen release is delayed by CO so that there is even less oxygen delivered than would be expected purely on the basis of the amount of oxygen not being carried by hemoglobin. For this reason, overt symptoms due to lack of oxygen can be observed at COHb levels of approximately 15 to 20 percent, or even less, in healthy people. Levels of COHb over 40 percent can be lethal.

The uptake of CO increases as respiratory rates increase. This puts children at greater risk since they breathe more rapidly, in proportion to their body weight, than adults. This explains the unfortunate situation of a family in an automobile stuck in a snowstorm with the motor running being found with the adults unconscious and the children dead. The fetus is also at higher risk due to the greater affinity of CO for fetal, as compared to adult, hemoglobin.

All cases of fatal CO poisoning are readily preventable. In addition to automobile exhaust, other lethal sources of CO are often related to home heating systems. Blockage of flues, or inappropriate repair work on the home heating source or on ducts, is often responsible for CO toxicity. Symptoms of CO toxicity, such as headache, weakness, and listlessness, tend to be worse in the morning and to go away during the day if people leave the home. Many fatal cases are preceded by visits to physicians or emergency departments with only symptomatic treatment. Home CO alarms are relatively cheap and are an effective means of prevention. CO poisoning occurs more rapidly at high altitude due to the relative lack of oxygen to compete for the oxygen-combining site of hemoglobin. Conversely, symptomatic CO poisoning is treated with oxygen.

CO is also made in the human body through the normal catabolism of heme (oxygen-carrying hemoglobin), which leads to a background concentration in the blood of approximately 0.5 percent COHb. Concentrations of 2 to 3 percent COHb have been associated with an increased risk of angina attacks in susceptible individuals with preexisting arteriosclerotic heart disease. Preventing this adverse consequence is the major basis for

the current U.S. ambient standard for CO. There has been a significant decline in outdoor CO levels in the United States as a result of decreased automotive emissions of carbon monoxide.

BERNARD D. GOLDSTEIN

(SEE ALSO: *Ambient Air Quality [Air Pollution]*)

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CARCINOGEN

A carcinogen is an agent that can cause cancer. Carcinogens can be chemicals, viruses, hormone, ionizing radiation, or solid materials. Carcinogens produce cancer by changing the information that cells receive from their DNA, causing immature cells to accumulate in the body rather than differentiate into normal functional cells. Carcinogens may be *genotoxic*, meaning that they interact physically with DNA to damage or change its structure. Ionizing radiation is a genotoxic carcinogen. Other carcinogens may change how DNA expresses its information without changing its structure directly, or may create a situation in a cell or tissue that makes it more susceptible to DNA damage from other sources. These are known as *nongenotoxic* carcinogens, or *promoters*. Arsenic and estrogen are nongenotoxic carcinogens. Still other carcinogens, such as nickel, may interfere with cell division, changing the number or structure of chromosomes in new cells after a cell divides.

Several changes in a cell's DNA are usually needed to transform a normal cell into a cancer cell. Such changes can accumulate over time, and can sometimes be repaired. Cells can also die before enough changes occur to turn them cancerous. The places that become altered in the DNA of

cancer cells are called *oncogenes* and *tumor suppressor genes*. Oncogenes and tumor suppressor genes are particular locations on DNA that control a cell's ability to perform its biological functions and to control its growth.

Susceptibility to the action of carcinogens is very complex and is affected by genetic heritage, behavior, physiology, nutrition, external exposures, and other factors. For example, some chemicals are carcinogenic in their original form (direct carcinogens), while some must be metabolized in the body to their active form (indirect carcinogens). In such cases, individual susceptibility to a chemical carcinogen is affected by the rate at which the chemical metabolizes in the body into a cancer-causing form or into a harmless form. This rate varies from person to person.

Some carcinogens have been identified from studies of people exposed to various substances over time. These include cancer in cigarette smokers and leukemia in people breathing benzene in the workplace. Carcinogens have also been identified using laboratory animals exposed over time, usually to high doses. Saccharin was found to be a carcinogen through experiments to produce bladder cancer in rats, and aflatoxin was found to produce liver cancer in rats. Some substances that are carcinogens in laboratory animals, like saccharin, are not carcinogens in people because of differences in how they are metabolized or differences in how they produce cancer. The International Agency for Research on Cancer (part of the World Health Organization) and the U.S. National Toxicology Program publish documents listing chemicals and other exposures that they believe are known to be carcinogenic to humans and those that are suspected or likely to be carcinogens to humans.

GAIL CHARNLEY

(SEE ALSO: *Ames Test; Cancer; Carcinogen Assessment Groups; Carcinogenesis; Toxicology*)

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CARCINOGEN ASSESSMENT GROUPS

Of the perhaps 70,000 chemicals in commerce, only a few dozen are known to cause cancer in humans. Many others are strongly suspected, but unproven, of being capable of causing human cancer. Public concern about cancer has led national and international scientific groups to be chartered to evaluate the cancer-causing potential of chemical and physical agents. These groups include the International Agency for Research on Cancer of the World Health Organization, and the U.S. National Toxicology Program, which is administered by the National Institute of Environmental Health Sciences.

Although differing in details, these scientific bodies use what is known as a “weight of evidence” approach to identify those agents that have the specific capability of causing cancer. In this approach, scientific groups review the evidence and then assign each chemical or physical agent to a category that roughly corresponds to possible, probable, or known human carcinogens, or negative or no evidence of human cancer-causing capabilities. Certain carcinogen assessment groups, such as that of the U.S. Environmental Protection Agency, go beyond the hazard identification step to also evaluate the potency of the chemical in causing cancer. This permits a numerical prediction of the risk of cancer from a specific level of exposure.

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(SEE ALSO: *Carcinogen*; *Carcinogenesis*; *Environmental Protection Agency*; *National Institute for Environmental Health Sciences*; *Risk Assessment*, *Risk Management*; *World Health Organization*)

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CARCINOGENESIS

Although there are many different forms of cancer, the basic multistage process by which various tumors develop is similar for all cancers. This process is called carcinogenesis. Carcinogenesis begins when carcinogens (cancer-causing substances) damage the DNA in a cell (e.g., a genetic mutation) and/or cause changes in other cell components or cell activities that can predispose them to cancer. These altered cells look normal, but they grow faster than the surrounding normal cells—a stage called hyperplasia. In time (often years), another mutation occurs: the mutated cells grow excessively and appear abnormal in shape and orientation. This stage is called dysplasia, and the cells are called premalignant lesions. After more time, a third mutation occurs. The cells now become more abnormal in rate of growth and appearance, and a tumor develops. If the tumor does not break through the boundaries between tissues, it is “in situ” cancer. In situ tumors can develop further mutations, break through tissue boundaries, and invade surrounding tissues; at this stage, they become malignant tumors that can send cells throughout the body to establish new tumors (metastasis). During the development of a malignant tumor, DNA damage occurs as an accumulation of mutations in as many as six or more genes.

Two types of genes, proto-oncogenes and tumor suppressor genes, play important roles in tumor development. A proto-oncogene codes for proteins that stimulate cell division. When a mutation occurs in a proto-oncogene, it can become a carcinogenic oncogene that causes these proteins to be overactive, resulting in the formation of large numbers of cells. In contrast, tumor suppressor genes code for proteins that inhibit cell division. When a mutation occurs in a tumor suppressor gene, the inhibitory proteins may not function properly, and inappropriate growth of cells remains unchecked. Mutated forms of other genes, such as those that help regulate the invasion of surrounding tissues and metastasis, also may contribute to tumor development. Some people inherit certain cancer-related gene mutations, and these people may be at risk for early development of cancer.

Carcinogenesis can be initiated by chemical agents (e.g., tobacco smoke, pesticides, certain

metals); physical agents (e.g., ionizing radiation, ultraviolet [UV] radiation, mineral fibers such as asbestos); and viruses (e.g., Epstein-Barr virus, hepatitis B and C viruses, human papillomavirus). In addition to cancer-causing agents from the environment, highly reactive oxygen-containing molecules that can damage DNA are formed continuously in the body (e.g., endogenously) as a result of biochemical reactions. Other endogenous mutagenic mechanisms also exist. The relative importance of environmental agents versus endogenous molecules in causing the genetic mutations that contribute to carcinogenesis is a matter of debate.

Once inside the body, most chemical carcinogens are metabolized; that is, they are transformed in some way by the body's physical and chemical processes. Chemical carcinogens can be converted into highly reactive compounds that can damage DNA and other cell components, or they can be detoxified and thus prevented from doing cellular damage. The metabolic fate of chemical carcinogens is linked to the activities of particular enzymes—protein molecules in the body that help chemical reactions occur but are not themselves changed in the reactions. The activities of these enzymes can differ among individuals because of the occurrence of genetic polymorphisms (different forms of the genes that code for the enzymes) and the differing activities can either increase or decrease a person's susceptibility to environmental carcinogens. For instance, a higher risk of lung cancer is associated with certain polymorphic forms of the gene CYP1A1, which codes for an enzyme that acts on chemical carcinogens in tobacco smoke. Thus, even though genetic factors (e.g., polymorphisms, inherited mutations) and environmental factors (e.g., carcinogens, radiation, viruses) can make independent contributions to carcinogenesis, these factors also can interact to influence cancer development. A clear example of a gene-environment interaction is observed in people who have inherited a defective copy of the gene that directs the repair of DNA damaged by UV radiation; these people are more susceptible to sunlight-initiated skin cancers than people without the defective gene.

Hundreds of diverse chemicals have been tested to determine whether they are carcinogens,

including air pollutants (e.g., gasoline vapors, carbon tetrachloride), water pollutants (e.g., chlorination byproducts), industrial materials (e.g., asbestos, polychlorinated biphenyls), pesticides (e.g., malathion, lindane), herbicides (e.g., chlorophenoxy compounds), pharmaceuticals (e.g., adriamycin, chloramphenicol), food additives (e.g., butylated hydroxytoluene [BHT], food coloring agents), and naturally occurring compounds in foods (e.g., aflatoxins, saffrole). Data for approximately 1,300 compounds tested in animal experiments can be found in the Carcinogenic Potency Database (<http://potency.berkeley.edu/app14.html>). It is difficult, however, to predict human cancer risk resulting from low-dose exposures based on information from animal experiments that use extremely high doses of chemicals; thus, the value of animal experiments for assessing human risk is still being debated.

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(SEE ALSO: *Behavioral Determinants; Cancer; Carcinogen; Environmental Determinants of Health; Genes; Genetics and Health; Medical Genetics*)

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CARDIOVASCULAR DISEASES

Cardiovascular disease is a general diagnostic category consisting of several separate diseases of the heart and circulatory system. Cardiovascular diseases have been the major health problem and the leading cause of death in the United States for several decades. Despite impressive and sustained declines in the mortality rates from these diseases, the magnitude of the problem is still staggering. In 1997 alone, nearly 1 million people died of cardiovascular disease, which was about 40 percent of all deaths. The two most important components are

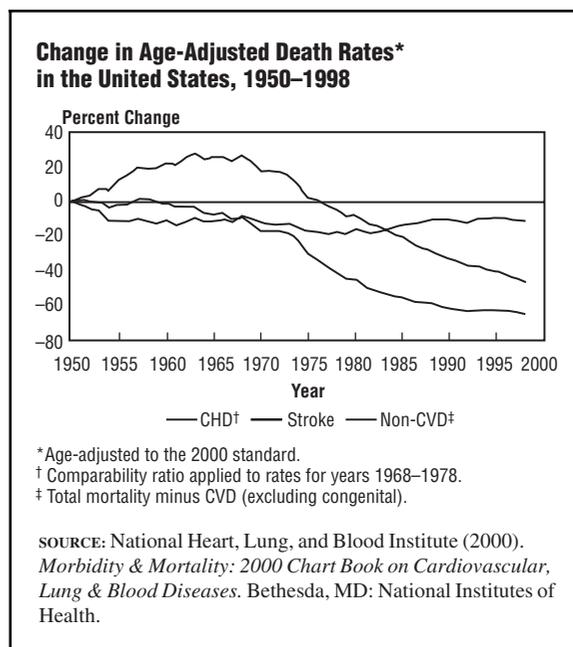
coronary heart disease and cerebrovascular disease, with 460,390 dying of coronary heart disease and 158,060 dying of cerebrovascular disease in 1998. In 2000, it was estimated that cardiovascular diseases carried a direct health expenditure cost of \$186 billion and additional indirect costs of \$190 billion, making these diseases a continuing major contributor to the escalating cost of health care in the United States.

These diseases have not always been the major health problem of the United States. In 1900 the five leading causes of death were: (1) pneumonia and influenza; (2) tuberculosis; (3) diarrhea, enteritis, and ulceration of the intestines; (4) diseases of the heart; and (5) intracranial lesions of vascular origin. These categories all had rates greater than 100 per 100,000 population. By 1940, only two disease categories still had rates greater than 100 per 100,000: diseases of the heart and cancer and other malignant tumors. The infectious diseases had been substantially reduced, but the “epidemic” of cardiovascular disease, especially coronary heart disease had begun. By 1963, the mortality rate from coronary heart disease reached its peak, and there has been a progressive and steady decline since then (see Figure 1). Despite the continued magnitude of the coronary heart disease problem, the focus recently has been on this dramatic reversal. Not only is the percentage of decline large (56% from 1963 to 1998), but this has greatly impacted the total number of deaths in the United States, leading to an increase in life expectancy. To illustrate the impact of this change, it is estimated that if the rate of coronary heart disease mortality had not changed from its peak in 1963, in the year 1998 an additional 684,000 Americans would have died from this cause.

**RISK FACTORS IN
CARDIOVASCULAR DISEASE**

From several studies around the world, several risk factors for cardiovascular disease have been identified. These risk factors can be grouped into two broad categories: unmodifiable factors (such as male gender, and family history of premature heart diseases) and potentially modifiable factors (such as cigarette smoking, high blood pressure, high blood-cholesterol level, physical inactivity,

Figure 1



diabetes, and obesity). These factors can be used to identify those in the population who are at especially high risk of developing cardiovascular disease.

Cigarette Smoking. Cigarette smoking has been established as a risk factor not only for lung cancer, emphysema, and bronchitis but also for coronary, cerebral, and peripheral vascular disease. This association has been seen in many countries, among widely diverse ethnic groups, in both sexes, and across various adult age groups. In addition, the risk increases with heavier cigarette use and the longer one has smoked. Equally important has been the observation that this increased risk falls rapidly over time when people quit smoking. For coronary heart disease, approximately 40 percent of the increased risk is removed within five years of quitting, although it takes several more years of nonsmoking to achieve the level associated with someone who has never smoked.

High Blood Pressure. High blood pressure is a powerful risk factor for cerebrovascular disease as well as for coronary heart disease. An estimated 50 million people have high blood pressure, defined as a level equal to or greater than 140 mmHg systolic pressure or 90 mmHg diastolic pressure,

or as being on a regimen of antihypertensive medication. An important result of epidemiologic studies has been the observation that the relationship between blood pressure and cardiovascular risk is not only a positive one (higher blood pressure results in higher disease rates) but also a smooth one (there was no sharp breakpoint in the curve such that below a certain blood pressure level the risk remained constant or became nonexistent). Thus, the lower the blood pressure, within reasonable physiologic limits, the lower the level of risk. These observations prompted several important intervention trials, which have now clearly established the value of aggressively treating elevated blood pressure.

Blood Cholesterol Levels. A clear and positive relationship between blood cholesterol levels and subsequent coronary heart disease has repeatedly been demonstrated. Recent information has refined the nature of this association but not weakened it. Cholesterol in the plasma is transported by lipoproteins. The cholesterol level associated with the low-density lipoprotein (LDL) fraction is positively correlated with coronary heart disease, whereas the cholesterol associated with the high-density lipoprotein (HDL) is negatively correlated (the higher the level, the lower the risk). These observations have been verified in several different populations and have been shown to be independent of each other, as well as of other known risk factors. The evidence regarding HDL, although more recent than that for LDL, supports a powerful and independent role for HDL in lowering coronary heart disease risk and probably explains a significant portion of the difference in risk between men and women, with women having higher average levels of HDL than men.

Physical Inactivity. An association between a less active lifestyle and increased risk of coronary heart disease has been shown in multiple longitudinal and cross-sectional studies in such diverse groups as London transit workers, United States longshoremen, and United States college graduates. Traditionally, this risk factor was considered less important and less powerful than the three already mentioned. However, recent reviews of the total body of scientific evidence have led to the classification of this risk factor as one of the four major modifiable risk factors for coronary heart disease. Consequently, there are more consistent

recommendations for an active lifestyle and recognition of its importance not only to health but also to disease prevention.

Obesity. Initial epidemiologic data identified obesity as an important risk factor for coronary heart disease. Subsequent analyses, however, suggested that obesity was not a primary risk factor, but rather acted indirectly through elevation of blood pressure and cholesterol levels. More recent analyses of the data from the Framingham Heart Study, with longer follow-up of people in the cohort, have once again suggested that obesity is indeed a primary risk factor that acts independently of those other factors. Clinically, the resolution of this issue of primary versus secondary causation is somewhat irrelevant. Weight reduction should lower the risk of coronary heart disease, whether it acts through a lowered blood pressure and/or cholesterol level or as a lowered risk factor itself.

Diabetes. Diabetes is a powerful and independent risk factor for cardiovascular disease, which remains the major cause of death in diabetic persons. An important remaining issue is whether and elevated blood-glucose level is responsible for the observed higher rate of cardiovascular disease and, if it is, whether lowering or, preferably, normalizing the glucose level will lower the risk. Regardless of the answers, for the present the important observation is that diabetic individuals are at higher risk of cardiovascular disease, and thus careful attention should be paid not just to the blood-glucose level and its control but also to the other risk factors that may coexist in a given patient and additionally elevate the risk.

Other risk factors for cardiovascular disease, such as homocysteine and Lp(a), have been identified in single or multiple studies, but further information is needed to establish them as independent, important prognostic factors.

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(SEE ALSO: *Atherosclerosis; Blood Lipids; Blood Pressure; Coronary Artery Disease; Diabetes Mellitus; Fats; Foods and Diets; HDL Cholesterol; LDL Cholesterol; Lifestyle; Lipoproteins; Physical Activity; Smoking Behavior; Smoking Cessation; Tobacco Control*)

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CAREERS IN PUBLIC HEALTH

As a field of employment, public health offers a wide range of opportunities, requiring all levels of skills, and both technological and interpersonal expertise. Public health practice is distinguished within the general field of health practice by the regular interprofessional collaborations required for success. There are few (if any) tasks that need to be done in public health that are done by only one profession, and there are many challenges that benefit from the thinking of people trained with different world views. Public health is practiced in settings that range from the most sophisticated of laboratories in large urban centers to plain meeting rooms in small hamlets. As an additional challenge, any one public health worker may move from office to field investigation to legislative hearing in the course of a week's work. Individuals originally employed for a specific technical skill, such as the ability to perform a new laboratory test or explain a new vaccine, may, over the course of five or ten years, move into a completely different part of public health, drawn by shifts in community need, opportunity for advancement, or desire to continue learning.

Public health encompasses many familiar professions: medicine, nursing, social work, dentistry, pharmacy. But there are some roles that are less

familiar: health educator, sanitarian, environmental engineer, disease investigator. Some people in these fields have chosen public health practice as a career at the outset, and obtained training in public health or a public health-related area as a part of their professional education. For others, public health represents a midcareer shift, perhaps associated with a desire to focus not on the treatment of disease but on its prevention. Many public health careers are at the technical level: laboratory technicians, radiation safety technicians; technical support staff in vital records and health statistics, or in communicable disease clinics and community outreach programs.

CORE PREPARATION

Preparation for work in public health can be obtained in a number of ways, and some specifics are discussed below. There is a core of material—a mix of knowledge, skills, and attitudes—that underlies all public health practice and ties together the multiple jobs that make up public health. First among these is an appreciation for the worldview of public health—the values and perspectives that shape how those practicing public health look at experiences and people. Practitioners of public health share an interest in populations and groups, in addition to individuals. That is, while they work with individual people on a regular basis, such people are seen as representatives of families, neighborhoods, or other clusters, sharing common risk factors, exposed to common threats to health, and with a shared potential for health promotion.

The public health worker has a strong bias toward prevention, rather than response after an illness or injury has occurred. One of the best examples of this is the implementation of immunization programs. Even in parts of the world where other public health and medical services are lacking, campaigns to immunize children against measles and polio are successful. The number of cases of vaccine-preventable diseases has dramatically decreased, and new vaccines are being developed to combat other conditions not now preventable. The prevention focus also includes secondary prevention; that is, the early diagnosis of disease so that treatment is prompt and complications are avoided. The development of screening programs for breast and cervical cancer, linked to referral

and follow-up, are among recent advances in this aspect of public health. Health education for the community, enabling individuals to make their own decisions about preventive choices, has also flourished in recent decades.

Public health workers are also distinguished by their attention to systemic solutions rather than a series of individual ones. For example, to control waterborne diseases, the assurance that wells and public water systems are safely built and protected from contamination has been an important part of public health effort. Where this protection is lacking, individual households must arrange for treatment, or boil water before use. At the community level, public health workers have concentrated not only on providing individual health education, but on building health education into the school curriculum at all grade levels.

Finally, from an ethical viewpoint, people working in public health share a strong commitment to social justice and equity, balanced with an appreciation of the role of individual autonomy and decision making. It is possible to become passionate about public health from a perspective of enlightened self-interest (making the world safer so that I am safer). However, it is more likely that those who are drawn to careers in public health have an interest in assuring that all people in the community have equitable access to all kinds of health-related services. There is a role for overruling individuals when their actions put others at risk, such as the person with infectious tuberculosis who refuses to take medication or the restaurant owner who does not maintain cooking and storage facilities at proper temperatures. The enforcement is carried out, however, with attention to due process and using the least restrictive approach necessary.

RANGE OF INTERESTS

Although there is a core of interests, as described above, public health encompasses many specific program areas, and it is possible to develop a rewarding career within any one of them. The following discussion does not represent an exhaustive list of all public health programs, but does provide a sense of the range.

At the heart of most public health programs are the people responsible for vital and health

statistics and a continuing epidemiology program. These people, with skills in statistics, taxonomy, nosology, epidemiology, and research, continually accrue new information about communities and populations, analyze it, and provide it back to others in a form that makes it useful. The findings of these efforts provide the basis for other public health actions, as they identify newly emerging problems; shifts in the age, gender, or ethnicity of the population; or new experiences with historically important conditions. In addition, those in the vital records area provide a public service in the documentation of important life events (e.g., birth, death, marriage, divorce) and provide both summary information to policy makers and individual documents for the persons involved.

Control of infectious diseases has been important in public health since its inception. Common programs include those focused on tuberculosis, syphilis, gonorrhea, chlamydia, HIV (human immunodeficiency virus), and hepatitis. In the United States, each state has a long list of reportable diseases that are regularly monitored, with individual cases identified and often linked to treatment. States pool data on diseases of national interest and nations share similar information through the World Health Organization. In addition, those persons who might have spread the disease, and those who might have been infected, are identified. With tact, but a great deal of determination, these persons are located and linked to diagnostic and (if needed) treatment services. Making regular updates in the listing of reportable diseases and maintaining the relationships needed to assure comprehensive reporting from laboratories or clinicians are part of this effort.

Newer disease-control efforts have focused on environmental causes of various conditions and chronic diseases. Conditions that might be monitored, or be the subject of screening or risk-reduction programs, include lead poisoning, cancer, diabetes, obesity, heart disease, and occupational diseases. The epidemiology, care finding, and follow-up are similar to the infectious disease programs, but the laboratory backup needed is quite different, and the reduction of disease in the community often comes at a much slower pace. A broad-based community effort to reduce the disease risk associated with tobacco use, for example, began in the 1960s; and while deaths from lung cancer are declining, they remain high.

Maternal and child health is another major focus of public health. The range of programs in this area includes screening of newborns for conditions such as phenylketonuria, providing a full range of reproductive health services to men and women, prenatal and postnatal care, and programs to promote healthy growth and development. The support of good nutrition, particularly in pregnant women, nursing mothers, and very young children, has been a significant part of this effort. Injury prevention and violence prevention are among the newer components of comprehensive child health programs. School health education and comprehensive school health services, including on-site clinics, have also emerged as important components. In areas with limited medical care systems, this portion of the public health mission may expand dramatically, because failure to assure a healthy beginning to life has such severe negative effects later in life. Clinicians (pediatricians, midwives, obstetricians, pediatric nurses, dentists, nutritionists, and social workers, to name a few) are part of these public health program teams.

Mental health services are also a part of the public health enterprise. In some communities, treatment is primarily in community settings or inpatient facilities. The large hospitals built in the late eighteenth and early nineteenth centuries have come to symbolize some of the worst of public mental health policy. It is regrettable that the closure or downsizing of these institutions has not been accompanied by an increase in the community-based programs needed to support the chronically mentally ill on new pharmaceutical regimens. Contemporary approaches to public mental health include programs managed by those with expertise in suicide prevention, violence prevention, and substance abuse treatment and prevention. Some of these programs are managed separately, while others are integrated or coordinated with maternal and child health or chronic disease programs. The psychiatrists, psychologists, social workers, counselors, and substance abuse specialists working in these areas find that teamwork and collaboration are essential skills.

Environmental health is almost too broad a term for discussion in one paragraph. It includes programs that assure a safe supply of drinking water and food, proper disposal of human and industrial waste, and efforts to keep the air and soil

free of contamination. These programs require the input of laboratory specialists in biochemistry and radiation physics, as well as field work by engineers, hydrologists, biologists, sanitarians, and others. Many environmental programs include the inspection and licensing of businesses, including restaurants, grocery stores, lodging facilities, and manufacturing plants. Oversight of the potentially hazardous chemicals used as pesticides in agriculture or other settings is also a part of this work. The ability to communicate successfully with people for whom health is not a central concern but a cost of doing business is a special skill in these circumstances.

Occupational health is a special subset of public health that is practiced in both the public and private spheres. Assurance that a workplace is safe for all levels of personnel it is expected, and it is supported by strong legislation (though implementation is difficult). Work includes development of ever-safer approaches to tasks, education of both workers and supervisors about best practices, and inspection and enforcement of laws. While the formal occupational health agencies are the most visible part of this effort, many large employers and some worker organizations have substantial investments in occupational health. Physicians, nurses, industrial hygienists, and a variety of engineers are typically involved in this effort.

Public health also includes programs related to the delivery of personal health services. Many of these programs are designed to assure that health services of all kinds are delivered safely. These include the licensing of hospitals, clinics, home health agencies, long-term care facilities, ambulatory surgical centers, and individual health practitioners. Staffing of these programs requires a combination of nursing, medical, environmental health, pharmacy, and engineering expertise. The programs are sensitive in that reimbursement for services is tied to successfully passing inspections, and the need for services is such that closure of an inadequate facility may seem to be a worse option than allowing it to continue operating under supervision. Another portion of work is related to the financing of care for particular groups. In some communities, this includes the management of large governmental programs, such as Medicaid, with a need for fiscal and management experts as well as health professionals. It may, however, also include smaller programs to serve a

newly arrived refugee group or a small group with a particular condition that has become a matter of public health interest.

Advocacy and community development activities are both a traditional part of public health and a newer area for career development. Given the concentration of many public health problems in disenfranchised communities, the public health worker is often the one giving voice to otherwise unheard concerns. With an interest in assuring the conditions within which people can be healthy, public health has an overall mission to foster healthy people living in healthy communities—meaning an ongoing interest in how the community as a whole functions. Work with community groups such as civic clubs, voluntary health agencies, school support groups, and others is an essential part of public health. And since much of public health involves some form of governmental action, either in financing or program management, governmental advocacy is an important part of the effort.

Finally, there are many roles in public health for those with administrative skills. These include fiscal and personnel management, computer and information systems development and management, logistics and materials management, and general administration. In each of these areas, public health settings employ a full range of entry-level, technical, and professional staff. While these may be considered generic skills, their application in systems that are responsive to the community, and that must be able to respond during times of emergency or disaster, require unique skills and handling. This means that even the people employed for routine management or systems maintenance functions must understand the core concerns of public health and be a part of the overall effort.

JOB SITES AND SALARIES

Public health is practiced in all employment sectors, including government; private for-profit; private not-for-profit; and voluntary. The core of public health is the network of federal, state, and local governmental health authorities. At the federal level, the largest agency involved is the Department of Health and Human Services, with its well-known units: Agency for Healthcare Research and Quality, Centers for Disease Control and Prevention, Food and Drug Administration, Health Care

Finance Administration, Health Resources and Services Administration, Indian Health Service, National Institutes of Health, and Substance Abuse and Mental Health Services Administration. Public health workers are also found in the Environmental Protection Agency, the Occupational Safety and Health Administration (Department of Labor), the Department of Agriculture, and the National Highway Traffic Safety Administration (Department of Transportation). All branches of the uniformed services have public health functions within their health programs. This list should not be taken as exhaustive: Anywhere there is a unit that is charged with preventing disease outbreaks, reducing exposure to hazards, preventing injuries, promoting health, assuring access to health services, or responding to the health aspects of disasters, public health is being practiced.

At the state and local level, the same range of services is provided, but the exact configuration of agency scope varies. Further, state and local jurisdictions have very different policies regarding the balance between direct provision of any assigned service and contracting for its performance with some outside organization. In some areas, for example, all maternal and child health services are conducted by private, not-for-profit agencies under contract to the health agency. In other areas, the public agency does almost no advocacy or community development, leaving that to the voluntary and private sectors.

There are jobs for public health workers in the private, not-for-profit sector, often in services funded with public grants and contracts. While many of these are the direct health services portion of public health, laboratory services, computer systems, and health education programs may also be set up this way. The voluntary sector includes both large and small organizations, such as those associated with a specific disease (cancer, diabetes), or a specific population group (women's health, children's health) or a specific intervention (against drunk driving, for gun control). While much of the work in these organizations is done by volunteers, most have at least a small staff supporting the communications network and developing materials for the volunteers to use.

Because of its association with social justice and services to the disenfranchised, and its role licensing and overseeing private businesses, it is

common to think of all public health being practiced in the public or voluntary sector. However, many industries employ public health workers. They may be focused on the occupational health of the employees, or they may be part of the quality assurance function, as they are in large fast-food chains. In the for-profit health industry, they may be providing epidemiologic services or health education services parallel to those in the public sector. The pharmaceutical industry employs people with public health training in a variety of functions; one of the important issues for these workers is maintaining their collegial ties with others in the public health workforce while continuing to work in places that may come under the scrutiny and even criticism of their colleagues.

Of the various areas of health employment, public health is often listed near the lower end of the income scale. Certainly compared to some of the surgical specialties in medicine, public health is far from a way to make a fortune. Because so many public health workers are in government employment, it is difficult to make rapid changes in compensation packages when there is a shift in competition for workers. The countervailing benefit of stable employment with a good benefit package, however, appears to be of less importance in a world in which people expect to change jobs many times over a career. While it sounds a bit Pollyannaish, the compensation that appears to be most important to public health workers is the satisfaction of contribution to the community, and to the well-being of many individuals.

GETTING INTO PUBLIC HEALTH

One of the simplest entry points into public health is through one of the health professions such as medicine, nursing, or dentistry. Completion of basic preparation in any of these fields may meet minimum qualifications for entry-level positions in public health. In nursing, for example, graduates with a bachelor's degree in nursing have the basic preparation necessary to function as a public health nurse. However, specialization in public health is often necessary and may be obtained through additional study. The Master of Public Health (M.P.H.) degree or its equivalent takes an additional year or two of study, often combined with work in the field. In medicine, one

recognized credential is board certification in preventive medicine, though many pediatricians, infectious disease specialists, obstetricians, family physicians, and others add the M.P.H. to their specialty training if public health becomes their area of interest.

The M.P.H. degree may also be an added specialty for those with credentials in engineering, environmental science, biology, or chemistry. The title "sanitarian" is used to designate a group of professionals with basic scientific education who have completed supervised practice in environmental health.

The first degree earned by a public health professional may be in almost any professional or academic area. There are some who enter public health at the entry level with a technical or bachelor's degree in a laboratory science, health education, computer systems, or statistics (to name a few). These individuals may eventually find it valuable to add the M.P.H. or other graduate degree as a way of increasing depth of knowledge and meeting requirements for advancement. The M.P.H. provides a common opportunity to learn more about the core of public health, and to learn how to apply existing skill and knowledge to a public health program area.

The role of volunteers has been mentioned, but should also be identified as a career path opportunity. A number of those practicing public health as a full-time career began their involvement as a volunteer, either in a community agency or within a specific program area. An interest in public health that developed around an initial interest in stopping HIV infection, getting access to breast cancer screening, or controlling pesticide use may lead to a job in one of these areas, and eventually to the wider field of public health. Others have had their first direct exposure to public health through a classroom assignment or internship. Many public health agencies are eager to share what they do with students from all levels, and they develop opportunities for experience that may be as short as a day, or as long as a year or two. This is an excellent way for someone interested in public health to discover what public health careers are all about.

Promoting the physical and mental health of a community and preventing disease, injury, and

disability are rewarding goals. Achieving them is the focus of a career in public health, requiring not only technical skills but commitment, patience, and appreciation of the value of each individual within the context of a community. There is almost no area of interest in human health that is not represented on the public health workforce, and there are no two jobs in public health that are identical, as each is shaped by the community with which it works. Whether the beginning, middle, or culminating portion of a life's work, it is an area of opportunity.

KRISTINE GEBBIE

(SEE ALSO *Accreditation of Public Health Training Programs; Association of Schools of Public Health; Certification of Public Health Workers; Communications as a Career; Council on Education for Public Health; Epidemiologist; Finance as a Career; Health Educator; Laboratory Technician; Nongovernmental Organizations, United States; Nurse; Public Health Nursing; Research in Health Departments; Sanitarian; Social Work; Training for Public Health; Vital Statistics*)

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CARIES PREVENTION

Dental caries is a bacterial disease that begins with demineralization of the outermost dental enamel and progresses, if not halted, to loss of tooth substance and infection of the dental pulp. Demineralization begins with acid formation in dental plaque, the acid being a by-product of the metabolism of simple carbohydrates (sugars, cooked starches) by certain plaque-resident bacteria, principally the mutans streptococci. If demineralization is not checked, it leads to tissue loss and further bacterial penetration. The carious process is reversible in the early demineralization stage: Fluoride and other minerals in plaque can buffer the acid and lead to remineralization of the early lesion. Prevention of dental caries, therefore, is based on promoting an intra-oral environment in which demineralized enamel can quickly be remineralized, and where plaque pH does not remain below neutral for prolonged periods.

According to the United States Department of Agriculture, average sugar consumption in the United States rose from 122 pounds per person in 1981 to 154 pounds per person in 1997, one of the highest levels of sugar consumption in the world. Reasonable restriction of simple-carbohydrate foods (candies, sugared soft drinks, cookies) is prudent for caries-susceptible persons, despite the paucity of population-based data to demonstrate the effectiveness of such action. Dental sealants, applied

directly to teeth by a dentist or hygienist, are highly effective at preventing caries on the chewing surfaces of the teeth.

Fluoride acts in several ways to prevent caries. The principle action is thought to be that fluoride in dental plaque inhibits the initial demineralization of enamel, and then promotes remineralization of early lesions. The constant availability of fluoride in plaque to respond to acid challenges leads to the gradual establishment of a more acid-resistant enamel crystal as a result of the repeated cycles of demineralization and remineralization. Fluoride also inhibits glycolysis, the process by which cariogenic bacteria metabolize simple carbohydrates, and there is evidence that fluoride also has antibacterial action in plaque. There may be some incorporation of fluoride into the enamel crystal prior to tooth eruption, which may increase resistance to solubility in acids.

Fluoride in toothpaste is considered by many researchers to be the most effective use of fluoride in controlling caries, although today fluoride is available from a variety of sources. Brushing with a fluoride toothpaste twice each day, a social norm in American society, ensures that fluoride will be present in dental plaque when an acid challenge arises. Addition of fluoride to public water supplies at around 1.0 parts per million has particular benefits for lower socioeconomic groups who may not brush their teeth that often. Fluoride is also used effectively in school-based programs as a mouthrinse or as fluoride supplements, and dentists can apply fluoride gels or varnishes directly to the teeth of their more caries-susceptible patients. Use of fluoride in all these ways is considered to be the chief reason for the remarkable improvement in the oral health of Americans between 1980 and 1995.

BRIAN A. BURT

(SEE ALSO: *Gingivitis; Oral Health; Plaque; Primary Prevention*)

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CARPAL TUNNEL SYNDROME

See Ergonomics

CARPAL TUNNEL SYNDROME, CUMULATIVE TRAUMA

Among the most common problems currently seen in the workplace are those injuries due to cumulative trauma from repetitive motion. Repetitive activities are found in many occupational settings, including traditional manufacturing. Examples include work on an automobile assembly line or in food processing plants, such as a chicken processing facility. Repetitive activities are also found in the office environment, where repetitive trauma results from the prolonged use of keyboards. Repetitive trauma and carpal tunnel syndrome can also be seen in nonemployment situations due to underlying disease processes such as diabetes, or to repetitive activities such as knitting and sewing.

Cumulative trauma problems tend to effect joint surfaces or the neurological system. Joint surfaces may be worn to the point of causing pain.

Carpal tunnel syndrome, a common problem, arises because the nerve, artery, and vein supplying the hand all travel through a narrow space in the wrist (the carpal tunnel), which can become irritated and swollen from regular and repetitive use. The most likely structure to be affected is the nerve, and pain is the most common presenting symptom. Other joints which may be affected from cumulative trauma are the elbow, shoulder, knee, and ankle. Repetitive activities or professional athletics are frequent causes.

There are several ways that cumulative trauma problems can be managed. Ideally, the repetitive activities causing the difficulty should be altered. This can be done in workplace settings, such as on an automobile assembly line, where workers can shift specific job activities every few hours and rest certain body parts while using others. For other settings or tasks that do not allow for such rotation, such as keyboarding, workers should be given regular rest breaks from these activities. When there is no possibility of altering the specific nature of the job there are supportive items that can be used. The use of splints, wrist rests, or other devices to optimize the positioning of the hand, and the adjustment of furniture height, may help in preventing and ameliorating carpal tunnel syndrome. Medication is sometimes used, as well, with variable results.

Should the problem persist, or worsen to the point where nerve damage can be documented by electrophysiological testing, then surgery may be necessary to open up the carpal tunnel space to relieve pressure on the nerve involved.

Congressional restrictions on collecting data about these difficulties has made it difficult to determine how widespread carpal tunnel syndrome and other cumulative trauma problems may be. There also has been a delay in the implementation of workplace regulations to help relieve these problems. After many years of planning and discussion, ergonomic regulations were put in place by the federal government, but quickly taken back, with additional plans made for further study of these issues.

ARTHUR L. FRANK

(SEE ALSO: *Occupational Disease; Occupational Safety and Health*)

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CARRIER

The *Control of Communicable Diseases Manual*, published by the American Public Health Association, defines a carrier as a person or animal that harbors a specific infectious agent without discernable clinical disease and serves as a potential source of infection. Several varieties of carrier are recognized.

HEALTHY OR ASYMPTOMATIC CARRIERS

These are persons who harbor an infectious agent but never fall ill or manifest any overt evidence that they are infected. This commonly happens with certain virus diseases, such as several forms of viral hepatitis and poliomyelitis, and with some bacterial diseases, including diphtheria and meningococcal meningitis. The pathogenic organisms responsible for these and other diseases in this category live as commensal organisms in the carrier's respiratory and/or gastrointestinal tract, apparently coexisting without causing disease because the host is not susceptible to infection or because the organisms are not virulent. Carriers of the diphtheria bacillus, meningococcus, or other organisms in this category manifest no symptoms or signs of infection, but the organisms can be recovered from their nose, throat, or from their feces. Moreover, appropriate serological tests may reveal evidence of inapparent infection. Animals and birds can be carriers of some human diseases. For instance, jungle yellow fever is carried by monkeys and possibly other jungle-dwelling small mammals. The rabies virus, which is almost invariably fatal when humans are infected and not protected immediately by antirabies vaccine, is carried by bats who seem to suffer no ill effects at all. *Salmonella* organisms may be carried by many varieties of animals and birds—cattle, rodents, pets such as dogs and cats, tortoises, chickens, ducks—and of course by humans. Some may be healthy carriers, and others are chronic carriers who were infected at some time in the past and have not stopped harboring and excreting the infectious agent.

INCUBATORY AND CONVALESCENT CARRIERS

The pathogenic organisms that cause many diseases can infect healthy people who come into contact with the person harboring the pathogen either during the incubation period or during convalescence. One of the reasons that measles is so highly infectious is that it is at its most contagious stage shortly before the characteristic rash appears. Experienced family physicians and pediatricians soon learn how to recognize children in the incubation period of measles and do their best to minimize transmission by isolating children with a dry cough, red eyes, and fever. Although we should no longer have to be concerned about the risks of transmitting measles when virtually all children are immunized, occasional outbreaks still occur, so continuing vigilance is necessary. Some types of the common cold can similarly be transmitted during the incubation period.

Many diseases remain infectious for a time after the acute stage has passed and the sick person has become apparently well again. Persons in this category are convalescent carriers, and are the most frequent source of infection for others. The common cold is very often transmitted by incubatory and convalescent carriers—and, of course, by those who carry on with their normal activities without acknowledgment and treatment of their cold. Convalescent carriers can be a serious problem with many forms of diarrheal diseases, notably shigella and sonne dysentery. Investigation of outbreaks of diarrhea often reveals that the source of infection is a carrier who works as a cook or food handler in a restaurant. Among the best known, though rare, carrier states in this category, is typhoid. Convalescent cases can remain infectious for long periods, especially when typhoid bacilli lurk in such organs as the gall bladder, whence they are excreted in the feces. Typhoid carriers commonly have had overt disease at some time in the past and continue to carry typhoid bacilli, which they excrete and thereby expose others to infection. But some typhoid carriers have no history of overt disease in the past. The infamous Typhoid Mary may have been an example. The convalescent carrier state may be temporary, lasting only until residual symptoms disappear, or it may be prolonged, chronic, or even permanent.

A very important category of carrier state occurs with many sexually transmitted diseases (STDs) and with HIV (human immunodeficiency virus) infection. Persons with STDs and HIV are more often outwardly well than overtly unwell, and all too often they are sexually active. There are many recorded instances of a sexually promiscuous person with gonorrhea infecting one hundred or more people over a relatively short period.

JOHN M. LAST

(SEE ALSO: *Sexually Transmitted Diseases*; *Typhoid*; *Typhoid Mary*; *Universal Precautions*)

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CARRYING CAPACITY

In ecological theory, the carrying capacity (K) of a geographical region, with respect to a particular species, is the maximum population size that the region can support. It is assumed that the birth and death rates are density-dependent, the former declining and the latter increasing as the population size (N) increases and food per individual decreases. Then the population will reach a stable maximum, the two rates intersect, and $N = K$. When a species is introduced into a region, it will experience a high, unconstrained growth rate. As N approaches K, the growth rate will fall. Thus N follows an S-shaped curve that rises steeply at first and then reaches a plateau with $N = K$. If the trends in the birth and death rates are linear, then this curve is the logistic function, first described by Verhulst in 1845. The model assumes a closed population (no immigration or emigration), no importation of food, and no improvement in the efficiency of food production. These assumptions are restrictive in the context of nonmigratory human populations, but anthropologists have estimated the carrying capacity for isolated hunter-gatherer tribes. Even where the assumptions hold, it has been observed that many animal species, including homosapiens, restrict their fertility to

maintain the population density below the level at which mortality rises.

For the world population as a whole, migration is not an issue. Over the years, several authors have estimated the global carrying capacity based on maximum food production. In 1983, Bernard Gilland calculated a global carrying capacity of 7.5 billion. However, improvements in food production have permitted the world population to reach 6 billion in the year 2000 without any evidence of increase in mortality.

GERRY B. HILL

(SEE ALSO: *Population Density; Population Forecasts; Population Growth; Sustainable Health*)

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CARSON, RACHEL

Rachel Louise Carson (1907–1964) was born in Springdale, Pennsylvania, a small rural town on the banks of the Allegheny River. Carson became one of the few students to major in biology at the Pennsylvania College for Women, and, in 1932, she received an M.A. in zoology from Johns Hopkins University. Carson was deterred from continuing graduate-level work because there were limited opportunities for women in the sciences, and also because she was the breadwinner for her widowed mother and orphaned nieces. Instead, Carson secured employment with the United States Bureau of Fisheries (later known as the Fish and Wildlife Service). She worked at the bureau for sixteen years as an aquatic biologist and wrote many of the pamphlets on its programs. During this period she also wrote her first two books, *Under the Sea-Wind* (1941) and *The Sea Around Us* (1951). The original impetus for *Silent Spring* (1962), Carson's seminal work, came during World War

II. The pesticide DDT (dichloro diphenyltrichloroethane) had been hailed as a technological marvel after the city of Naples, fearing an epidemic of typhus in 1943, dusted the city and its citizens with this potent chemical and eradicated the disease. From her position in the government, however, Carson became aware of the mounting scientific evidence that pointed to DDT's ineffectiveness as well as its potential hazards. She approached *Reader's Digest* in 1945 with the idea for an article on the dangers of pesticides to the natural world, but was rejected. After the success of her second book allowed her to pursue writing full-time, Carson returned to the idea. In *Silent Spring*, Carson translated science into a populist language and placed pesticides on the nation's public health agenda. While working on *Silent Spring*, Carson was diagnosed with breast cancer, and, two years after its publication, she lost this personal battle on April 14, 1964.

JENNIFER KOSLOW

(SEE ALSO *Environmental Determinants of Health; Environmental Movement; Pollution; Toxicology*)

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CASE-CONTROL STUDY

The case-control study, a widely used method of observational epidemiological study, is an application of medical history-taking that aims to identify the cause of disease among a group of people, or the cause-effect relationships of a condition of interest. The underlying concept is simple. The past medical history, or history of exposure to a suspected risk or protective factor, of a group of persons with the disease or condition of interest (the cases) is compared with the past history of another group of persons (the controls) who resemble them in as many relevant respects as possible, but who do not have the disease or condition of interest. Statistical analysis is used to determine whether there is a stronger association of past exposure to the suspected risk or protective factor

with the condition of interest among the cases than among the controls. The method can be called a retrospective study because it is concerned with events in the past. However, the cases are often collected prospectively, with cases added as they occur, so there is possible confusion with what used to be called a prospective study but is now almost always called a cohort study. It has also been called case-compeer study and case-referent study, but case-control study is the most widely used term.

The method evolved out of analyses of series of cases. The concept was mentioned in the writings of the nineteenth-century French physician Pierre Charles Alexandre Louis and a simple form of it was used by the nineteenth-century English physician William Augustus Guy. In the 1930s, the English physician Janet Lane-Clayton used this method to study risk factors for breast cancer, and in 1939, just as war was breaking out in Europe, F. H. Muller, a German physician, used a case-control study design to demonstrate that a past history of cigarette smoking was strongly associated with lung cancer. Following World War II, several investigators in England and in the United States adopted Muller's methods for case-control studies of smoking and lung cancer, which had become a very common and lethal form of cancer. In 1950, Doll and Hill in the England and Wynder and Graham in the United States published large case-control studies of cigarette smoking and cancer of the lung almost simultaneously in the *British Medical Journal* and the *Journal of the American Medical Association*, respectively. Many more case-control studies of this and other kinds of cancer soon established the utility of the method.

Case-control studies have proved particularly useful in studying very rare conditions. During 1969 and 1970, eight cases of adenocarcinoma of the vagina were seen in adolescent girls and young women in Boston, Massachusetts. This was, up till then, an extremely rare, almost nonexistent condition, and it was clear that these young women must have been exposed to some unusual cancer-causing agent. Each of the eight cases was matched with four otherwise similar but healthy females of the same age. Their, and their mothers', past histories of many kinds of exposure to medications, vaginal douches, and other substances, were compared. Seven of the eight cases had a history of their mothers having been given artificial estrogen to

prevent miscarriage early in pregnancy (this had been a popular though unproven method of preventing threatened miscarriage since the 1950s; it has now been shown to be useless). None of the controls had a similar history. There was less than a 1 in 100,000 likelihood of this distribution occurring by chance. Adenocarcinoma of the vagina was caused by prenatal exposure of the developing female fetus to diethylstilbestrol, an artificial estrogen. Later studies showed that genital dysplasia in boys and young men was another consequence of prenatal exposure to artificial estrogen.

These examples, and many others, illustrate the value of the case-control study. It is a relatively cheap, rapid, and reliable method of establishing evidence of an association between an exposure to a risk (or protective) factor and an unfavorable (or favorable) outcome. It does not require study of large numbers. The concept is readily understandable, so members of the lay public, political decision makers, and the media can easily grasp the significance of the findings.

There are, however, some important shortcomings. The results can be biased in many ways—by flawed information about past exposure to risk, inappropriate selection of controls, and various confounding factors. The validity of results based on the use of controls who may have been exposed to similar or different combinations of risk, biases introduced by selective recall or recording of relevant past exposure to risk, and the most suitable way to analyze the results have generated endless debates in epidemiological journals.

The advantages of the case-control method are: (1) it is an excellent way to study rare diseases and diseases with long latency, (2) a relatively quick answer can be obtained, (3) it is relatively cheap, (4) it usually requires only a few cases, (5) it can often make use of existing records, and (6) it can study several possible causes or exposures to risk simultaneously.

The disadvantages of the method are: (1) it relies on subjects' recall and/or completeness of existing records, (2) it may be difficult or impossible to validate this information, (3) there is incomplete allowance for extraneous factors, (4) the selection of a suitable comparison (control) group may be difficult, (5) rates cannot be calculated, (6) the mechanism of disease cannot be studied, and (7) a proof of causation cannot be established.

Analysis of the results of a case-control study makes use of a simple approximation, the *odds ratio*. This ratio is based on the assumption that the condition under study is relatively rare. If it is, the total number exposed to risk is close to the number of healthy persons exposed, and the total number not exposed to risk is close to the number of healthy nonexposed persons.

No other epidemiologic method has been so much discussed. Several books and many learned articles have been written about it. Many of the shortcomings can be overcome by ingenious designs such as the use of a “nested” case-control study in which both cases and controls are drawn from the same large population that is being used in a cohort study. Case-control studies have undoubtedly been overused, and many spurious associations have been reported. Nonetheless, the value of the method in rapid and inexpensive assessment of a new or serious health problem has been proved beyond doubt.

JOHN M. LAST

(SEE ALSO: *Cohort Study*; *Cross-Sectional Study*; *Epidemiology*)

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CATARACT

Cataract, the leading cause of blindness worldwide, is a clouding of the crystalline lens of the eye. Symptoms of cataract include blurred vision, difficulty reading print and street signs, light sensitivity, and glare disability. Most cataracts are age-related, but environmental factors such as ultraviolet light exposure, tobacco smoking, diabetes mellitus, trauma, certain congenital infections, and some medications can accelerate their growth. In

some hereditary conditions, such as galactosemia, a single gene defect is responsible. Treatment of visually significant cataract, which is highly successful, involves surgically removing the cloudy lens and implanting a clear plastic replacement lens.

KEVIN M. MILLER

(SEE ALSO: *Vision Disorders*)

CATASTROPHE THEORY

Catastrophe theory is the mathematical theory that explains the observation that small incremental changes in the value of a variable in a natural system can lead to sudden large changes in the state of the system. The best-known, everyday example is the change in the state of the chemical H₂O from solid (ice) to liquid (water) to gas (steam). The same processes occur in nature with many other chemical substances. In biology, medical practice, and public health there are many examples of catastrophe theory in operation. They include certain stages in the process of carcinogenesis and spread of cancer, in gene frequencies in populations, and in phases in the development, continuation, and decline and disappearance of epidemics. The same processes operate in the dissemination of ideas, innovations, and fashions.

The word “catastrophe,” with its suggestion that the outcome is always undesirable, may have been an unhappy choice to describe this process. While this is certainly the case in the explosive onset of many epidemics, the same mathematical process operates in reverse when an epidemic or epidemic disease virtually disappears quite suddenly from a population. This happens when the balance of susceptible and immune individuals shifts from the proportion required to sustain an epidemic to a marginally smaller proportion where the probability of transmission of an infectious agent to a susceptible host falls below the critical level required to sustain the epidemic. Catastrophe theory should not be confused with chaos theory, although both may operate together in some circumstances.

JOHN M. LAST

(SEE ALSO: *Chaos Theory*; *Epidemic Theory*; *Herd Immunity*)

CAUSALITY, CAUSES, AND CAUSAL INFERENCE

Causality describes ideas about the nature of the relations of cause and effect. A cause is something that produces or occasions an effect. Causal inference is the thought process that tests whether a relationship of cause to effect exists.

CAUSALITY

Ideas about cause vary as culture and philosophical concepts generate their own momentum and logical requirements. In epidemiology, ideas of causality changed as societies, understanding of disease, and technical resources changed. In nineteenth-century England, William Farr, John Snow, John Simon, and others founded an ecologic epidemiology, imbued with the Sanitary Movement's concern about the wretched context of urbanization and industrialization and its attendant miasma theory.

Late in the century the advances of Louis Pasteur, Robert Koch, and others studying bacteria displaced the theory that miasma caused disease. In Germany, this specific-cause theory was challenged early in the twentieth century. Germ theory sought proximate, singular microbial causes of disease. For seventy-five years, however, it dominated an anglophone laboratory-based epidemiology and focused on infectious disease control.

By the mid-twentieth century, epidemic infectious disease was receding in the face of effective action and social change. Epidemic chronic diseases—cancer and respiratory or cardiac disorders—overrode other epidemiological concerns. A. Bradford Hill, Richard Doll, Jeremy Morris, and others led a search for causal factors in the new epidemics. The need became apparent for theory to accommodate multiple coexisting causes, now understood as risk factors.

Such shifts are inevitable for and epidemiology obliged, in a dynamic world, always to evolve new means and theory for coping. Unamended multiple cause theory too is unlikely to be enough to meet rising challenges. Despite its core in population level studies, epidemiology in the past half century concentrated on individual-level disease risk, but studies on several levels, including change over time, are increasingly frequent, however.

CAUSES

For contemporary epidemiologists, what elements constitute the idea of cause? This public health science is chiefly observational. Neither humans nor societies are readily manipulable as rigorous experiment requires, excepting circumstances such as permit and clinical trials, which can randomize groups to neutralize differences other than the experimental intervention.

In the observational sciences, inference about causes is well served by a pragmatic concept of determinants, here defined as something making a difference to outcome. Everyone would not accept so broad a sweep. Galileo's seventeenth-century formulation was that causes be "necessary and sufficient." In the experimental sciences this came to mean one to one relationships of specific causes to given effects. In 1840, Friedrich Henle developed a similar mode for the testing of his idea that infection, not miasma, was a cause for disease.

Later, Koch revised Henle in devising a set of postulates. These sealed Koch's work on bacteria as the proximate cause of tuberculosis. In the germ theory era, the postulates served to guide the search for specific organisms as one to one causes of given diseases. The postulates require laboratory-based experiment; they entail not only observation (does a singular bacterial distribution parallel disease-affected sites?) but intervention (do bacteria, cultured and then transmitted to animals, produce lesions analogous to human disease?).

Causality, thus defined by experiment with specified active agents producing change, excludes from consideration two other types. First, it excludes steady-state conditions, like sex or social position or climate or location. Being contextual, if not always passive, these cannot be actively structured to produce change, as is done in experiment. In the lexicon of determinants for noninterventionist science, such conditions are nonetheless determinants. Experiment cannot reproduce them; they are detected in controlled comparisons of different times and places.

Second, change upon rigorous experimental intervention cannot but exclude a panoply of determinants antecedent and subsequent to the change agent. A table of the possible combinations

inherent in Galileo's causal requirements results in the following:

	Necessary	Sufficient
1.	+	+
2.	+	-
3.	-	+
4.	-	-

Here, determinants emerge as necessary and sufficient (row 1: both always present); necessary but not sufficient (row 2: always present but only with others); sufficient but not necessary (row 3: sometimes effective alone); and, probably most often, neither necessary nor sufficient but contributory (row 4). Thus, taken separately, Galileo's criteria encompass a multicausal theory that accommodates conditions and causal chains. Without multicausality, in truth, no theoretical legitimation exists for the chronic disease epidemiology of the twentieth century.

CAUSAL INFERENCE

The nature of cause must be agreed before it can be inferred. David Hume, an eighteenth-century Scottish philosopher, isolated three properties essential to cause. Freely translated, these are association (cause and effect occur together), time order (causes precede effects), and connection or direction (repeated demonstrable, hence predictable, linkages exist between cause and effect). Hume's analysis endures and has hardly been improved on.

Causal inference is a judgmental process, not a snapshot but a movie. Causal hypotheses arise either from observation, existing knowledge and inductive reason, or from intuition. Hypotheses enunciated beforehand (a priori) can be subjected to repeated tests that allow their elimination or survival in respect, successively, of the causal properties. For each, criteria (or guidelines, canons, or postulates) assist judgment. They can be grouped under five categories, some with subcategories: strength; specificity; consistency; predictive performance; and coherence. Each is useful depending on the property under test and the type and quality of available research evidence.

Association is judged by the presence and strength of probabilities based on preset expectations of variation (so-called chance occurrence) and by consistency upon replication. Given survival, tests for time-order rely on establishing the sequence of cause and effect; reversal assures elimination. Failing elimination, the acid test for the property of connection or direction is difficult indeed: It depends on the complete array of criteria, with all alternative explanations and confounding accounted for.

In counterpoint, Hume rejected the validity of inductive logic (generalization from assembled particular observations) and thereby created an enduring problem for causal inference. He could find, he said, no logical compulsion to believe the sun would rise tomorrow. For him, logic could not demonstrate "necessary connection" from cause to effect. Following Hume, Karl Popper in the twentieth century found proof of hypotheses (verification) beyond logical reach. His theory allowed conclusive rejection (falsification) alone. His epidemiological followers prosecuted an intense debate in support.

Popper, aiming to falsify hypotheses, insisted solely on deductive logic (prediction of particular outcomes from prior general hypotheses). He dismissed such longstanding counters to his view of science as Bacon's (1599) or John Stuart Mill's (1856) inductive logic. Mill spelled out inductive "canons" implicit in the casual inferences of much observational science, including epidemiology. Despite Popper's insistent rejection, all scientists practice induction. Obligatory pragmatists, many also recognize added value in Popper's "hypothetico-deductive" procedure.

Other perspectives exist in epidemiology. Kenneth Rothman espouses a Popper-like view of causal inference but also provides heuristic if nondynamic model of multiple "sufficient and component" causes. James Robins, Sander Greenland, and others, following one of Hume's ideas modeled by Jerzy Neyman in 1923, elaborate the "counterfactual" approach. Limiting causes to change agents, this excludes steady-state conditions as causative if not as context, and demands strict formulations amendable to mathematical logic. A thought experiment compares an entity after exposure to the same entity had there been

no exposure, a comparison unattainable in practice. Instead, the outcome variable is adjusted statistically. Bayesian probability theory provides artillery for applications. Tests for counterfactuals in securing or dismissing uncertain causality in epidemiology are awaited with interest.

MERVYN W. SUSSER

(SEE ALSO: *Epidemiology*)

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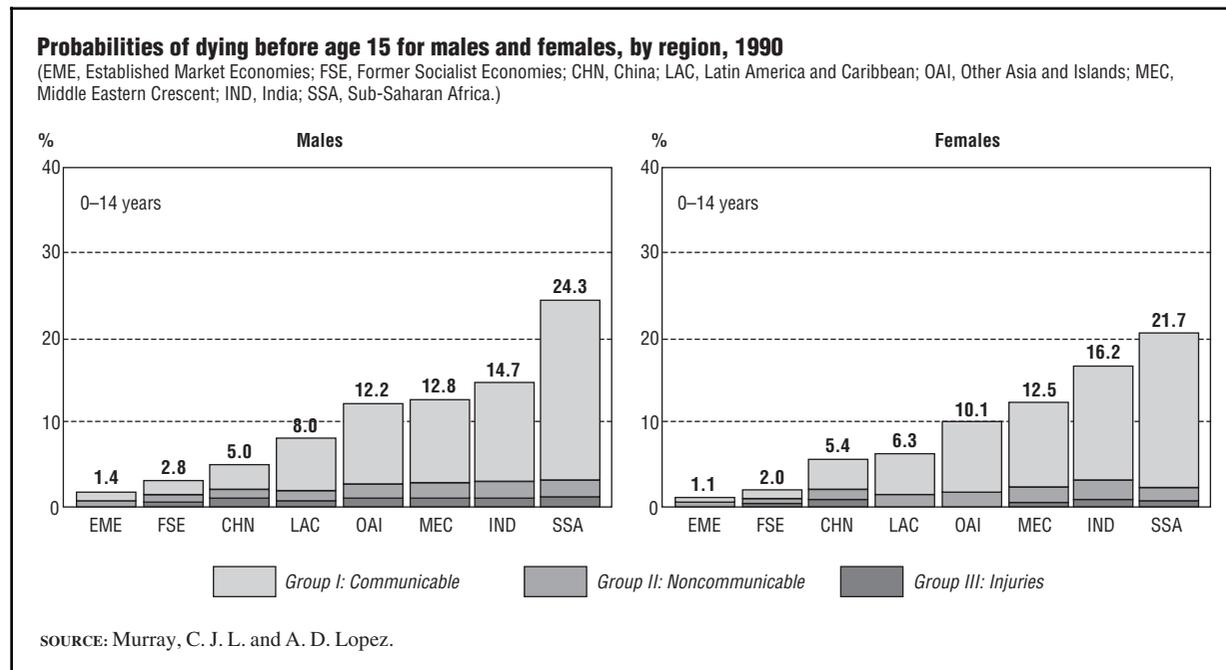
CAUSES OF DEATH

In looking at patterns and variables in causes of death worldwide, it is important to consider physical, economic, social, and environmental factors, as well as the age structure of different populations. In the early 1990s, for example, the developed countries of the world accounted for 11 million of the world's nearly 50 million deaths. The large majority of these (10.4 million) were due to noncommunicable diseases—mainly cardiovascular disease (5.3 million), cancer (2.3 million), respiratory disease (0.5 million), and injuries (about 0.7 million). Of all deaths occurring in developing countries, however, 40 percent (16 million) were due to communicable, maternal, and perinatal causes, and 60 percent to noncommunicable diseases (18 million) and injuries (3.5 million). Deaths from injuries caused roughly the same proportion of deaths in both developed and developing regions, but were twice as common among males than among females.

In developing countries, differences occur in the distribution of causes of deaths. The probability of dying before the age of fifteen varies according to sex and cause of death in the various areas, though the breakdown between communicable and noncommunicable disease is similar to that discussed above (see Figure 1). Discrepancies are largely due to the methods used to estimate the number of deaths.

The distribution of causes of mortality is changing, and is likely to continue to change. In developed countries, deaths from communicable diseases and perinatal and maternal causes fell from 6 percent to 2 percent of all deaths between 1985 and 1997, while the percentage in the developing world fell only slightly, to 53 percent. Over the same period, deaths from cardiovascular diseases fell from 51 percent to 46 percent of all deaths in developed countries, but increased from 16 percent to 24 percent in the least developed countries—those countries where manufacturing accounts for

Figure 1



less than 10 percent of GDP, where adult literacy is less than 20 percent, and where the per capita GDP is \$100 (1968) or less.

A comparison of the extremes of the spectrum of development shows a marked difference in the age distribution of deaths. In developed market economies less than 2 percent of deaths occur before the age of twenty (this is likely to be 1 percent by 2025), while in the least developed countries the figure rises to 40 percent (23 percent by 2025). Similarly, deaths above the age of sixty-five represents about 77 percent of all deaths in the developed market economies (projected to 88 percent by 2025), but only about 12 percent (31 percent in 2025) in the developed countries.

The impact of health structures within a nation is less well known, but is likely to affect mortality. One striking case is that of AIDS (acquired immunodeficiency syndrome). New therapies have led to a marked fall in deaths from AIDS in the developed world. With few exceptions (e.g., Brasil), however, these therapies are not systematically applied in developing countries, for reasons of cost, and a lack of adequate health structures for distribution and education, and deaths from AIDS in those countries continue to rise. Both the age

structure of a population and the conditions under which it lives will thus affect not only the amount of death a population encounters, but the way the death comes.

MICHEL C. THURIAUX

(SEE ALSO: *Certification of Causes of Deaths; Infant Mortality Rate; Mortality Rates*)

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CENSUS

A census is an enumeration of all the people of a nation or a registration region, a systematic and complete count of all who are living in specified places, usually on a specific date. The practice of conducting a periodic census began in Egypt in the

second millennium before the common era, where it was used for tax gathering and to determine fitness for military services. The Romans adopted the practice in the first century B.C.E. Jesus of Nazareth was born in Bethlehem because Mary and Joseph had gone there to be enumerated in a Roman census. The Domesday Book was a census of English landowners and their resources soon after the Norman conquest. Many European nations held censuses of varying quality and completeness from time to time until the modern era, when the practice became a formal part of the business of a modern state. The first modern census in England was in 1801, and has been repeated at ten-year intervals ever since, except when interrupted by the Second World War.

In democratic societies, one important purpose of the census is to obtain a precise count of the people in each electoral district who are eligible to vote. For this reason even the politicians who oppose government “interference” in people’s lives usually support the census. However, many people in nations with a past history of totalitarianism resist attempts to gather detailed personal information that is routinely gathered elsewhere.

Like most modern democracies, the United States conducts a complete enumeration every ten years, under the auspices of the Bureau of the Census, which publishes detailed reports. Some nations, such as Canada, hold an interim census at the five-year interval between the decennial census, often on a random sample basis. The rationale for this is that the composition and locations of the population is changing so rapidly that accurate current information is required to maintain essential services.

Information for the census is gathered in most countries by enumerators who visit every dwelling, systematically recording the name, sex, and age of everyone living there. Much other information is often collected at the same time and put to various uses. This may include other details about individuals and families, including ethnic origins, language, occupation, and marital status. Occasionally the census includes questions on health conditions, particularly chronic conditions and permanent disabilities such as blindness. Other useful facts include details about dwellings. This may include the number of bedrooms (a measure

of crowding when related to the number of occupants); facilities for cooking and safe storage of food; sanitation and access to hot water; number of cars owned or used; number of telephones; and ownership of appliances such as television sets and computers. Some of this information has public health significance, and some is in the category of socially useful data. Some people regard questions with this level as unduly intrusive, but most willingly cooperate when reassured that the information will be used only to compile statistics. In the United States, census enumerators have all taken an oath of secrecy, and they can be punished with fines or even imprisonment if they disclose the facts they gather to any unauthorized person.

In certain countries, illegal immigrants or others living outside of conventional society avoid enumeration by various means, causing census to underrepresent the population. In parts of the United States with appreciable numbers of illegal immigrants, the proportion missed in the census may reach 10 percent. Estimates of actual numbers can be based on unobtrusive measures and indirectly obtained information such as school attendance and hospital room recordings.

JOHN M. LAST

(SEE ALSO: *Bureau of the Census; Demography; Vital Statistics*)

CENTER FOR MENTAL HEALTH SERVICES

The Center for Mental Health Services (CMHS) is the federal government agency that directs national efforts to promote mental health services and prevent mental illness. In 1992, the U.S. Congress established CMHS through Public Law 102-321, which created the Substance Abuse and Mental Health Services Administration (SAMHSA). CMHS is one of three centers that comprise SAMHSA; the other two focus on substance abuse prevention and treatment.

CMHS, through its partnership with states, administers mental health block grants; funds research on evidence-based practices; works with state and local service agencies; and disseminates research findings to improve service systems for

adults with serious mental illness as well as children and adolescents at risk for mental disorders, juveniles in the justice system, underserved and ethnic minorities, the homeless, and students in public schools.

SHELAGH A. SMITH

(SEE ALSO: *Center for Substance Abuse Prevention; Community Mental Health Centers; Mental Health; Mental Retardation*)

CENTER FOR SUBSTANCE ABUSE PREVENTION

The Center for Substance Abuse Prevention (CSAP) is the U.S. agency responsible for the prevention of alcohol, tobacco, and illicit drug problems in the U.S. population. Because such problems are intrinsically linked with other public health problems, CSAP partners with public and private sector organizations, including other federal agencies, state agencies, professional organizations, and business and health care organizations. CSAP develops comprehensive, culturally appropriate, science-based prevention strategies, policies, and systems that target both individuals and the environments in which they live. The National Clearinghouse for Alcohol and Drug Information (NCADI), established by CSAP, has become the nation's largest disseminator of knowledge about prevention and treatment of alcohol and drug problems.

NANCY J. KENNEDY

(SEE ALSO: *Addiction and Habituation; Alcohol Use and Abuse; Cocaine and Crack Cocaine; Drug Abuse Resistance Education [DARE]; Marijuana; Substance Abuse, Definition of; Tobacco Control*)

CENTERS FOR DISEASE CONTROL AND PREVENTION

The Centers for Disease Control and Prevention (CDC) is a federal agency, under the United States Department of Health and Human Services (USDHHS), whose vision is to promote healthy people in a healthy world through prevention. CDC's mission is to promote health and quality of

life by preventing and controlling disease, injury, and disability. The agency addresses a broad range of preventable health problems, from infectious disease to chronic diseases and risk factors to negative environmental effects on health. Most of CDC's seven thousand employees live and work in Atlanta, Georgia, the agency headquarters. CDC employees are also stationed in state and local health departments in all fifty states and in about twenty countries worldwide. CDC has facilities in Alaska, California, Colorado, the District of Columbia, Florida, Illinois, Maryland, North Carolina, Ohio, Pennsylvania, Puerto Rico, Washington, and West Virginia.

CDC has three primary functions: to actively protect the health and safety of the nation; to provide credible information so that the general public, health care providers, and leaders in government can make well-informed health decisions; and to promote better health in all stages of life through strong partnerships.

CDC has always demonstrated a strong commitment to protecting health and safety. In 1942, malaria in the southeast United States was more common, so it made sense to establish the Office of Malaria Control in War Areas in Atlanta. Dr. Joseph Mountin, a leader of the Public Health Service, wanted to create a national organization to keep more than six hundred bases and essential war-industrial establishments in the southern United States malaria-free. At the end of World War II, Mountin created the Communicable Disease Center from these initial malaria-control efforts. The agency's purpose was to gather physicians, entomologists, and engineers in the battle against a wide range of infectious health risks.

Over the past fifty-three years, CDC's name has changed along with the evolution of its focus. The agency has maintained its commitment to the prevention and control of infectious disease, while building its efforts to address the leading health threats of the nation, including environmental hazards like lead poisoning, chronic diseases like cancer and heart disease, occupational illnesses, and injuries at home, on the road, and on the playground. CDC has worked to reduce the spread of AIDS (acquired immunodeficiency syndrome) since its recognition in 1981. CDC has instituted important changes in treating and controlling the spread of this disease, including ensuring that the

nation's blood supply is safe and reducing the risk of HIV (human immunodeficiency virus) transmission in health care settings.

Along with actively protecting health and safety, CDC provides credible health information to various decision makers, including individuals making personal health decisions and policy leaders making decisions affecting larger populations. Working with state and local partners, CDC collects and analyzes data to monitor health threats, detect disease outbreaks, and identify risk factors and causes of diseases and injuries. CDC also conducts research to identify what works in disease and injury control and prevention.

CDC's National Health and Nutrition Examination Survey (NHANES), for example, is the nation's most comprehensive study of the health and nutritional status of Americans. Each year, approximately five thousand randomly selected residents in twelve to fifteen counties across the country have the opportunity to participate in the survey. NHANES is a unique resource for health information in the United States. Without it, decision makers would not have adequate data on health conditions and issues, such as obesity, environmental (secondhand) tobacco smoke, and lead poisoning.

CDC also provides information to the public via comprehensive public health communication programs on such issues as diabetes, skin and colorectal cancer, HIV, and hepatitis C. International travelers turn to CDC to obtain timely updates on disease outbreaks in foreign countries and a list of suggested immunization. The agency also publishes guidelines, such as its Community Prevention Guidelines, to identify evidence-based practices for disease control and prevention.

CDC's third function is to promote better health in all stages of life through strong partnerships. The agency has forged relationships with other federal, state, and local health agencies, not-for-profit organizations, and members of private industry who have an interest in reducing the burdens of disease, injury, and disability. CDC's strongest traditional partnerships have been with state and local health departments. Through the National Breast and Cervical Cancer Early Detection Program, for example, CDC is providing funds and technical assistance to fifty states, five U.S. territories, the District of Columbia, and fifteen

American Indian/Alaska Native organizations. This program exemplifies how the combination of public health expertise in screening and detection, quality assurance, professional and public education, and coalition building can address critical gaps in health care needs. The program delivers critical breast and cervical cancer screening services to underserved women, including older women, women with low incomes, and women of racial and ethnic minority groups.

CDC has evolved from an agency focused on fighting infectious diseases to one that addresses a variety of health issues on both national and international fronts. In the future, it may need to address additional health issues—such as responding to bioterrorism, using genetic information to improve health, reducing violence in society, and closing the gap in health disparities among racial and ethnic groups.

JEFFREY P. KOPLAN

(SEE ALSO: *Communicable Disease Control*;
Noncommunicable Disease Control)

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CERTIFICATION OF CAUSES OF DEATHS

Identifying and documenting the cause of death of individuals is an important part of public health procedures. It is important to keep such records in order to establish the main causes of death in a community, to track changes in death rates, and to help determine how certain causes of death can be prevented. Death record information helps to assess future preventive, corrective, or palliative actions that might be taken, such as improving car safety or emergency services, or instituting health-education programs about a certain disease. It is also important to know the age and sex of deceased persons in order to identify risks specific to age and gender, and to identify those deaths that can be classified as premature. Of course, identifying the cause of death is also important for legal

reasons, especially in cases of violent death, and to help surviving friends and relatives deal with the death of a loved one.

In countries with well-developed civil and medical death registration procedures, a physician or qualified health worker registers a death on a certificate. Death certificates tend to follow a standard format. The section dealing with the cause of death is usually in two parts. Part one lists the chain of events that, in the opinion of the reporting physician, led directly to death. The *immediate cause* is listed first. This is the final disease, injury, or complication directly causing death, and should not be confused with the *mode of death* (heart failure, respiratory arrest, etc.), as often happens. The immediate cause may be followed, if appropriate, by the chain of up to four disease or injury events that led to the immediate cause of death—these are known as the *intermediate* and *underlying* causes of death. Part two of the death certificate reports other significant diseases, such as diabetes, or conditions, such as heavy drinking or smoking, that contributed to death but were not listed in part one as a cause of death.

A few examples will help clarify the terminology used. Suppose a child falls off a bicycle, suffers a cranial fracture, and dies from a cerebral hemorrhage. On the death certificate the immediate cause of death is listed as a cerebral hemorrhage, due to or as a consequence of a cranial fracture (intermediate cause), which was due to or as a consequence of a fall off a bicycle (underlying cause).

Another example would be a man who died from a rupture of the heart after an acute myocardial infarction following chronic insufficiency of the blood supply to the heart. He also suffered from diabetes and was a heavy smoker. On part one of the death certificate the immediate cause of death is listed as “rupture of myocardium.” The intermediate cause is “acute myocardial infarction.” The underlying cause is “chronic ischemic heart disease.” On part two, “diabetes” and “smoking” are listed as significant contributing conditions.

Other elements, such as the duration of each causal element, the performance of an autopsy, and the manner of death (natural, accidental, suicide, or homicide) may also be entered according to local or national requirements. The tenth revision of the *International Statistical Classification of*

Diseases and Related Health Problems, known as ICD-10, provides standardized lists of causes of death. It also deals with special requirements for the recording of death in cases of maternal death (linked to pregnancy, childbirth, or postpartum), infant death, or accidental death.

MICHEL C. THURIAUX

(SEE ALSO: *Causes of Death; Child Mortality; Infant Mortality Rate; Mortality Rates*)

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CERTIFICATION OF PUBLIC HEALTH WORKERS

Since public health has such a broad scope, public health workers need many different skills. Most public health workers, however, have not been trained to deal with the problems they will face in the twenty-first century. The types of knowledge needed for the practice of public health include: 1) basic competency, which provides a fundamental understanding of what public health is, what public health does, and how public health achieves its mission; 2) cross-cutting, or core competencies, which provide general knowledge, skills, and abilities in areas that cut across all dimensions of public health practice; and 3) technical competencies, which provide the technical knowledge, skills, and abilities needed for a defined program area. Most training and continuing education provided by federal agencies focus on the development of technical competencies, but few courses are offered that provide basic or cross-cutting competencies.

Many additional barriers exist to achieving a competent work force. There is no firm agreement on the basic knowledge needed for public health workers. An integrated system to deliver lifelong learning does not exist, and there are few incentives for participation in training. Continuing education and national competency standards, which could positively influence participation in lifelong learning activities, do not exist for public health workers.

Certification means providing some external validation that a worker has knowledge in a given area. Many public health experts have taken the position that a competency certification is needed to assure minimum levels of knowledge in certain areas of public health practice and that certification should be required for certain jobs. A national task force, sponsored by the Centers for Disease Control and Prevention recommended in the year 2000 that a system for the certification of public health workers be developed.

RAY M. NICOLA

(SEE ALSO: *Careers in Public Health; Engineer, Public Health Career; Nurse; Physician; Training for Public Health*)

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CERVICAL CANCER

Invasive cervical cancer affects nearly 12,800 women in the United States annually, and in approximately 5,000 of these women the disease will be fatal. The incidence of cervical cancer is bimodal, with two peaks occurring between thirty-five years and sixty-four years of age. Since the advent of Pap smear screening, the incidence of cervical cancer has decreased in the United States; however it continues to be a leading cause of death for women in Third World countries.

A tremendous volume of experimental and epidemiological evidence suggests that cervical dysplasia (pre-malignant changes) and carcinoma (malignant changes) are caused by various subtypes of the human papillomavirus (HPV), with cocarcinogenic effects derived from tobacco abuse. HPV is sexually transmitted and is highly infectious. Women who have early coitus (prior to age eighteen) or more than two sexual partners in their lifetime have an increased risk for cervical cancer. HPV initially causes cervical dysplasia or intraepithelial neoplasm (CIN), which, if untreated, may progress to carcinoma. Although some of the

smaller of these lesions may spontaneously regress, given enough time all CIN lesions carry the possibility of progression to carcinoma.

With early viral effects, often no visible features to the naked eye are observed, with the exception of occasional keratinizing lesions that appear as a whitish plaque. Therefore, most cervical dysplasia is identified by cervical cytology (e.g., the Pap smear). The Pap smear is the most important tool in the secondary prevention of cervical cancer.

The evaluation of a patient with cervical dysplasia requires a colposcopic examination. This examination uses a dilute 3 percent acetic solution to help delineate the cervical lesion under 10X to 20X magnification. The lesion should be biopsied and the determination of invasion needs to be made. If no invasion is identified, the lesion should be treated in the pre-malignant state; however, once the cellular basement membrane is penetrated, invasion into the deeper tissues occurs. Often a procedure known as a cervical conization is necessary to determine whether invasion has occurred and to what depth the invasion extends.

Women with cervical carcinoma often present with abnormal vaginal bleeding—postmenopausal, intermenstrual, postcoital, or increased menstrual flow. An excessive, malodorous vaginal discharge is often a presenting symptom. History of weight loss and sciatic pain are rare symptoms, but when present signify advanced stage disease.

The most common variety of invasive cervical cancer is squamous cell carcinoma, which accounts for the majority of cervical cancer. Adenocarcinoma of the cervix appears to be increasing in frequency relative to squamous cell carcinoma; recent studies suggest as many as 15 to 20 percent of cervical cancers are now adenocarcinomas. The adenocarcinomas are believed to have a poorer prognosis than squamous cell carcinomas of similar stage.

Cervical carcinomas spread by direct invasion into the cervical stroma and surrounding pelvic organs. The tumor can also spread through the lymphatic channels into regional lymph nodes. The major path of spread is lateral—through the paracervical lymphatics into the parametrium and, ultimately, into the lateral pelvic sidewall. The tumor may also spread inferiorly into the vaginal stroma, anteriorly into the bladder, or posteriorly

into the rectum. These tumors are known to metastasize to the external iliac nodes, obturator nodes, internal iliac nodes, and common iliac nodes. After metastasis to the pelvic nodes, cervical cancer spreads beyond the pelvis to the para-aortic nodes, and ultimately the supraclavicular nodes. Once the diagnosis of cervical cancer is established, the stage of the disease is clinically established by an estimation of the extent of the disease. Stage I disease is localized to the cervix; stage II disease is that which has extended beyond the cervix, but not to the sidewall; stage III disease is that which extends to the pelvic sidewall; and stage IV disease extends beyond the true pelvis.

The management of stage I carcinoma can be accomplished by either surgery or radiation with chemosensitization. Both produce similar cure rates, which approach 90 percent for stage I disease. In younger patients, surgical intervention is the usual option. Surgery allows the patient to maintain ovarian function, since low doses of radiation will cause cessation of ovarian function. In elderly patients, radiation is often used instead of surgery.

Radiation may also have permanent effects on the bowel and bladder function (as may surgery), however, by tailoring the radicality of the surgery, one can often minimize bladder and bowel dysfunction. Once the tumor has extended beyond the cervix, radiation with chemosensitization is the only option for cure. As the disease advances beyond stage I, the chance for long-term survival decreases.

THOMAS J. RUTHERFORD

(SEE ALSO: *Cancer; Human Papillomavirus Infection; Pap Smear; Screening*)

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CERVICAL CYTOLOGY

See Pap Smear

CHADWICK, EDWIN

Edwin Chadwick (1800–1890) was the principal architect of the Sanitary Reform movement in Britain in the nineteenth century; his influence on the philosophy of public health and its translation into legislation was profound. Born near Manchester to a family of Wesleyan landowners, Chadwick was raised in London and trained in law. His father, James, had edited a radical journal, the *Spectator*. Following the appearance of some of his own writings in the *Westminster Review*, Edwin came to the attention of two of the leading philosophers and social theorists of the early eighteenth century, Jeremy Bentham and John Stuart Mill. Chadwick served as Bentham's literary secretary from 1830 until the latter's death in 1832, the year in which Chadwick was appointed to the new Poor Law Commission. In that role, his industry in investigating the conditions under which the poor lived, as well as his "knowledge of law, . . . infinite capacity for taking pains over details, and his skill in marshalling the facts" (Marston 1925, p. 23) led him to exert a steadily greater influence on British public policy in a variety of areas relating to public health.

His advocacy led to the 1836 act that established a registry for births and deaths, and to the 1848 Public Health Act establishing a central board of health. He also influenced legislation on factories, child labor, and water supplies. He served as secretary to the Poor Law Board, and as a member of the first board of health (1848–1852). His sanitary philosophy, most fully explicated in his *Enquiry*

into the Sanitary Conditions of the Labouring Population of Great Britain (1842) viewed the improvement of drainage, housing, and water supply as an essential national economic good, as it prevented the early deaths of working men. Often uncompromising in his belief in the value of government intervention to remedy unsanitary conditions, he was frequently opposed by his business interests, and held no public office after 1852. He did, however, spend the rest of his long life advocating quietly for “The Sanitary Idea,” and was knighted by Queen Victoria in the ninetieth and final year of his life.

NIGEL PANETH

(SEE ALSO: *Filth Diseases; History of Public Health; Poverty and Health; Sanitation*)

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CHAGAS DISEASE

See Trypanosomiasis

CHAOS THEORY

Chaos theory was originally a branch of mathematical physics developed in 1963 by Edward Lopez. It deals with events and processes that cannot be modeled or predicted using conventional mathematical laws and theorems, such as those of probability theory or biostatistics. Chaos theory is concerned with finding rational explanations for such phenomena as unexpected changes in weather. The theory assumes that small, localized perturbations in one part of a complex system can have widespread consequences throughout the system. The vivid example often used to describe this concept, known as the “butterfly effect,” is that the beating of a butterfly’s wings can lead to a hurricane if the tiny turbulence it causes happens to

generate a critical combination of air pressure changes. The key word here is “if,” and much of chaos theory is concerned with attempts to model circumstances based on this conditional conjunction. Unpredictable events in medicine, such as the course of certain cancers and the fluctuations in frequency of some diseases, may be attributable to chaos theory.

Toward the end of the twentieth century, humankind began to face a crisis that required comprehension of chaos theory. A complex set of natural and human-induced changes in global ecosystems—global climate change, stratospheric ozone attenuation, species extinctions and reduced biodiversity, social and demographic turbulence, economic globalization, technological revolutions in communications, violent regional conflicts, and political instability—began to have far-reaching implications. These factors all interact in complex ways that impact on human health and well-being and could cause dramatic changes in the prevailing patterns of health and disease. Public health policies and long-range plans require certain assumptions about the likelihood that events will occur in accordance with known trends about which data and information exist. Such plans tend to be based on extrapolations of trends, such as population numbers and age distributions, and the impact of specific diseases are projected.

Scenarios in long-range health planning need to take chaos theory into account if they are to cover all possible contingencies. For example, in long-range health plans for the application of technology to the diagnosis and treatment of cancers or coronary heart disease, one or more scenarios must take into account the possibility of innovative technical breakthroughs. This approach to long-range health plans has benefited from lessons learned by the oil and petrochemical industries in the 1970s, when only one major oil company was prepared for a sudden reduction in the available crude oil supply. This company’s plans had included supply change as one possible scenario. In the health sector, long-range plans are flawed if they do not allow for chaotic events.

JOHN M. LAST

(SEE ALSO: *Catastrophe Theory; Planning for Public Health*)

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CHERNOBYL

On April 26, 1986, at 1:23 A.M., an accident occurred during a test of a turbine generator on the Unit 4 reactor at the Chernobyl nuclear power station in the Ukraine. The accident resulted from the improper withdrawal of control rods and the inactivation of important safety systems—in violation of the operating rules—which caused the reactor to overheat, explode, and catch fire. Because the facility lacked an adequate containment structure, the damage to the reactor core and control building allowed large quantities of radiation and millions of curies of krypton-85, xenon-133, iodine-131, tellurium-132, strontium-89, strontium-90, plutonium-240, and other radionuclides from the reactor core to be released during the ensuing ten days, necessitating the evacuation of tens of thousands of people and farm animals from the surrounding area and resulting in radiation sickness and burns in more than two hundred emergency personnel and firefighters, thirty-one of whom were injured fatally.

The heaviest contamination occurred in the vicinity of the reactor itself and, to a lesser extent, in neighboring countries of eastern Europe. Those living in the vicinity of the reactor were given potassium iodide preparations to inhibit the thyroidal uptake of radioactive iodine, but infants in a number of areas elsewhere in eastern Europe are estimated to have received sizeable radiation doses to the thyroid gland, largely through ingestion of radioiodine via cow's milk, and the incidence of thyroid cancer in such persons has since risen dramatically in Belarus and in Ukraine. In areas outside Belarus, Russia, and Ukraine, organs other than the thyroid typically received only a small fraction of the radiation dose normally accumulated each year from natural background radiation. For example, the highest average effective dose in such areas during the first year was received in Bulgaria, where it is estimated to have

approximated slightly less than one-third of the average annual effective dose received from natural sources. Because of the small magnitude of the average dose to a given individual, the ultimate health impacts of the accident cannot be predicted with certainty. However, nonthreshold risk models for the carcinogenic effects of radiation imply that the collective dose to the population of the northern hemisphere may cause up to thirty thousand additional cancer deaths during the next seventy years.

The accident, by far the worst nuclear reactor accident to date, highlighted flaws in the design, as well as the operation, of the Chernobyl reactor. The reactor's lack of adequate containment and its positive void coefficient, which made the reactor potentially unstable at low-risk power levels, prompted the International Atomic Energy Agency subsequently to recommend the decommissioning of all Chernobyl-type reactors, a recommendation yet to be fully implemented throughout eastern Europe. In spite of the fact that the accident also prompted reassessment and upgrading of the safety of nuclear power systems everywhere, nuclear power has fallen into disfavor in most countries because of the magnitude of the disaster. To many experts, nevertheless, nuclear power still compares favorably with other sources of energy in its impact on human health and the environment, and it is expected to continue to play a role in helping to meet the world's rapidly growing demands for energy.

ARTHUR C. UPTON

(SEE ALSO: *Nuclear Power; Nuclear Waste; Radiation, Ionizing; Three Mile Island*)

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CHEWING AND SMOKELESS TOBACCO, SNUFF

Smokeless tobacco (ST), referred to by many as "spit tobacco" is tobacco designed for oral use where no combustion takes place, such as occurs when one smokes tobacco. The tobacco is placed in the mouth, in the form of snuff (moist, dry, sachet) or chewing (loose-leaf, plug, twist), where several compounds are absorbed through the mucous membrane. Since the 1970s, the practice of using smokeless tobacco has grown at a steady rate in the United States especially among young white males. Smokeless tobacco is a nicotine-delivery system. Reports reveal no differences between cigarette smokers' and snuff users' intensity of addiction. Smokeless tobacco is not a safe alternative to cigarette smoking but can cause disease and addiction.

ELBERT D. GLOVER

(SEE ALSO: *Addiction and Habituation; Substance Abuse, Definition of; Tobacco Control*)

CHICKEN POX AND SHINGLES

Chicken pox (varicella) is a highly infectious, acute viral illness caused by the varicella zoster virus. The illness is characterized by a generalized pruritic, vesicular rash with fever and systemic symptoms usually lasting from seven to ten days. In the pre-immunization era in the United States, there were approximately 4 million cases, 11,000 hospitalizations, and 100 deaths every year. Most cases occurred in children under ten years of age. Complications from chicken pox include pneumonia, encephalitis, cerebellar ataxia, infections, and bleeding disorders. Infants, adults, and immunocompromised persons are at higher risk of severe disease, hospitalization, and death.

Once a person recovers from chicken pox, the virus stays in the body for life (becomes latent), residing in nerve cells known as dorsal root ganglia. The virus can reactivate, resulting in herpes zoster (shingles), which usually presents as a band-like rash in an area of the body that receives

innervation from one sensory nerve. Approximately 15 percent of persons who have had chicken pox will develop shingles at some point in their lives, the risk increasing with advancing age. Most cases are associated with a vesicular rash, though some affected persons experience local pain as well. However, persons older than fifty years may develop a severe pain syndrome lasting for months known as post-herpetic neuralgia.

In 1995, a live, attenuated vaccine was licensed in the United States for routine childhood immunization against chicken pox. Since then, the number of cases of chicken pox has decreased significantly. Another vaccine has been tested for prevention or modification of shingles.

KARIN GALIL
JANE SEWARD

(SEE ALSO: *Communicable Disease Control; Immunizations*)

CHILD ABUSE

See Domestic Violence

CHILD CARE, DAYCARE

Each weekday, approximately 13 million infants, toddlers, and preschoolers in the United States spend part of the day being cared for by someone other than their parents. This number represents three out of five young children in the United States. During the last decades of the twentieth century, increased employment of mothers outside the home significantly increased child-care demand.

Child care is provided by both not-for-profit and for-profit entities. Child care can be divided into two types: center-based child care (e.g., child-care centers, Head Start, preschool) and home child care (e.g., care in a provider's home, babysitter or nanny in the child's home, relative care).

Child care creates challenges and opportunities for public health. Increased use of child care has significantly changed the epidemiology of illnesses and injuries among young children. For

example, children enrolled in child care have increased exposure to common, highly communicable childhood diseases such as common colds and other infections (e.g., respiratory tract infections, skin infections such as impetigo and ringworm, and intestinal tract infections). Common behaviors by infants and toddlers promote the spread of germs, such as sucking on fingers and toys. Child-care-associated illnesses have substantial economic impact through direct medical costs and lost workdays for both staff and parents.

However, quality center-based child care can also benefit public health by increasing the quality of nutrition, raising immunization rates, and stimulating child development. Out-of-home child care provides venues for teaching and reinforcing health-promotion and disease-prevention behaviors such as hand washing or exercise. In addition, child care can serve as a link connecting families to community health services such as immunizations, lead screenings, dental education, and injury and violence prevention.

Child care is regulated at the state level, and much variation exists between states. States regulate topics such as child/caregiver ratios, employee background checks, and caregiver training in early childhood development. In-home child-care providers are much less regulated than center-based child-care providers. For example, only eleven states require home child-care providers to have training in early childhood education prior to serving children.

LINDSAY B. GOODMAN

(SEE ALSO: *Child Health Services; Child Welfare; Head Start Program; Regulatory Authority*)

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CHILD HEALTH SERVICES

Ensuring children's health is critical not only for reducing child morbidity and mortality, but also for increasing the likelihood of a healthier adult life. The primary goal of child health services, however, is to prevent the major causes of death, difficulties, and disease during childhood: accidental injuries, infections, education problems, and behavioral problems.

Child health services address environmental risks, problems related to low family income, sociopsychological stress, and traditional medical services. Early detection and treatment of disease and disability requires screening, counseling, and, for high-risk populations, interventions. For children from birth to age ten, screening includes measurements of height and weight, blood pressure, hearing, and vision. Counseling, or anticipatory guidance, relates to injury prevention, diet and exercise, substance use, and dental health. Immunizations for children generally include diphtheria-tetanus-pertussis (DTaP), oral poliovirus, measles-mumps-rubella, *H. influenza* type B, hepatitis B, and varicella. Interventions for high-risk populations are dependent on the population, but range from HIV (human immunodeficiency virus) testing for infants of mothers at risk for HIV to hepatitis A vaccine for children traveling to developing countries.

For children older than age ten, additional screening recommendations include a Pap smear and chlamydia screening for sexually active females and assessment of problem drinking for all adolescents. Counseling with this age group covers sexual behaviors, smoking, drinking, and other drug use. Immunizations should include a tetanus-diphtheria booster for those aged eleven to sixteen. Hepatitis B and varicella vaccines should be given to those who did not receive them at earlier ages. High-risk populations include those who engage in high-risk sexual behavior or drug use and those with certain medical conditions. Interventions specific to each of these populations are needed.

The U.S. government's *Healthy People 2010* objectives provide guidance to those planning for or providing child health services. Central among these is access to care. Unfortunately, certain economic, educational, racial, and ethnic factors, as

well as disability status, affect such access. To be of benefit, health care must not only be available, it must also be accessible in an ongoing and routine fashion. The American Academy of Pediatrics recommends six well-child visits during infancy. An additional three such visits are recommended during a child's second year, annual visits are recommended through age six, and visits every other year through the remainder of childhood. Access to care is essential in order to accomplish the screening and preventive care previously noted, as well as to ensure that children receive treatment for both acute and chronic illnesses.

In addition to access to care, *Healthy People 2010* addresses levels and severity of child health-related issues and conditions. Pediatric asthma and diabetes; accidents, violence, and suicide; mental health; tobacco use; and nutrition and physical activity are areas in which little or no improvement has been seen. Equally important aspects of child health include dental exams and oral health; school nursing and health education; environmental hazards (particularly lead); food-borne pathogens; sexuality; alcohol and other drug use; and vision and hearing. Developmental disabilities, the reduction of specific diseases, and access to a medical home for children with special health care needs are also addressed by *Healthy People 2010*. Each of these constitutes an aspect of child health and can serve as a touchstone for individuals and communities in both the provision and monitoring of child health services.

IRIS J. MELTZER

(SEE ALSO: *Alcohol Use and Abuse; Child Care, Daycare; Childhood Injury; Child Mortality; Child Welfare; Congenital Anomalies; Healthy People 2010; Immunizations; Lead; Maternal and Child Health; Oral Health; Well-Baby Clinics*)

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CHILD MORTALITY

Child mortality is typically defined as the number of deaths of children under five years of age in a given year per one thousand children in this age group. The age parameters, however, may vary among different reports. Some reports might include only children between the ages of one and four years, while others might include all minor children. It is imperative to note the operational definition employed in a report before making comparisons with other reported data.

The utility of child mortality as a health indicator depends upon the population context in which it is used. For example, in a developed country, where the leading global causes of child mortality are not as prevalent, the rates of specific causes of child mortality could be used in the prioritization of prevention programming (e.g., geared toward motor vehicle passenger safety). In a developing country, however, child mortality rates may play a more significant role as an indicator of broader health, and of environmental and social issues, such as malnutrition, water sanitation, poverty, and access to health systems.

From a statistical perspective, it is important to note that child mortality may drastically skew life expectancy measures. For example, the reported life expectancy at birth for a population with a high child mortality rate may be significantly shorter than a population with a low child mortality rate—even though the life expectancy at five years of age might be similar between the two populations.

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(SEE ALSO: *Child Health Services; Infant Mortality Rate; Maternal and Child Health; Mortality Rates; Rates*)

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CHILD WELFARE

Child welfare policies and initiatives target the care, health, and well-being of children, with the goal of improving child health with the public

health sector. These policies and initiatives aim to protect children from the harmful effects of poverty, family and parenting problems, child abuse and neglect, and inadequate resources.

Reducing poverty among children has been a major concern of child welfare. According to the Children's Defense Fund, one in five American children lived in poverty in 2000. The Personal Responsibility and Work Opportunity Reconciliation Act of 1996 changed the emphasis of American welfare policy from subsidizing poor families with children to promoting the employment of adult family members through a variety of programs. The possible long-term impact of this legislation on American children has raised concerns among child advocates, who have recommended a "safety net" of special services for children. The availability of food stamps, Medicaid, health insurance, housing, transportation, and child care through state and federal programs has been viewed as essential to the support of poor families with children.

Child welfare policies and initiatives have also addressed the prevention, identification, and treatment of child abuse and neglect. In 1997, almost 3 million American children were reported to have been abused or neglected. Of those cases reported, almost 1 million were substantiated. Child protective services are available in most American communities for investigating reports of child abuse and neglect and developing plans to address these concerns. Home visitor programs, parenting programs, community counseling and social services, and other forms of family support are intended to prevent or reduce the potential for abuse and neglect of children. However, many children (over 520,000 in 1998) end up being placed outside their homes in foster care, kinship care, or residential care, each year. Tragically, many children suffer severe emotional and physical trauma as a result of child abuse and neglect, and several children die each day from abuse or neglect.

Child advocates stress the need to improve child welfare policies and the welfare system. Improving the welfare of children requires a concerted effort from parents, extended family, neighbors, community services, health professionals and

educators, and the faith community, as well as local, state, and federal government.

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(SEE ALSO: *Child Care, Daycare; Child Health Services; Domestic Violence; Women, Infants, and Children Program [WIC]*)

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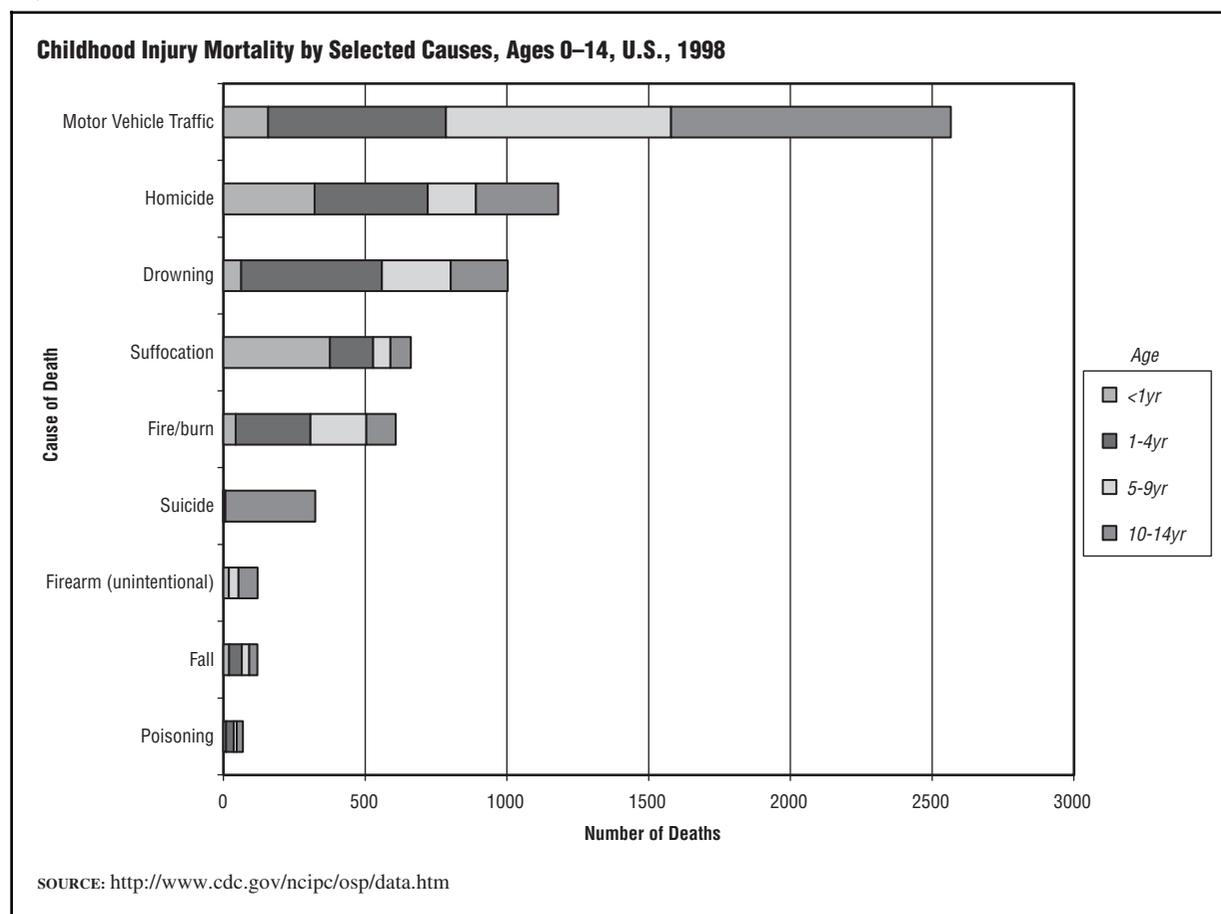
CHILDHOOD INJURY

Injury is defined as "unintentional or intentional damage to the body resulting from acute exposure to thermal, mechanical, electrical, or chemical energy or from the absence of such essentials as heat or oxygen" (National Committee for Injury Prevention and Control, 1989). Examples include damage caused by falls, motor-vehicle crashes (e.g., to pedestrians, cyclists, occupants), poisoning, suicide, fire, drowning, suffocation, and homicide. Many of these events were once considered "accidents," or random unavoidable events. Today, injury events, like diseases, are considered predictable, preventable, and controllable using a public health approach that includes surveillance, risk-factor identification, intervention development and implementation, and evaluation and dissemination.

EPIDEMIOLOGY OF CHILDHOOD INJURY

Since 1950, injuries have replaced infectious diseases as the dominant threat to children's health.

Figure 1



Injuries are the leading cause of the death of children, accounting for 48 percent of mortality in children one to fourteen years of age in the United States. In every industrialized country, injury is the leading killer of children, accounting for almost 40 percent of all deaths in this age group.

About twenty children die every day in the United States from a preventable injury: more than die from all other diseases combined. Motor-vehicle crashes result in the most deaths in every age bracket past age one (see Figure 1). One in four children annually will be injured severely enough to miss school or require medical attention or bed rest, and for every injury-related death, there are approximately 19 hospitalizations, 233 hospital emergency-department visits, and 450 physician visits.

The most serious injuries to children are traumatic brain injuries and injuries from residential

fires, which are particularly lethal, disabling, disfiguring, and the most costly to treat. Traumatic brain injuries account for 39 percent of all injury-related death in those under twenty years of age, or about 5,000 deaths per year in the United States. Residential fires result in about 900 deaths to this age group each year.

Death rates are higher for unintentional injuries than for violence at every age, but violence is a growing problem among children. In 1997, homicide was the third leading cause of death for children ages five to fourteen, and children who witness violence are more likely to have social, emotional, and academic problems later in life.

Many socioeconomic and demographic factors influence childhood injury risks. Among those under age fifteen, African-American and Native-American children have injury rates that are twice

that of whites. Disparities in income, education, housing, employment, and other socioeconomic factors, rather than race, are believed to account for these differences. Location is another risk factor for injury. Most children are injured in the home or on streets and highways.

Nonfatal injuries in children under fifteen result in 25 percent of all hospital emergency-department (ED) visits. An estimated 4.6 million males and 2.9 million females under age fifteen were treated for injuries in U.S. hospital EDs in 2000. Unintentional injuries accounted for 97 percent of the visits, while violence accounted for 3 percent. Nonfatal injury rates were 33 percent higher in males than females younger than five, 41 percent higher in ages five through nine, and 68 percent higher in ages ten through fourteen. Assault and sexual assault account for the greatest number of violence-related visits. Falls; being struck by, or against, something; cycling; and bites and stings were the leading causes of unintentional injury visits to EDs.

THE COSTS OF INJURY

The cost of injury and violence in the United States is estimated at more than \$224 billion per year, an increase of 42 percent between 1990 and 2000. Injury is also one of the most costly afflictions to children. Childhood injuries are estimated to cost \$12 billion in medical-care expenses, representing 14 percent of all medical-care expenses for children. Emergency visits for child and adolescent injury cost an estimated \$4 billion per year. Yet, it is estimated that for every dollar spent on a bike helmet, society can save between \$17 and \$44; a dollar spent on a child safety seat saves between \$18 and \$30; a dollar spent on smoke alarms saves \$27; a dollar spent on pediatric counseling can save \$10; and a dollar spent on poison-control telephone services can save \$7.

INJURY PREVENTION

Childhood injury prevention encompasses prevention of both violence and unintentional injury. Unintentional injury deaths to children declined about 40 percent between 1980 and 2000, and 2000 overall homicide rates were at their lowest level in three decades.

Prevention of childhood injuries has been successful due to three highly interdependent strategies: (1) education and behavior change, (2) technology and engineering, and (3) legislation and enforcement.

Education and behavior-change strategies are designed to reduce risky behaviors, provide early detection of potential harm, and eliminate exposure to environmental hazards. Efforts are usually directed to adult caregivers, parents, and the child, but can also target legislators and engineers, with the goal of improving environmental and product safety. Office-based pediatric injury counseling conducted by pediatricians or their staff and the use of behavior-modification strategies with children have demonstrated effectiveness in reducing injury risk behaviors.

Legislation and enforcement have been very effective in reducing childhood injury. Examples include legislation requiring child safety seats, child-resistant closures on medications and household cleaning agents, fire-retardant clothing, and the use of bicycle helmets. The effectiveness of these laws is related to a motivated public, informed and willing legislators, and strong enforcement programs; however, laws may not be appropriate to address all types of injuries (e.g., falls).

Technology and engineering contribute to the safety of consumer goods, residential homes, neighborhoods, playgrounds, and automobiles. Better product design and performance can prevent many injuries. For example, fire deaths associated with children playing with lighters dropped 43 percent after implementation of a standard requiring cigarette lighters to be child-resistant. Ten-year lithium-powered smoke alarms and automatic sprinkler systems could prevent most fire-related deaths. New products such as airbags, scooters, snowboards, and in-line skates have created new patterns of injuries, often stimulating the development of new protection technology (e.g., smart airbags, lightweight knee and elbow pads, wristguards).

The use of a combination of these and other health-promotion strategies can reduce injuries. It is not a matter of allegiance to one or another type of intervention, but the need for flexibility in combining strategies to arrive at the most effective mix.

Prevention strategies include installing and maintaining smoke alarms properly; correctly using child safety seats, booster seats, and safety belts; reducing hot-water temperatures; and installing four-sided fencing around residential pools. Improving the safety of toys, installing window guards and stair gates, increasing the use of bicycle helmets and sports protection devices, slowing traffic speeds in areas where children walk and play, and reducing bullying will all prevent injuries. Supervising children at play, training children to evacuate in a fire, building safe walking paths, enforcing child-protection laws, packaging medications in child-resistant containers, and reducing access to lethal weapons would also help reduce injuries in children. Some claim that implementing proven and effective environmental interventions alone could reduce childhood injury deaths by as much as one-third.

Organized community-based injury-control programs, such as those in Sweden, have demonstrated that health-promotion approaches to injury prevention can be both cost-effective and popular with the public. If the United States had injury death rates as low as Sweden's, 4,700 excess child-injury deaths a year would be prevented.

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(SEE ALSO: *Child Health Services; Child Mortality; Child Welfare; Children's Environmental Health Initiative; Child-Resistant Packaging; Domestic Violence*)

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CHILDREN'S ENVIRONMENTAL HEALTH INITIATIVE

It is well known that children are different from adults when it comes to susceptibility to environmental exposures. The studies of Japanese exposed to A-bomb radiation showed that children,

especially those with in utero exposures, had more and earlier cancers than did adults who were exposed. The hormone DES and the sedative thalidomide caused birth defects and (in the case of DES) cancer in offspring of women who were given the drugs during pregnancy, with no such effects found in exposed adults. Successively, lead, PCBs, and methylmercury have been shown to cause subtle impacts on IQ and cognition in children at levels much lower than those which cause effects in adults. More recently, questions have been raised about endocrine effects of chemicals on children exposed during critical periods of development, as well as about the causes of developmental disabilities in children.

Children also have different exposure patterns. Their intake rates of food, water, and air are higher, per body weight, because they have higher rates of metabolism. They eat different arrays of foods than adults and their proximity to the ground, their play behaviors, and their mouthing habits result in a greater exposure to contaminants in dust and soil.

In the United States, "children's environmental health," as a field of study, resulted from the work of a small technical committee of the American Academy of Pediatrics that was established in 1957 as the Committee on Radiation Hazards and Epidemiology of Malformation. As is evident from this title, initial concerns were over the hazards of radiation (diagnostic and fallout-related) and the causes of birth defects. However, the committee soon became involved in other issues, such as the safety of drinking water, and in 1962 it was renamed the Committee on Environmental Hazards (it is now called the Committee on Environmental Health). It published its first statement on environmental risks to children, *The Hazards of Radioactive Fallout*, in 1962. Over time, the committee has formulated positions for the pediatric community on numerous environmental hazards for children including environmental tobacco smoke, air pollution, lead poisoning prevention, child labor, and noise levels in newborn nurseries.

In the early 1990s, two important advocacy organizations were created that did much to further the initiative: the Alliance to End Childhood Lead Poisoning and the Children's Environmental Health Network (CEHN). These two advocacy organizations brought various environmental and

public health scientists and advocates together to catalyze their efforts into a much larger movement. By 1992 the major federal agencies (Centers for Disease Control and Prevention [CDC], Housing and Urban Development [HUD], and the Environmental Protection Agency [EPA]) had completed strategic plans to eliminate lead poisoning, a bolder goal than had ever previously been put forward. Congress had enacted the Lead-Based Paint Hazard Reduction (1992), Title XI of the Housing and Community Development Act, which directed all three agencies to put in place a regulatory and assistance framework to address the abatement of lead in housing. In 1991, CEHN developed the first training curriculum for pediatric environmental health for health care providers, and in 1993, in partnership with the National Institute of Environmental Health Sciences (NIEHS) held the first scientific meeting on this topic. CEHN promoted consideration of children's unique exposures, physiology, and susceptibility based on developmental stages.

In 1993 the National Academy of Sciences (NAS) published the report *Pesticides in the Diets of Infants and Children*, in which the expert committee concluded that the EPA risk-assessment process for pesticides was inadequate for ensuring that children's health would be protected because the EPA was not considering the dietary patterns of young children (which are very different than adults) nor their susceptibilities (testing did not assess a number of child health endpoints such as developmental neurotoxicity.) The report concluded that the risk-assessment procedures that were used by the EPA, which considered that two tenfold "uncertainty factors" would be sufficient for extrapolating from high-dose testing of laboratory animals to lower dose exposures of people, were inadequate, and suggested that the EPA should apply an additional factor of ten to account for the susceptibility of children.

In 1993, numerous administrative reforms were undertaken, including improvement of dietary surveys, pesticide residue monitoring, and food intake models to better assess dietary patterns of children. Additionally, EPA moved to add child health endpoints to pesticide studies required of manufacturers for approval of pesticides. In 1996 the U.S. Congress enacted the Food Quality Protection Act (FQPA). This act included a requirement for an additional tenfold "margin of safety"

to protect children. There were other innovative provisions (also recommended by the NAS) including the requirement for aggregate (all routes of exposure) and cumulative (all pesticides that share a common mode of action) assessment of pesticide risks to children. In the case of the EPA, the pesticide reassessments required by the FQPA have already resulted in cancellations of many of the household uses of organophosphate pesticides (for example, chlorpyrifos and diazinon), which were particularly risky for children because of the greater potential for exposure and the likelihood of cumulative impacts from all of the organophosphates. Likewise, uses on foods that children eat (e.g., apples) have been sharply curtailed (e.g., chlorpyrifos and methyl parathion). However, cumulative assessments have yet to be completed, and it is difficult to predict what the total impact of FQPA will be by the time of the completion of required reviews of all food pesticide standards in 2006. FQPA contained an additional provision requiring screening and testing of pesticides for potential to disrupt the endocrine system.

Meanwhile, progress was made on other fronts. The EPA, in 1996, published a white paper on children's environmental health that established a number of goals, most of which were eventually realized. Following on this, the EPA, NIEHS, and CDC joined together in 1998 in the Children's Environmental Initiative that funded the first Centers for Children's Environmental Health and Disease Prevention Research at academic medical and public health centers across the country. The EPA also established an Office of Children's Health Protection, which coordinates policies across all environmental areas and issues reports on the state of children's health and the environment. To guide its efforts and assist with establishing priorities, EPA created a Children's Health Protection Advisory Committee.

In 1997, President Clinton issued an executive order on children's environment, health, and safety requiring that all federal agencies consider the risks to children in their actions. The executive order also established the Council on Children's Environmental Health, co-chaired by the secretary of health and human services and the Environmental Protection Agency administrator. The executive order required that all agencies incorporate knowledge about exposures and susceptibilities to children in their decisions. This resulted in

policy changes in a number of areas, most notably the Food and Drug Administration's policy on pediatric testing of drugs. The council soon established a focus on four areas: childhood cancer, developmental disabilities, asthma, and injuries. By 2000 it had brought about a number of changes, including the creation of a national childhood cancer registry, the development of an integrated federal strategy to eliminate lead poisoning, and a national plan of action to address the asthma epidemic. It also developed the vision and plans for a children's environmental prospective study, a study that would enroll large numbers of children as infants and track them in an effort to understand the impacts of environmental exposures early in life on developmental and health outcomes.

Between 1998 and 2000 the federal Agency for Toxic Substances and Disease Registries and the EPA established so-called Pediatric Environmental Health Specialty Units (PEHSUs) in medical institutions in each of the ten federal regions in the United States. The PEHSUs provide clinical consultation and referral services for evaluation of individual pediatric patients with suspected environmental health problems. In 1999 the American Academy of Pediatrics published the *Handbook of Pediatric Environmental Health*, a manual that provides a definitive guide to this area for clinicians and broad coverage of the field. Children's environmental health is now established as an area of study in pediatrics. Moreover, consideration of children's risks is becoming a routine part of health, environment, and safety assessments. Thus, the expansion of scientific capability in these areas will go hand in hand with being able to provide health protection for children.

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(SEE ALSO: *Agency for Toxic Substances and Disease Registry; Environmental Determinants of Health; Environmental Protection Agency; Food and Drug Administration; Lead; Maternal and Child Health; Pesticides; Risk Assessment, Risk Management; Uncertainty Analysis*)

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CHILD-RESISTANT PACKAGING

In the 1960s there were several ingestions of aspirin by children. Many of these resulted in serious injury or death. In response, the United States Congress passed the Poison Prevention Packaging Act (PPPA) of 1970 which requires child-resistant packaging on products that could cause serious injury if accessed by young children.

Child-resistant packaging, or "special packaging," is designed or constructed to be significantly difficult for children under five years of age to open within a reasonable time but not difficult for normal adults. Child-resistant packaging saves lives. It is estimated that more than eight hundred children's lives have been saved by the requirement of child-resistant packaging on aspirin and prescription drugs. However, such packaging is called child-resistant, rather than childproof, because some children will be able to open it. For this reason experts caution people to lock up all medicine and hazardous material out of the reach of children.

SUZANNE BARONE

(SEE ALSO: *Childhood Injury; Safety; Safety Standards*)

CHINESE TRADITIONAL MEDICINE

Chinese traditional medicine comprises four interrelated therapies: Zhong Yao (herbal medicine), Zhen Jiu (acupuncture and moxibustion), Qi Gong

(vital energy exercises), and Tui Na (therapeutic massage), although some purists prefer not to include the latter two theories. There is no distinct demarcation between clinical medicine and public health practice. Chinese traditional medicine considers a person's well-being physically and mentally. It approaches health with due consideration to nature in all its complexity and multidimensionality. Enhancing natural healing is central to Chinese medical practice. The basic concepts underlying all Chinese medical therapies are the Taoist doctrine of yin and yang (the theory of opposites); the five elements (metal, wood, water, fire, and earth); and "Qi" (pronounced chee), the vital energy of life that circulates in the human body via a system of pathways.

Traditional Chinese medicine has a different paradigm from that of Western biomedicine, and the world depicted in the former is not easily translated to the latter. Chinese medicine treats the body as a microcosm that follows macrocosmic laws and is continually influenced by macrocosmic factors, such as the seasonal patterns created by conjunctions of sun, moon, and stars. It defines health as the process of refining body essences, cultivating vital and spiritual forces, and maximizing physiological functions. Generally, biomedicine treats the body as a sovereign entity and sees health as the absence of pathology.

In China today, there is an effort to integrate Chinese traditional medicine and biomedicine in clinical practice and research. Doctors trained in biomedicine regularly prescribe herb-based antibiotics, and traditional doctors often depend on X-rays and scientific instruments for their diagnoses and treatment of injuries.

HERBAL MEDICINE (ZHONG YAO)

The earliest known work on Chinese herbs appeared as early as 100 B.C.E. Li Shih-chen's (1386-1644) chronicle of herbal medicines (1578), which has been used for the last four centuries, consists of 52 volumes, cataloging 1,898 herbs or substances and a total of 11,096 separate prescriptions. The *Encyclopedia of Traditional Chinese Medicinal Substances*, published by the Jiangsu College of New Medicine in 1997, identifies 5,767 substances. The majority of Chinese traditional medicines are of herbal origin, but minerals and animal parts are

also included in Zhong Yao pharmacopoeia. Prescriptions usually comprise four or more herbs, with interaction among them for complementary and synergistic pharmacology. They are boiled as medicinal tea or processed into pills for oral ingestion. Some of these substances are also formulated as paste or plaster for external application.

In herbal medicine, there are four main diagnostic methods: visual inspection, inquiry, auscultation and smelling, and pulse diagnosis. The pulse reveals specific aspects of a person's health. Taking a pulse is, therefore, one of the diagnostic acts of a Chinese herbalist doctor. The doctor tries to identify the psychosocial, environmental, and dietetic causes of symptoms, and prescribes remedies, including advice on psychosocial issues.

Another belief is that the use of medicines must be assisted by nourishment of the body. Herbal therapies often provide nutrients for the body to overcome illness and to build up the body's defense against disease. Good medicines and nutrients replenish and strengthen the essence of "Qi." When Qi, which flows through channels and collaterals (jing and luo) in the body, is blocked or out of balance, illness or pain ensues.

ACUPUNCTURE/MOXIBUSTION (ZHEN JUI)

Zhen Jiu consists of acupuncture and moxibustion, both of which have been practiced as therapeutic techniques in China for more than 2,000 years. They are used to induce stimulation in various locations of the body to treat ailments and relieve pain. The practice requires a thorough knowledge of anatomy and physiology as well as the system of Qi flow. There are fourteen channels and numerous collaterals under the body surface, which connect the body surface to various internal organs. Along the channels and collaterals are more than 360 acupoints and a number of extraordinary acupoints.

Acupuncture (the use of needles), and moxibustion (the use of heated herbs), aimed at specific acupoints along the pathways (channels and collaterals) in the body, can correct the flow of Qi and blood to restore optimal health and to block pain. Such stimulation can prompt a cascade

of chemicals in the muscles, spinal cord, and brain to release the body's natural painkilling endorphins (a morphine-like substance generated by the body) and can impact on Qi, blood circulation, and various body functions. Magnets, mild electric current, manual pressure, or even low frequency lasers can also stimulate these acupoints to the same effect. These trigger points are rich with nerve endings that are linked to various parts of the human body. Some of the sensitive points that affect various body functions are located in the ear and on the sole of the foot. Acupuncture's painkilling effect has been used successfully for anesthesia in surgery, including thyroid surgery and some thoracic procedures.

VITAL ENERGY (QI GONG)

Qi Gong, as an art of healing and health preservation, dates back to the Tang Yao period, some twenty centuries B.C.E. Dancing and body movements, and various ways of breathing, exhalation, and exclamation were recognized as ways to readjust some functions of the human body and treat diseases.

Medical scholars throughout Chinese history, beginning with the Qin dynasty (200 B.C.E.), have written about Qi and body movements. In the Song and Yuan dynasties (900–1300 C.E.), Taoist and Buddhist priests introduced the importance of cultivating the Tiantian (inner elixir). Since 1978, Qi Gong masters have popularized such practice for health preservation and disease prevention.

One of the characteristics of Qi Gong is to allow practitioners to cultivate their demeanor and stamina to enable them to engage in strenuous activities. Another is to cultivate the ability of practitioners to transmit Qi to patients through needles or their hands. Patients are also taught to undertake Qi exercises to maintain health. There are dynamic exercises involving multiple movements of limbs and the body and static exercises that call for simple postures with mind concentration and breathing exercise. After symptoms and signs are analyzed, Qi doctors prescribe specific therapies for problems. Inappropriate Qi therapies can be harmful and Qi exercises need to be adapted and individualized to each person's needs and situation.

MASSAGE (TUI NA)

Tui Na, literally meaning pushing and pulling, refers to a system of massage, manual stimulation and manipulation of muscles, tendons, ligaments, joints, and trigger points. Different schools—each with its own theory, training, style, and practice—have been established in various regions of China. Those in northern China tend to be more vigorous, while those in southern China are more subtle. Some use rolling movements, while others focus on bone setting and digital point pressure. Some aim at health preservation, while others are designed to treat specific ailments.

A distinct aspect of Tui Na is the extensive training of the hands to reach a state of “conditioned reflex,” which is necessary to accomplish focused and forceful movements on various areas of the body. Generally speaking, all massage methods promote blood circulation, remove blood stasis, restore and treat injured soft tissues, and correct deformities and abnormal positions of bones and muscles. Dynamic wave signals can influence the physiological function, the pathological state of the body fluid, the balance of yin and yang, Qi blood circulation, and mind and emotion interaction.

The relationship among Qi Gong, acupuncture, and Tui Na are quite close, as they are all based on the same theoretical basis of Chinese traditional medicine.

**CHINESE TRADITIONAL MEDICINE
IN THE WEST**

For some time, the scientific community in the West looked upon traditional remedies in the East with suspicion. The former could not accept the claim of the latter without objective scientific evaluation. In recent decades, however, there has been a healthy crossover from Western biomedicine to Chinese traditional medicine. Pharmacologically, the cross-fertilization came earlier. Aspirin, one of the West’s popular pain-relieving compounds, for instance, has its origin in a tree bark.

Biomedicine is increasingly looking toward traditional medicines for possible solutions to some of the intractable chronic illnesses. As life expectancies lengthen, chronic illnesses will increase. As environment-related diseases increase

and lifestyle-related illnesses become more prevalent, Chinese traditional medicine, which takes a more holistic view of health and has had thousands of years of empirical successes, should offer different approaches to the treatment of diseases and advice for health preservation and promotion.

At the end of the twentieth century there was an explosion of interest in herbs as food supplements for better health. The trend of self-help for better health fueled this interest. Ginseng is an example of an herb that is widely accepted as an agent to help fight cancer as well as to add vitality to life. While many Chinese herbal medicines have proven to be effective, however, quality and dosage control remains a serious concern.

Pharmaceutical companies have to comply with governmental regulations on the production of drugs, but food supplements are not subject to similar review and control for quality and proper dosage. The perception that all herbs, because they are natural, have no side effects is erroneous and some herbal substances are toxic. It is important therefore to be educated about herbs before consuming them.

JACK CHIEH-SHENG LING

(SEE ALSO: *Acculturation; Barefoot Doctors; Bioculturalism; Cultural Factors; Ethnicity and Health; Holistic Medicine; Immigrants, Immigration; Traditional Health Beliefs, Practices*)

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CHI-SQUARE TEST

Studies often collect data on categorical variables that can be summarized as a series of counts. These counts are commonly arranged in a tabular format known as a contingency table. For example, a study designed to determine whether or not there is an association between cigarette smoking and asthma might collect data that could be assembled into a 2-2 table. In this case, the two columns could be defined by whether the subject smoked or not, while the rows could represent whether or not the subject experienced symptoms of asthma. The cells of the table would contain the number of observations or patients as defined by these two variables.

The chi-square test statistic can be used to evaluate whether there is an association between the rows and columns in a contingency table. More specifically, this statistic can be used to determine whether there is any difference between the study groups in the proportions of the risk factor of interest. Returning to our example, the chi-square statistic could be used to test whether the proportion of individuals who smoke differs by asthmatic status.

The chi-square test statistic is designed to test the null hypothesis that there is no association between the rows and columns of a contingency table. This statistic is calculated by first obtaining for each cell in the table, the expected number of

Table 1

Observed values for data presented in a two-by-two table			
Variable 2	Variable 1		Total
	Yes	No	
Yes	a	b	a+b
No	c	d	c+d
Total	a+c	b+d	n

SOURCE: Courtesy of author.

events that will occur if the null hypothesis is true. When the observed number of events deviates significantly from the expected counts, then it is unlikely that the null hypothesis is true, and it is likely that there is a row-column association. Conversely, a small chi-square value indicates that the observed values are similar to the expected values leading us to conclude that the null hypothesis is plausible. The general formula used to calculate the chi-square (X^2) test statistic is as follows:

$$X^2_{(df)} = \sum_{i=1}^{r \cdot c} \frac{(O_i - E_i)^2}{E_i}$$

where O = observed count in category; E = expected count in the category under the null hypothesis; df = degrees of freedom; and c, r represent the number of columns and rows in the contingency table.

The value of the chi-square statistic cannot be negative and can assume values from zero to infinity. The p-value for this test statistic is based on the chi-square probability distribution and is generally extracted from published tables or estimated using computer software programs. The p-value represents the probability that the chi-square test statistic is as extreme as or more extreme than observed if the null hypothesis were true. As with the t and F distributions, there is a different chi-square distribution for each possible value of degrees of freedom. Chi-square distributions with a small number of degrees of freedom are highly skewed; however, this skewness is attenuated as the number of degrees of freedom increases. In general, the degrees of freedom for tests of hypothesis that involve an $r \times c$ contingency table is

Table 2

Expected values for data presented in a two-by-two table

Variable 2	Variable 1		Total
	Yes	No	
Yes	$(a+b)(a+c)/n$	$(a+b)(b+d)/n$	a+b
No	$(c+d)(a+c)/n$	$(c+d)(b+d)/n$	c+d
Total	a+c	b+d	n

SOURCE: Courtesy of author.

equal to $(r-1)(c-1)$; thus for any 2x2 table, the degrees of freedom is equal to one. A chi-square distribution with one degree of freedom is equal to the square root of the normal distribution, and, consequently, either the chi-square or standard normal table can be used to determine the corresponding p-value.

The chi-square test is most widely used to conduct tests of hypothesis that involve data that can be presented in a 2x2 table. Indeed, this tabular format is a feature of the case-control study design that is commonly used in public health research. Within this contingency table, we could denote the observed counts as shown in Table 1. Under the null hypothesis of no association between the two variables, the expected number in each cell under the null hypothesis is calculated from the observed values using the formula outlined in Table 2.

The use of the chi-square test can be illustrated by using hypothetical data from a study investigating the association between smoking and asthma among adults observed in a community health clinic. The results obtained from classifying 150 individuals are shown in Table 3. As Table 3 shows, among asthmatics the proportion of smokers was 40 percent (20/50), while the corresponding proportion among asymptomatic individuals was 22 percent (22/100). By applying the formula presented in Table 2, for the observed cell counts of 20, 30, 22, and 78 (Table 3) the corresponding expected counts are 14, 36, 28, and 72. The observed and expected counts can then be used to calculate the chi-square test statistic as outlined in Equation 1. The resulting value of the chi-square

Table 3

Hypothetical data showing chi-square test

Symptoms of asthma	Ever smoke cigarettes		Total
	Yes	No	
Yes	20	30	50
No	22	78	100
Total	42	108	150

SOURCE: Courtesy of author.

test statistic is approximately 5.36, and the associated p-value for this chi-square distribution that has one degree of freedom is 0.02. Therefore, if there was truly no association between smoking and asthma, there is a 2 out of 100 probability of observing a difference in proportions that is at least as large as 18 percent (40%-22%) by chance alone. We would therefore conclude that the observed difference in the proportions is unlikely to be explained by chance alone, and consider this result statistically significant.

Because the construction of the chi-square test makes use of discrete data to estimate a continuous distribution, some authors will apply a continuity correction when calculating this statistic. Specifically,

$$\chi^2_{(df)} = \sum_{i=1}^{r-c} (|O_i - E_i| - 0.5)^2 / E_i$$

where $|O_i - E_i|$ is the absolute value of the difference between O_i and E_i and the term 0.5 in the numerator is often referred to as *Yates correction factor*. This correction factor serves to reduce the chi-square value, and, therefore, increases the resulting p-value. It has been suggested that this correction yields an overly conservative test that may fail to reject a false null hypothesis. However, as long as the sample size is large, the effect of the correction factor is negligible.

When there is a small number of counts in the table, the use of the chi-square test statistic may not be appropriate. Specifically, it has been recommended that this test not be used if any cell in the table has an expected count of less than one, or if 20 percent of the cells have an expected count that is greater than five. Under this scenario, the *Fisher's*

exact test is recommended for conducting tests of hypothesis.

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(SEE ALSO: *Normal Distributions; Probability Model; Sampling; Statistics for Public Health; T-Test*)

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CHLAMYDIA

Chlamydia is a common sexually transmitted disease (STD) caused by *Chlamydia trachomatis*, a bacterium. Chlamydia can be transmitted during vaginal, anal, or oral sex. An estimated 3 million Americans are infected with chlamydia each year. Three-quarters of infected women and half of infected men have no symptoms. Sexually active girls and young women are especially susceptible to chlamydia because the cells that form the lining of the immature cervix are easily invaded by the bacteria. Women with symptoms might have an abnormal vaginal discharge or a burning sensation when urinating. When the infection spreads from the cervix to the fallopian tubes, some women still have no symptoms; others have lower abdominal pain, low back pain, nausea, fever, pain during intercourse, and bleeding between menstrual periods. Whenever the infection spreads past the cervix, permanent and irreversible damage can occur to the fallopian tubes, uterus, and tissues surrounding the ovaries. This damage can lead to chronic pelvic pain, infertility, and potentially fatal ectopic pregnancy.

Widely available laboratory tests can accurately detect chlamydia bacteria in a urine sample. Chlamydia can be treated and cured with antibiotics. Persons who engage in sexual behaviors that place them at risk of STDs should use latex or

polyurethane condoms every time they have sex, limit the number of sex partners, and not alternate partners. All young, sexually active, unmarried persons who do not use condoms every time they have sex should be screened for chlamydia yearly. Infected persons should notify all sex partners so they can receive treatment.

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(SEE ALSO: *Sexually Transmitted Diseases*)

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CHLORINATION

Disinfection is the most important step in the water treatment process to destroy pathogenic bacteria and other harmful agents. Chlorination is a very common and effective method for the disinfection of drinking water, and it has been the single most important process for assuring the bacteriological safety of potable water supplies. The practice was introduced in Belgium in 1903, and was first used in the United States in 1908 in Chicago. A sharp decline in typhoid deaths was noted following the onset of chlorination, as was also the case with cholera, dysentery, and hepatitis A. Chlorination has also contributed to a major decline in infant mortality rates due to waterborne illness. Waterborne epidemics have virtually disappeared in the industrialized world. When waterborne disease outbreaks have occurred, they have generally been traced back to a failure of the chlorination system.

Chlorine is a very cost-effective disinfection process. Chlorine concentration is generally 1 milligram per liter, which is about 1 part per million. Chlorine can be added directly as chlorine gas, or indirectly as sodium-hypochlorite solution.

Chlorine is applied both to drinking water and to wastewater. *Chlorine demand* is a measure of the chlorine added to the water system that combines with the impurities and is not available for disinfection. The lower the pH of the water, the more effective chlorine is for disinfection. After the chlorine is added to the water, there must be sufficient contact time for the chlorine to effectively destroy the bacteria.

The chlorination system generally includes chlorine storage and feed equipment. In most cases, a metering device (a chlorinator) allows the chlorine to mix via a small side stream of water. In contrast to a short-acting disinfectant (such as ozone), chlorine also has the benefit of being residual in the system. Should a pipe break or another type of accident occur, there is usually enough residual chlorine in the system to provide for protection of the water supply. Chlorine is used extensively when interruptions of water piping or cross-connections occur. Chlorine used at higher amounts will kill all potential organisms present, but at usual treatment levels certain resistant organisms, such as cryptosporidia, may survive. Chlorine is also used to clean reservoirs, basins, wells, and pipes. Algae can also be controlled with the use of chlorine.

Chlorine does have some undesirable characteristics, including imparting undesirable taste and odors to the water, especially when phenol is present. Also, the reaction of chlorine with the organic material that can be present in the water results in a group of disinfectant by-products, known as the trihalomethanes (THMs). The most common THM is chloroform, which has been shown to cause cancer in laboratory animals. Chlorine itself is highly toxic and must be handled with extreme care at the water treatment facility.

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(SEE ALSO: *Disinfection By-Products in Drinking Water; Drinking Water; Water Quality; Water Treatment*)

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CHLOROFLUOROCARBONS

Chlorofluorocarbons (CFCs) are a class of chemicals that contain only atoms of carbon, chlorine, and fluorine. As a group, they are unreactive, stable, and poorly soluble in water. Commercially, the most important CFCs were derivatives of methane and ethane. These included trichlorofluoromethane (CFC-11), dichlorodifluoromethane (CFC-12), 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113) and 1,2-dichloro-1,1,2,2-tetrafluoroethane (CFC-114). CFCs were first introduced in the 1930s as safe replacements for refrigerants such as sulfur dioxide, ammonia, chloroform, and carbon tetrachloride. During World War II they were used to produce aerosols of insecticides. During the next fifty years the applications expanded to include foam blowing, precision cleaning, air conditioning, refrigeration, and propellants for medicinal, cosmetic, food, and general-purpose aerosols. These uses eventually resulted in large emissions of CFCs into the atmosphere. Because of their low chemical reactivity, CFCs typically have long atmospheric residence times, and as a consequence are distributed globally.

In 1974, M. Molina and F. Rowland hypothesized that when CFCs reached the stratosphere they would break down to release chlorine atoms. The chlorine atoms would then react with stratospheric ozone, breaking it down into oxygen. Since stratospheric ozone absorbs much of the sun's ultraviolet radiation, decreased stratospheric ozone levels could lead to increased ground-level ultraviolet radiation. This could adversely affect crop growth, and also lead to increases in cataracts and nonmelanoma skin cancer. Following reports of a marked drop in "column ozone" over Antarctica (the "ozone hole") during the Antarctic winter of 1986, most of the nations of the world drafted and signed an agreement calling for the phaseout of CFCs. This agreement is known as the Montreal Protocol. Included were all CFCs and bromochlorofluorocarbons (halons), which are used in fire suppression systems.

The banning of CFCs has led to research to identify other chemicals that can be used in the same applications but without the same environmental concerns. Two classes of chemicals that have been identified are the hydrochlorofluorocarbons (HCFCs) and the hydrofluorocarbons (HFCs). The presence of hydrogen in the molecule promotes attack by hydroxyl radicals in the atmosphere leading to more rapid breakdown and shorter atmospheric lifetimes. While HFCs do not contain chlorine and therefore can not contribute to ozone depletion, HCFCs do contain chlorine and can contribute to ozone depletion. However, due to the presence of hydrogen, their atmospheric lifetimes are much shorter than the CFCs and the corresponding ozone depletion values are smaller, typically by a factor of between 10 and 100. In subsequent amendments to the Montreal Protocol, the HCFCs have been classified as transitional substances and they are also scheduled for a phase-out, but at much later dates.

One of the reasons the CFCs have been used so extensively and in such a wide variety of applications is their low level of toxicity. The acute, median lethal concentration for a four-hour exposure to many of these materials is greater than 50,000 parts per million (ppm) (5% in the air). In longer term exposure studies, rarely are effects seen below 20,000 ppm (2% in the air). The one exception to this is the potential of all of these compounds, as well as hydrochlorocarbons and hydrocarbons, to sensitize the heart to the action of adrenaline. In the 1960s, it was first reported that teenagers were abusively inhaling CFCs to get a preanesthetic "high." However, in some cases, the individual would get excited, run around and then die, with no apparent cause of death. Subsequent research demonstrated that this effect could be reproduced in laboratory animals which are now used to test possible CFC replacements.

GEORGE M. RUSCH

(SEE ALSO: *Ambient Air Quality [Air Pollution]; Atmosphere; Hazardous Air Pollutants; Melanoma; Skin Cancer; Ultraviolet Radiation*)

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CHOLERA

Cholera is an acute diarrheal illness caused by a bacterium, *Vibrio cholerae*. There are several environmental strains of *Vibrio cholerae*, which are found mainly in brackish waters and marine environments, but only two strains are responsible for cholera epidemics in humans, serogroups O1 and O139.

The first described cholera pandemic was in Europe from 1817 to 1823. However, the disease was known in Asia prior to that, with the first possible descriptions dating back as far as 2,000 years ago in India and China. Since that first pandemic there have been a total of seven pandemics. The cholera outbreaks that occurred in London, England in 1849 and 1854 are important in the history of the disease. John Snow, a physician, recognized that cholera was spread via water contaminated with human waste when he identified the source of the London outbreak as the Broad Street water pump. This discovery stimulated the future development of adequate water and sewage systems, which led to the control of many infectious diseases.

The seventh pandemic started in Sulawesi, an island in Indonesia, in 1961 and then spread rapidly through Asia and the Middle East. In 1970, for the first time in over one hundred years, cholera was found in West Africa. In 1991, cholera appeared in Peru and quickly spread throughout the remainder of South and Central America. As was the case with Africa, cholera had not been seen in the western hemisphere for over one hundred

years. As of 2001, the seventh cholera pandemic showed no signs of abating.

Cholera is acquired by ingestion of *V. cholerae* in water, seafood, or other foods that have been contaminated by human excrement. The incubation period can range from a few hours to five days, depending on the inoculum size and the underlying health of the person. Cholera can cause a spectrum of disease, from no clinical symptoms to a mild diarrheal illness or a severe fulminant illness resulting in death. The diarrhea is caused by an enterotoxin produced by the *V. cholerae* that stimulates the small intestine to secrete large volumes of fluid and electrolytes. Some factors that predispose to severe disease include having blood group O, low gastric acid levels, and malnutrition. The very young and the very old are at particular risk for severe disease. Persons living in endemic areas appear to develop some natural immunity to the infection.

In symptomatic infections, there is an abrupt onset of copious diarrhea, often accompanied by abdominal cramps and vomiting. The diarrhea is typically watery and clear with mucous flecks—often described as “rice water stools.” It is unusual for fever to develop. Uncomplicated cholera is a self-limited disease that resolves in three to six days. In more severe cases, fluid losses from diarrhea can amount to over 20 liters a day and can lead to profound dehydration that produces weakness, muscle cramping, loss of skin turgor, and sunken eyes and cheeks. If the fluid losses are not rapidly corrected, death results. The fatality rate can be over 50 percent in cases of severe cholera; however, with prompt and adequate rehydration the death rate may be as low as 1 to 2 percent.

The infection is diagnosed by identification of *V. cholerae* bacteria in stool. The organism can be grown in the laboratory on special alkaline culture media. It appears microscopically as curved, gram-negative rods. A clinical diagnosis can be made in severe cases if a patient presents with profuse, watery diarrhea in an endemic region. There are few other illnesses that cause such copious diarrhea.

The mainstay of treatment is fluid replacement, either intravenously or orally. In very severe cases, intravenous fluid replacement should be used. When fluids are administered by mouth, it is important to use an oral rehydration solution that contains the correct mix of sugars and electrolytes.

Antibiotics can be used to shorten the duration of illness by several days. Tetracycline, furazolidone, or doxycycline are all effective.

Prevention of cholera depends upon good sanitation and hygiene, including treatment of water supplies, adequate sewage control, and strict hygiene in food preparation. Good food preparation involves hand washing before contact with food, thorough cooking of food, eating food while it is still hot, and not allowing cooked food come into contact with raw foods or with water or ice.

There are several vaccines currently available to prevent cholera. The original cholera vaccine was a parenteral-killed preparation that provided about 50 to 60 percent protection and was only effective for a period of three to six months. This vaccine is no longer recommended for use. The World Health Organization currently advocates the use of a killed whole cell *V. cholerae* O1 vaccine (WC/rBS), which is combined with one of the toxin subunits and is given in two doses one week apart. This newer vaccine has been shown to confer 85 to 90 percent protection for six months. The vaccine can be used to prevent a cholera outbreak in a population felt to be at high risk of an outbreak, such as the inhabitants of refugee camps. It can also be offered to travelers going to high-risk regions. Another recently developed effective vaccine is the oral, single dose, live attenuated *V. cholerae* strain, devoid of the A toxin subunit (Mutachol), that provides from 62 to 100 percent protection for about six months. The level of protection varies for different cholera biotypes.

A concern about future cholera outbreaks is the possible emergence of new biotypes. Until 1992, the only strain of cholera identified as causing epidemics in humans was *V. cholerae* O1. That year a new serotype, O139, emerged in India. Neither previous exposure to O1 cholera, nor vaccination with current vaccines, confers protection against O139. Because *V. cholerae* exists naturally in brackish waters, and because of the possibility of new biotypes emerging, it is unlikely that cholera will ever be eradicated as a human pathogen. Good hygiene and sanitation are the best strategies we have for control of this disease.

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(SEE ALSO: *Communicable Disease Control; Epidemics; Waterborne Diseases*)

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CHOLESTEROL

See Blood Lipids; Cholesterol Test; HDL Cholesterol; LDL Cholesterol; VLDL Cholesterol

CHOLESTEROL TEST

A lipid profile test measures the lipids in the bloodstream most associated with risk of atherosclerosis. Lipids measured with this test include total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides. Originally, this was done by a lengthy ultracentrifugation of serum or plasma, which created zones of particles with different densities. More recently the process has been automated using rapid enzymatic processes that measure total cholesterol, HDL cholesterol, and triglycerides. In the fasting state, one can then use the Friedwald formula to calculate LDL cholesterol: $\text{LDL cholesterol} = \text{total cholesterol} - \text{HDL cholesterol} - \text{triglycerides}$. The ratio of total cholesterol divided by HDL cholesterol is used to predict the risk of coronary heart disease.

DONALD A. SMITH

(SEE ALSO: *Atherosclerosis; Blood Lipids; Cholesterol Test; HDL Cholesterol; LDL Cholesterol; Triglycerides; VLDL Cholesterol*)

CHRONIC ILLNESS

A chronic illness is a disease that has a prolonged course, does not resolve spontaneously, and rarely is completely cured. Typical examples include cancer, heart disease, diabetes, and arthritis. These illnesses are usually more common as a population ages. In the United States, as in most developed countries, chronic diseases account for approximately 70 percent of all deaths, and a similar proportion of all health care costs. Recent analyses have shown chronic illnesses to be a more important cause of the burden of disease in developing countries than was previously recognized.

The commonly held belief that chronic illnesses have noninfectious origins has become blurred. A few chronic illnesses, including cervical cancer, liver cancer, and some forms of arthritis, now appear to have infectious causes. Given the large chronic disease burden and the aging population, efforts to reduce the burden, arrest or slow deterioration, and prevent disability from these illnesses will be among the paramount issues in public health for the foreseeable future.

JAMES S. MARKS

(SEE ALSO: *Aging of Population; Cancer; Cardiovascular Diseases; Diabetes Mellitus; Epidemiologic Transition; Global Burden of Disease; Noncommunicable Disease Control*)

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CHRONIC RESPIRATORY DISEASES

Chronic respiratory diseases include disorders that affect any part of the respiratory system, not only the lung but also the upper airway (nose, mouth, pharynx, larynx, and trachea), the chest wall and diaphragm, and the neuromuscular system that

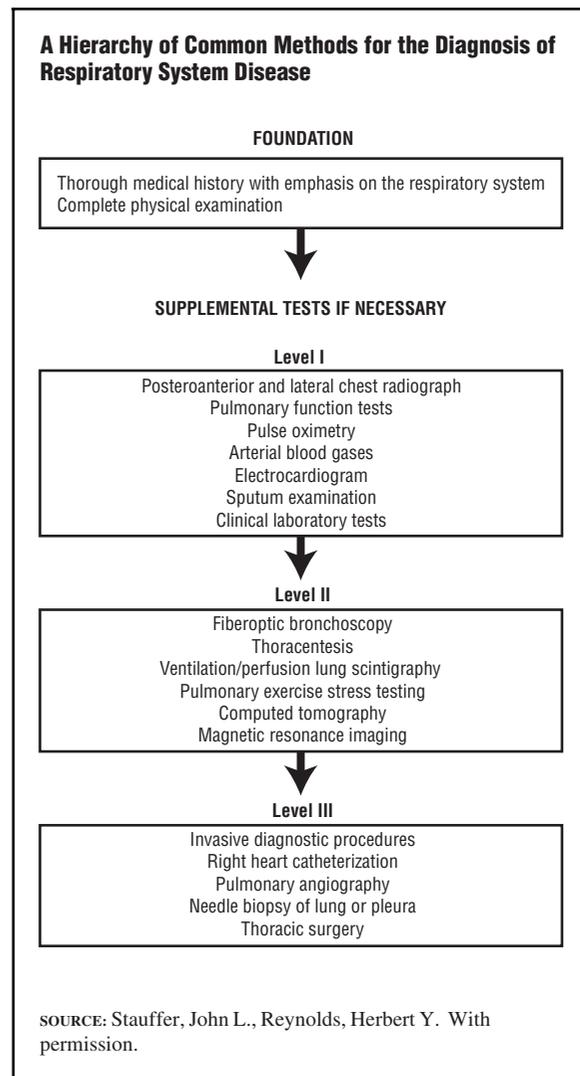
provides the power for breathing. Prolonged (chronic) diseases and disorders of the respiratory system in adults are those conditions that are present for months to years, and are treatable but generally not curable. Successful medical management of any chronic respiratory disease depends upon evaluating the patient as a whole and assessing the structure and function of the entire respiratory system.

The chronic diseases of the respiratory system collectively result in profound human suffering, mortality, and economic loss. For example, an estimated 163,000 Americans will die of cancer of the respiratory system in 2001. Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of death in the United States (behind heart diseases, cancer, and stroke) and now kills about 113,000 Americans annually. The death rate from COPD rose 44.5 percent between 1979 and 1997, an increase that was the highest among the top ten causes of death in the United States. Experts estimate that about 30 million Americans have COPD, and only about half of these have been evaluated and diagnosed. The total economic impact of COPD in the country is estimated to be about \$31.9 billion annually.

The huge impact of lung cancer, COPD, and other chronic respiratory diseases in our society is especially sobering in light of the fact that many of these conditions are preventable. The use of tobacco is the leading cause of preventable illness and death in the United States, accounting for about 430,000 deaths, or about 20 percent of all deaths, annually. Cigarette smoking is the primary risk factor for the development of COPD and lung cancer. About 25 percent of all Americans smoke cigarettes, and, tragically, 3,000 young Americans take up the smoking habit every day, greatly increasing their risk of dying prematurely from COPD, lung cancer, heart disease, or some other smoking-related disease. It is alarming that the percentage of high school and college students who smoke cigarettes increased during the early 1990s.

There are relatively few symptoms of respiratory disease, whether it be acute or chronic, as a diseased respiratory system has a limited number of clinical expressions. These include shortness of breath (dyspnea); cough, with or without phlegm (sputum) production; high-pitched continuous

Figure 1



breathing noise (wheezing); chest tightness; coughing up blood (hemoptysis); and chest pain. Uncommonly, patients with chronic respiratory disease are free of symptoms (asymptomatic) but have a disease process that is discovered incidentally, such as by a routine chest X-ray. Respiratory symptoms may be the early warning sign of chronic respiratory disease, but, unfortunately, they are commonly ignored, dismissed as being normal, or mistakenly attributed to aging or alternative disorders.

The medical evaluation of a patient with a suspected chronic respiratory disease starts with the physician's taking a detailed medical history,

with particular attention to the symptoms listed above and their timing (see Figure 1). A thorough history of respiratory illness always includes attention to relevant factors such as tobacco use, occupational and environmental exposure to noxious respiratory agents, travel, hobbies, immunizations, family medical history, current and prior medications, general medical health, and comorbid conditions, to name just a few relevant components. The medical history is followed by a physical examination, which must be complete in order to detect both pulmonary and nonpulmonary clues to the presence of a disease process. It is important to emphasize that pulmonary disorders, whether acute or chronic, may originate in the lung or secondarily involve the lung after originating in another part of the body. Diagnostic testing supplements the medical history and physical examination. A wide range of diagnostic tests is now available to help the physician diagnose a specific respiratory system disease correctly.

There are hundreds of different chronic respiratory diseases. Table 1 provides an outline of their major headings and a few important examples of each category. The list is not intended to be complete, and the reader is referred to medical textbooks or electronic sources for a more complete listing. The remainder of this section will address briefly a few of the most important chronic respiratory diseases.

COPD. Chronic obstructive pulmonary disease is the most important and common of the chronic respiratory diseases. Remarkably, few Americans know what COPD is. This condition has been defined as “a disease state characterized by the presence of airflow obstruction due to chronic bronchitis or emphysema; the airflow obstruction is generally progressive, may be accompanied by airway hyperreactivity, and may be partially reversible” (American Thoracic Society, 1995). Most patients with COPD have smoked at least one pack of cigarettes daily for twenty years or longer. By their fifth or sixth decade of life they suffer from dyspnea, productive cough (often worse in the morning), difficulty in clearing sputum from the airways, wheezing, or any combination of these symptoms. Slowly and gradually the symptoms progress year by year and are often mistakenly attributed to increasing age or to another disease such as asthma. Initially, the dyspnea occurs only with extreme exertion, but eventually, in severe

cases, it limits simple activities such as changing clothes, raising the arms above the head, bending over, or taking a shower. The diagnosis of COPD may be made by the medical history, physical examination, pulmonary function tests, and a chest X-ray, after exclusion of other conditions such as asthma, bronchiectasis, lung cancer, and congestive heart failure.

Essential steps in managing COPD are outlined in Table 2. Smoking cessation slows the age-related rate of loss of pulmonary function in middle-aged smokers with mild COPD. In COPD patients with low blood oxygen levels (hypoxemia), continuous oxygen therapy prolongs survival. All other treatment approaches are aimed at improving symptoms. No treatment intervention restores lung function to normal. Intense rehabilitation of patients with severe COPD provides temporary improvement in symptoms. Surgical treatment options are limited to a very small fraction of COPD patients and outcome benefits are the focus of ongoing research. Without treatment, COPD pursues a downhill course leading to premature disability and death.

Cancer. Cancer represents another broad category of chronic respiratory disease. Cancer may affect any part of the respiratory tract, including the larynx. Cancer that involves the lung is called “primary” if it originates in the lung and “secondary” if it spreads to the lung from another site. Primary lung cancer usually develops from the epithelial lining of the bronchi (bronchogenic carcinoma). Rarely it originates from the lung’s soft tissues or the outer lining on the lung’s surface (malignant mesothelioma). The layman’s term “lung cancer” usually refers to bronchogenic carcinoma, a deadly chronic disease that in about 90 percent of cases is caused by cigarette smoking.

Patients with bronchogenic carcinoma have a wide variety of initial clinical manifestations, but a typical presentation is a new or changing respiratory symptom in combination with an abnormal chest X-ray. Loss of appetite and weight loss are common. Unfortunately, by the time most patients (about 75%) seek medical attention, the lung cancer cannot be entirely removed by surgery (unresectable) because it has spread in the chest or elsewhere in the body (the stage of the cancer is advanced). Or, the patient may be too ill to tolerate chest surgery because of the systemic effects of

Table 1

Selected Chronic Pulmonary Diseases	
Diseases of the airway	Pleural diseases , i.e., chronic pleural effusion, pleural fibrosis
Chronic obstructive pulmonary disease (COPD)	
Asthma, i.e., chronic bronchial asthma, factitious asthma	Chest wall and diaphragm diseases , i.e., kyphoscoliosis, ankylosing spondylitis
Bronchiectasis	
Cystic fibrosis	Mediastinal diseases , i.e., mediastinal tumors, mediastinal fibrosis
Bronchiolitis	
Miscellaneous, i.e., tracheal and bronchial obstruction, chronic aspiration, atelectasis secondary to airway obstruction	Neuromuscular diseases
Lung cancer	Neurologic and neuromuscular transmission disorders, i.e., Guillain-Barré syndrome (acute idiopathic polyneuropathy, poliomyelitis)
Primary lung cancers	Muscular, i.e., polymyositis and dermatomyositis, muscular dystrophies
Bronchogenic carcinoma, i.e., bronchial carcinoid tumors, mesothelioma	Pulmonary vascular diseases , i.e., pulmonary thromboembolism, pulmonary hypertension
Secondary lung cancer	Occupational lung diseases , i.e., occupational asthma, pneumoconiosis, chronic hypersensitivity pneumonitis
Infiltrative diseases	Iatrogenic diseases , i.e., drug-induced lung disease, radiation-induced lung disease
Interstitial, i.e., idiopathic pulmonary fibrosis, interstitial pneumonitis	Chronic respiratory failure
Alveolar, i.e., pulmonary alveolar proteinosis, alveolar hemorrhage	
Disorders of the control of breathing , i.e., obstructive sleep apnea, central sleep apnea	
Infectious lung diseases , i.e., lung abscess, tuberculosis	
SOURCE: Courtesy of author.	

the cancer or another smoking-related condition such as COPD or heart disease. Anticancer drug therapy (chemotherapy), radiation therapy, and other treatment methods may provide temporary improvement in the size of the cancer (remission), diminution of symptoms (palliation), or slightly improved survival. Nevertheless, cure of lung cancer by nonsurgical approaches is rare, and most patients with unresected lung cancer die prematurely from the disease. Overall, only 14 percent of patients with lung cancer survive for five years.

Infiltrative Lung Disease. Another broad category of chronic respiratory disease is infiltrative lung disease, in which shadows (infiltrates) appear in the lung tissue on the standard chest X-ray. Infiltrates are caused by the accumulation of cells or fluids in parts of the lung in excess of their normal amount. Infiltrates may be localized (focal) or widespread (diffuse—involving all five lobes of the lung). They may involve the lung’s tissue framework (“interstitial” infiltrate), airspace (“alveolar” infiltrate), or both. Well over one hundred specific lung diseases fall into the category of infiltrative disease, which may be acute or chronic; many of them are occupational in origin. The chronic

infiltrative diseases share many similar findings, among which are unremitting dyspnea (sometimes with a dry cough); abnormal lung sounds (crackles) on chest physical examination; reduced amount of air in the lung (restrictive dysfunction) and reduced gas transfer (diffusing capacity) on pulmonary function testing; and hypoxemia, especially with exercise.

Idiopathic Pulmonary Fibrosis (IPF). A lung scarring of unknown cause, IPF is the prototype of the chronic infiltrative pulmonary diseases, just as COPD is the prototype of the chronic airway diseases. IPF affects men and women between the ages of fifty and seventy. The prevalence of IPF has been estimated to be three to six cases per 100,000 people. Although the exact cause of this disease is not known, cigarette smoking is a suspected risk factor. Progressive dyspnea, dry cough, and crackles on physical examination are typical clinical features of this disease. Patients with suspected IPF are often evaluated with high-resolution computed tomography (HRCT) imaging, which displays patchy scarring below the lung surface, especially in the lower lung zones. Biopsy of lung tissue via the airway (flexible fiberoptic bronchoscopy)

Table 2

Comprehensive Medical Management of COPD	
•	Establishing a sound relationship with a medical health care provider and medical institution
•	Patient education about COPD
•	Drug therapy Bronchodilators, i.e., anticholinergic drugs Anti-inflammatory agents, i.e., corticosteroids Antibiotics—only for active airway infection (e.g., acute exacerbation of COPD)
•	Smoking cessation Reduces the rate of decline in pulmonary function
•	Immunization—preventive therapy for selected adult patients particular annual influenza vaccine and vaccination against infection by <i>Streptococcus pneumoniae</i> every five years
•	Physical therapy measures, e.g., general aerobic conditioning, postural drainage with or without chest percussion
•	Supplemental oxygen Generally for patients whose partial pressure of oxygen in arterial blood is low Benefits Improved quality of life, improved survival, reduced hospitalization needs
•	Psychological and social support
•	Pulmonary rehabilitation Maintaining a healthy lifestyle Benefits Improvement in dyspnea, health-related quality of life, and walking distance Reduced hospitalization needs
•	Nutrition especially adequate protein and calorie intake daily and maintenance of ideal body weight
•	Home care and assistance with activities of daily living
•	Surgical options for a few selected patients, e.g., bullectomy
•	Care at the end of life including treatment of respiratory failure and following advance medical directives
SOURCE: Courtesy of author.	

or via the chest wall (video-assisted thoracic surgery) is often employed to confirm the clinical impression. Treatment of this condition is mainly supportive, as the scarring itself is not reversible. Continuous supplemental oxygen is helpful in reducing dyspnea. Anti-inflammatory therapy with corticosteroids or immunosuppressive agents is frequently attempted, but results are usually disappointing. Treatment with interferon has been investigated. Lung transplantation is an option for a few patients with IPF. Most patients with IPF have a poor prognosis, and median survival is about five years.

Ventilatory Control Disorders. The rate, depth, and rhythm of normal breathing are exquisitely controlled by a complex interplay of regulatory mechanisms in the brain, the respiratory system, the great blood vessels, and other parts of the body. Disturbances in any of these mechanisms may lead to altered breathing (ventilatory) control, sometimes with disastrous consequences. A number of chronic respiratory disorders may be attributed to abnormal control of ventilation, including sleep apnea and obesity-hypoventilation syndrome.

The most common and important disorder of ventilatory control is sleep apnea syndrome. An apnea is defined as cessation of airflow at the nose and mouth for more than ten seconds, and an hypopnea is a drop of oxyhemoglobin saturation of more than 4 percent with reduced airflow. Obstructive apneas occur because of temporary closure of the throat (pharynx) and central apneas occur because of a transient reduction in breathing effort. The consequences of apneas and hypopneas during sleep are nocturnal hypoxemia and poor sleep quality. Sleep apnea is confirmed by performing recordings of physiological variables during sleep (polysomnography). An excessive number of apneas and hypopneas during a night of sleep defines sleep apnea. Sleep apnea syndrome is present when sleep apnea is accompanied by associated symptoms, including loud and cyclical snoring, excessive daytime sleepiness and daytime sleep attacks, morning sluggishness, daytime fatigue or tiredness, neuropsychological impairment, and declines in personality.

Obstructive sleep apnea is very prevalent, being found in 24 percent of middle-aged men and 9 percent of middle-aged women. Obstructive sleep apnea syndrome (OSAS) occurs in 4 percent of men and 2 percent of women. Overweight middle-aged and older men are most commonly affected. Hypoxemia during sleep and sleep disruption may be so severe as to cause daytime problems, particularly excessive and inappropriate sleepiness. Patients with OSAS may fall asleep while driving a car, operating machinery, or performing a job. Substantial psychosocial consequences may follow, including personality changes, marital stress, and loss of employment. The medical consequences of OSAS include high blood pressure in the lung (pulmonary hypertension), and in the body as a whole (systemic hypertension); failure of the right

side of the heart; heart rhythm disturbances; and cardiovascular complications (stroke, myocardial infarction, and sudden death).

Treatment of OSAS consists of general measures such as patient education, weight loss, avoidance of alcohol and hypnotic medication, surgical relief of mechanical upper airway obstruction, and improved sleep habits. Many patients with OSAS are treated with nocturnal use of nasal continuous positive airway pressure (nasal CPAP) masks that stent the airway open during sleep, precluding pharyngeal obstruction. Dramatic improvement in symptoms is commonly observed. Results of treatment of central sleep apnea syndrome are less encouraging.

Obesity hypoventilation ("Pickwickian") syndrome is a disorder of ventilatory control in patients with moderate to severe obesity. This condition is thought to be caused by blunted breathing effort (ventilatory drive) and the mechanical load placed on the chest wall and abdomen by obesity. This disorder occurs in only a small percent of patients with obesity. The daytime hypoxemia and elevated blood carbon dioxide levels (hypercapnia) found in this condition may improve with significant weight loss. Patients with this condition also suffer from OSAS.

In conclusion, chronic respiratory diseases are very prevalent in our society. They cause untold suffering, premature death, and economic harm to patients, their families, and the nation. Chronic obstructive pulmonary disease, lung cancer, idiopathic pulmonary fibrosis, and obstructive sleep apnea syndrome are common examples of these chronic respiratory diseases. Treatment for these conditions is difficult and expensive, but successful management provides substantial symptomatic benefit for most patients. Many of the chronic respiratory diseases could be prevented by elimination of cigarette smoking.

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(SEE ALSO: *Asthma; Bronchitis; Lung Cancer; Occupational Lung Disease; Pulmonary Function; Smoking Behavior; Smoking Cessation; Tobacco Control*)

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CHURCHES

See Faith-Based Organizations

CIRRHOSIS

The term "cirrhosis" was first used by René Laënnec (1781–1826) to describe the abnormal liver color of individuals with alcohol-induced liver disease. The word cirrhosis comes from the Greek word *kirrhos*, the name for a yellowish-brown color.

The human liver is the largest single organ in the body and consists of parenchymal cells, which metabolize, detoxify, synthesize, and store nutrients. Normal functioning of these cells depends on their proper organization. Cirrhosis, the final common pathway for a variety of liver diseases, occurs when excessive fibrosis results in the conversion of normal liver architecture into structurally abnormal nodules. Cirrhosis is irreversible and can be life threatening—it is a public health concern because of its associated mortality and morbidity. The only available and definitive treatment is liver transplantation. Cirrhosis is, however, preventable in most cases.

PREVALENCE

The exact prevalence of cirrhosis is unknown, but it has been estimated, through autopsies, to be between 5 and 10 percent. Incidence of cirrhosis varies by country and region, and reflects relative contributions from different risk factors. In countries where alcohol consumption is common, alcoholic cirrhosis is the major contributor to the overall prevalence of cirrhosis. In countries with low alcohol consumption, hepatotropic viruses (hepatitis B and C) are the major contributors.

An estimated 25,000 individuals in the United States died from liver disease in 1998, making liver disease the tenth leading cause of death. For individuals between 45 and 64 years of age, chronic liver disease had an associated mortality rate of 19.6 per 100,000 persons and was the seventh leading cause of death. The mortality rate for

Table 1

Common Causes of Cirrhosis

- Alcohol
- Viral hepatitis: hepatitis B, hepatitis C
- Metabolic: alpha-1 antitrypsin deficiency, Wilson's disease, hemochromatosis
- Cholestatic: primary biliary cirrhosis, primary sclerosing cholangitis

SOURCE: Courtesy of author.

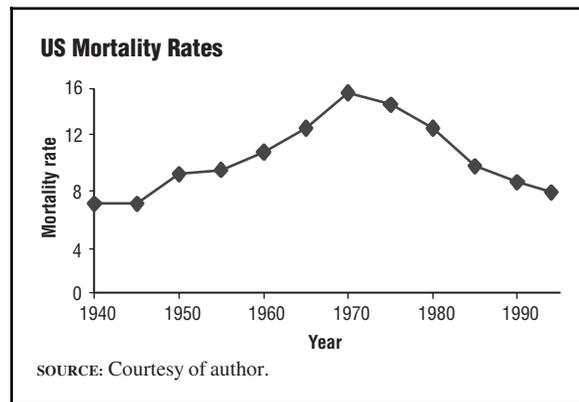
white men between 45 and 64 years of age was 28.2 per 100,000 persons, and cirrhosis was the fourth leading cause of death (in 1998).

CAUSES OF LIVER DISEASES

Ethanol. Ethanol (alcohol) is the most common cause of cirrhosis in the United States (see Table 1). Over three-quarters of Americans drink ethanol. The amount necessary to cause cirrhosis differs based on gender and nutritional status, and the relative risk of alcoholic cirrhosis increases with greater amounts of alcohol consumption. It has been estimated that alcoholic cirrhosis develops in women drinking at least 20 grams of alcohol a day for 5 to 10 years, and in men drinking at least 40 grams per day for the same period. A 12-ounce can of beer, 5-ounce a glass of wine, and a 1.5 ounce shot of hard liquor all contain between 10 and 20 grams of ethanol. Malnutrition and infection with hepatotropic viruses may also increase the risk of cirrhosis.

Compelling epidemiological data indicate a strong association between alcohol consumption and cirrhosis mortality. Between 1906 and 1934, per capita alcohol consumption in the United States dropped from 9.8 liters of absolute alcohol to 3.7 liters. Liver cirrhosis mortality fell from approximately 16 deaths per 100,000 prior to the Prohibition era, to 8 deaths per 100,000 during the Prohibition era and for several decades after Prohibition laws were repealed (see Figure 1). Between 1950 and 1973, however, mortality due to cirrhosis rose from 8.5 deaths per 100,000 to 14.9 deaths per 100,000. This increase followed and paralleled an increase in total alcohol consumption. Between 1970 and 1990, although total alcohol consumption remained stable, the mortality rate from cirrhosis decreased. Plausible reasons

Figure 1



for this discrepancy include lowering the greater than previously recognized nonalcohol contribution to the overall mortality rate due to cirrhosis and improved behavior regarding alcohol.

Hepatotropic Viruses. Hepatotropic viruses represent the second major category of the causes of cirrhosis. Hepatotropic viruses account for most orthotopic liver transplantations in the United States.

Approximately 4 million people in the United States are believed to be infected by hepatitis C. Prevalence varies considerably by country, e.g., from 0.1 to 2 percent in Europe and North America to 5 to 20 percent in Egypt (see Table 2). Hepatitis C infection results in chronic hepatitis in 85 percent of infected individuals, and in cirrhosis in 20 percent. The mean time progression to hepatic cirrhosis following viral infection is twenty years. Factors associated with progression of hepatitis C-related liver disease include chronic alcoholism and viral coinfection with hepatitis B.

Blood transfusion was the single major risk factor for hepatitis C infection until the early 1990s; today it accounts for a minority of hepatitis C cases because of blood screening for hepatitis C. Illegal drug use now accounts for more than half of the cases of hepatitis C infection, and this proportion is likely to increase in the near future when many individuals infected with hepatitis C in the 1960s and 1970s, largely as a result of sharing needles, seek medical attention.

Public health efforts are best directed at preventing viral hepatitis infection. Once patients are

Table 2

Worldwide Hepatitis C Virus Prevalence

Low prevalence (0.1 to 2%)

Australia
Brazil
Western Europe
North America
Mexico
Russia
Middle East

Intermediate prevalence (2 to 5%)

Parts of South America
Asia
Philippines

High prevalence (5 to 20%)

Egypt

SOURCE: Courtesy of author.

infected, antiviral therapy may eliminate the virus from the blood and prevent the progression to hepatic cirrhosis.

Approximately 1 to 1.25 million Americans are infected with the hepatitis B virus. Worldwide, an estimated 1 to 2 million people die of hepatitis B-associated liver disease annually (see Table 3). The worldwide prevalence varies greatly among countries, from 0.1 to 2 percent in Europe and North America, and from 5 to 20 percent in Southeast Asia and Eastern Europe. It is estimated that 12 to 20 percent of patients with chronic hepatitis B progress to cirrhosis within five years. The risk of hepatitis B infection from a blood transfusion was once up to 50 percent, but it is now exceedingly uncommon, largely as a result of blood screening. The implementation of hepatitis B immunization programs in infants has also contributed to the decreasing number of new cases of hepatitis B infection.

Although the major risk factor for hepatitis B transmission is sexual, the rate has also fallen significantly in recent years because of changes in high-risk sexual behavior. Like hepatitis C, progression to cirrhosis can be halted with antiviral therapy.

Cirrhosis is a major public health concern. The major causes of cirrhosis are mostly related to

Table 3

Worldwide Hepatitis B Virus Prevalence**Low prevalence (0.1 to 2%)**

North America
 Western Europe
 Australia
 New Zealand
 Parts of South America

Intermediate prevalence (2 to 5%)

Southern and Eastern Europe
 Middle East
 Western Asia through the Indian subcontinent
 Parts of Central and South America

High prevalence (5 to 20%)

Asia east of the Indian subcontinent
 Pacific Basin
 Amazon Basin
 Arctic Rim
 Asia Minor
 Parts of Eastern Europe
 Caribbean

SOURCE: Courtesy of author.

lifestyle behaviors such as alcohol consumption, injectable drug use, and unprotected sex. Public health efforts should focus on programs that address these activities.

SAMMY SAAB
 SERGIO E. ROJTER

(SEE ALSO: *Alcohol Use and Abuse; Hepatitis A Vaccine; Hepatitis B Vaccine*)

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CITIZENS ADVISORY BOARDS

Over the years, many public health leaders have defined the mission of public health. One interpretation, made in the Institute of Medicine's report *The Future of Public Health* (1988), defines this mission as "fulfilling society's interest in assuring conditions in which people can be healthy." A common theme in most definitions is reflected by the words *public*, *health*, and *society*.

Public health services are best provided when they are part of organized community effort. Most public health officials recognize the value of citizen involvement for the success of public health programs. For this reason, advisory boards representing diverse social, geographical, and professional interests are frequently appointed to provide suggestions about public health needs and programs. Advisory boards can expand the community's involvement in public health decisions, bring diverse viewpoints together for a common good, and act as a communication link between the community and official public health agencies.

The importance of community advisory boards to public health is particularly critical at the beginning of the twenty-first century. The core functions of public health, as defined in *The Future of Public Health* and the *Essential Services of Public Health* (1994), and as formulated through the Public Health Steering Committee, increase the importance of advisory board involvement in the delivery of these functions.

Advisory boards, as the name suggests, can only make recommendations. The appointing authority has the responsibility to evaluate and incorporate appropriate recommendations from a well-selected advisory board in the development of public health policy.

NED E. BAKER

(SEE ALSO: *Essential Public Health Services; Future of Public Health*)

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CIVIL RIGHTS

See Civil Rights Act of 1964 and Minority Rights

CIVIL RIGHTS ACT OF 1964

Slavery, segregation, poverty, and racism have shaped the health status of African Americans throughout American history. One hundred years after the Emancipation Proclamation of 1863, blacks were still denied the right to vote in some states and received an inferior education in most. Barriers to public health services and hospital care contributed to excess illness and death. Historically, African Americans have used the public policy process to facilitate the social changes necessary to win the full rights of citizenship. This process peaked during the civil rights movement of the 1960s, when Congress passed the Civil Rights Act of 1964, probably the most progressive legislation in American history. The act outlawed discrimination in public accommodations, public schools, and health care facilities. It also made possible the Medicaid-Medicare legislation of 1965, which led to improved health status of African

Americans and other racial and ethnic minority groups.

STEPHEN B. THOMAS

(SEE ALSO: *African Americans; Community and Migrant Health Centers; Community Organization; Enabling Factors; Ethnicity and Health; Inequalities in Health; Landmark Public Health Laws and Court Decisions; Politics of Public Health; Public Health and the Law*)

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CLASSIFICATION OF DISEASE

The word "classification" can refer to either a "thing" or an "activity." As a thing, a classification is a set of categories (pigeonholes) into which may be placed all the objects in the universe for which it has been designed. As an activity, classification is the process of placing the objects into the categories. This article shall deal only with the first meaning: a framework for organizing information.

Two terms are used in describing a classification: "universe" and "axis." The universe is the totality of the objects that are to be classified—all diseases, all automobiles, all causes of death, all reasons why people encounter the health system, all persons in a given population, and so on. An axis is an attribute or property shared by members of the universe. In health matters, there are many axes—ages of patients, causes of illness, disorders produced, physiological systems disrupted, reasons for encounters, and so on.

Every classification has basic attributes:

1. It deals with a defined universe.
2. It is designed for a specific purpose, which determines its scheme of organization.
3. It groups the objects, using as few groups as consistent with its purpose. In public health and epidemiology, classifications are designed primarily for compilation of statistics.

4. It uses a schema that depends on the logic of its author (which often is a committee).
5. It must accommodate all the objects in its universe and as a result always has one or more categories termed *other*, which are often called wastebasket categories.

In public health, diseases are only one of the kinds of “objects” that cause death or disability, so it is rare to develop classifications for them alone. The earliest use of classifications in public health was for presenting “causes of death,” which of course included injuries. Later, as classifications were expanded to include morbidity as well as mortality, their titles were expanded to “diseases, injuries, and causes of death.” In the latest version of the standard classification used in public health, the *International Statistical Classification of Diseases (ICD)*, the universe has become even broader, and the title of the tenth revision (1992) includes *Related Health Problems*.

In the early twenty-first century, only *ICD* is in widespread use. Its universe is all individuals who have (or should have) any contact with health services—for prevention, rehabilitation, acute care, long-term care, behavioral problems, investigation of abnormal findings, or for any other reasons. It is not surprising that, to handle this diversity, a number of different axes are found in the classification.

An early need for multiple axes involved trauma. Early mortality statistics showed deaths by external causes. But it was equally valid to tabulate the same deaths according to the injuries sustained. These are two different axes that are used by *ICD*.

Certain diseases are caused by infectious agents, and one chapter in the classification uses infectious agents as the organizing axis. Other chapters use physiological systems as their organizing axes—respiratory and circulatory, for example. Conflict arises, of course, because a disease such as bacterial pneumonia is both infectious and respiratory. If it is classified both ways, it will almost certainly be counted twice in the statistics.

Largely because of the multiple axis nature of *ICD*, an extensive set of rules called conventions has been developed to instruct the classifier how to handle these and other conflicting demands. One convention (which the United States has resisted)

is the use of dagger and asterisk coding in which a code marked with a dagger (+) indicates the underlying disease and that with an asterisk (*) indicates the manifestation.

It should be clear by this point that classifications in health care are not really classifications of diseases or injuries or causes of disability but are actually classifications of individuals who are of interest to the public health community. As a result, almost never can the classifying be done from a single factor, such as the diagnosis. Rather, the person’s other attributes, such as age and other diagnoses, must at least be considered and taken into the classification decision when called for by the conventions.

Retrieval of information for making statistical tabulations or finding individual case records is done by referring to the codes that have been substituted for the labels of the categories; retrieval is code-dependent. It is essential, then, to know the limitations presented by this fact. Retrieval can never produce any more detailed information than the category level—the code is equivalent to the category label. This is a serious limitation when, for example, an epidemic appears and it is a condition that is hidden in a wastebasket category. For example, in the 1970s, Guillain-Barré syndrome was lost in “Polyneuritis and polyradiculitis,” where it could not be separated from the other miscellany.

Also, in twenty-first-century information systems, neither the category label nor the category content can be known with certainty, because there is no method for determining the source of the code, that is, the classification from which the code was taken and the version of that classification. For example, code 395 was for Meniere’s disease in *ICD-6* and *ICD-7*. With *ICD-8* and *ICD-9* it was used for diseases of the aortic valve. Especially in *ICD*’s derivatives, such as the *International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)* in North America, changes are made annually to reflect new diseases and new knowledge. The result may be to add a new disease to an existing category or to move a disease from one category to another. In the mid-1980s, code 279.1 (deficiencies of cell-mediated immunity) was the category to which AIDS (acquired immunodeficiency syndrome) was assigned; after 1986, AIDS

was supposed to go to an infectious disease category. Whether it did or not is moot—279.1 looks just the same. This problem, the ambiguity of category labels and codes, will persist until the information systems are modified and standardized to tag each code with a unique source identifier.

In view of the requirement that a classification be designed with a purpose, it is no surprise that *ICD* is increasingly unsatisfactory. Beginning with the desire simply to tabulate mortality statistics, it has taken on the burden of trying to serve multiple purposes, to accommodate morbidity, health care reimbursement, quality review, epidemiological surveillance, evidence-based medicine, facility planning, public policy, and others. Developers of electronic medical records are expecting it to serve the needs for clinical care for individual patients as well. One classification cannot serve all masters equally well.

It will not be possible to have optimal classifications for public health and epidemiology, as well as for the other legitimate uses of health and health care information, until a simple but major modification of the information system is adopted. That modification is to capture and uniquely and permanently code the specific diagnoses (clinical entities) which go into the classification categories. When that is done, the entities can be distributed into a variety of classifications, each designed optimally for its intended purpose.

VERGIL SLEE

(SEE ALSO: *International Classification of Diseases*)

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CLEAN AIR ACT

Since the time of the Industrial Revolution, air pollution has been a major public health problem. In 1948, in Donora, Pennsylvania, an air pollution episode resulted in the deaths of nineteen people in a community of 14,000; 43 percent of the population were adversely effected. The cause was industrial emissions of combustion products combined with a thermal inversion. Today, air pollution still causes extensive rates of morbidity and mortality, and it poses a particular risk for children and those with chronic lung disease. Air pollution is a complex mixture of substances discharged into the air in a myriad of ways. Incinerators and combustion sources, including motor vehicles, emit large quantities of carbon dioxide, carbon monoxide, nitrous oxides, and sulfur dioxide; as well as more complex combustion by-products such as polycyclic aromatic hydrocarbons (PAHs), dioxins, furans, and benzo[a]pyrene. Feedstock materials (e.g., wastes that are included in incineration) that do not burn, such as cadmium, lead, chromium, mercury, and other metals also contribute to air pollution. Toxic-air contaminants may be emitted as products of incomplete combustion or in consequence of their manufacture, processing, use, or disposal.

In 1970, Senator Edmund Muskie led the effort to enact the Clean Air Act (CAA). It was a very ambitious statute in scope, technical detail, and in terms of precise timetables for compliance. Amendments in 1977 set new goals for attaining CAA standards, which had not been met in many parts of the United States. Amendments enacted in 1990 were directed to a number of areas that had not previously been addressed, including acid rain, ground-level ozone, stratospheric ozone depletion (by implementing the Montreal Protocol), and air toxics (control of toxic contaminants in air).

PRIORITY AIR POLLUTANTS

The CAA act established six "priority air pollutants": ozone, sulfur dioxide, respirable particulate matter, nitrogen dioxide (NO₂), carbon monoxide (CO), and lead. Priority air pollutants are

regulated by the Environmental Protection Agency (EPA) strictly on a public health basis, with an adequate margin of safety to protect the population and special attention given to protection of vulnerable populations. Regulations for priority air pollutants are called National Ambient Air Quality Standards (NAAQS). Initially, the EPA was to adopt standards for the priority pollutants within ninety days of enactment of the CAA. The CAA also directed the states to develop state implementation plans (SIPs) that would assure that the NAAQS would be met within those states within nine months of issuance of NAAQS. Automobile manufacturers were given a five to six year deadline to achieve 90 percent reductions in emissions of CO, hydrocarbons, and nitrogen oxides (NOx).

The CAA led eventually to the phaseout of leaded gasoline in the United States, which in turn resulted in the lowering of blood-lead levels across the nation. The act also succeeded in attaining large reductions in sulfur dioxide and carbon monoxide release levels in nearly every area of the country. An innovative pollution trading program for sulfur dioxides has played an important role in reducing acid rain and in creating new mechanisms for environmental protection.

More challenging have been efforts to reduce pollution from two sectors: motor vehicles (cars and trucks) and coal-fired utilities. Difficulties in these areas have been compounded by Congressionally mandated delays in evaluation and tightening of fuel economy standards, the increased demand for energy in a growing economy, and the increased numbers of vehicle miles driven by an expanding population. These pressures have in turn created pressures to change the standards for priority pollutants to include the consideration of costs as well as public health benefits.

HAZARDOUS AIR POLLUTANTS

Hazardous air pollutants (HAPs) developed a higher public profile in 1985, due to the catastrophic release of methyl isocyanate (MIC) at a pesticide production facility in Bhopal, India. Prior to 1990, HAPs were regulated based on complex risk determinations, and standards had been promulgated for only six of them. Frustrated by the slow progress, Congress, in 1990, directed the EPA to establish standards for nearly two hundred HAPs, listed by name in the statute. These standards are called

the National Emissions Standards for Hazardous Air Pollutants (NESHAPs). Congress directed the EPA to establish these standards based on the maximum achievable control technology (MACT). This strategy has resulted in a 90 percent decrease in emissions of toxic air contaminants from regulated industry. In a later phase, the EPA must conduct "residual risk" analyses and tighten the MACT standards if they provide inadequate in protecting the public health. It remains to be seen whether this very complex risk analysis will be successful. Congress directed two studies that are to direct the EPA in the methodology for this effort.

LYNN R. GOLDMAN

(SEE ALSO: *Acid Rain; Ambient Air Quality [Air Pollution]; Carbon Monoxide; Emissions Trading; Hazardous Air Pollutants*)

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CLEAN INDOOR AIR LEGISLATION AND ENFORCEMENT

See Smoking: Indoor Restrictions

CLEAN INDOOR AIR ORDINANCES

Clean indoor air ordinances came about as a result of two landmark reports published in 1986: the National Research Council of the National Academy of Sciences report entitled *Environmental*

Tobacco Smoke: Measuring Exposures and Assessing Health Effects, and the U.S. Surgeon General's Report entitled *The Health Consequences of Involuntary Smoking*. These reports, along with other authoritative scientific studies, described the health risks to nonsmokers of breathing tobacco smoke in various settings. The terms used to describe the tobacco smoke being breathed by the nonsmoker became known as involuntary, passive, second-hand, or environmental tobacco smoke (ETS). The 1986 Surgeon General's Report reached three important conclusions: (1) ETS causes disease, including lung cancer in healthy nonsmokers; (2) children of smoking parents have an increased frequency of respiratory infections, slower development of lung function, and are more likely to have middle-ear disease; and (3) the simple separation of smokers and nonsmokers within the same space does not reduce the exposure of the nonsmoker to ETS. In 1992, the Environmental Protection Agency (EPA) designated ETS as a Class A carcinogen, which placed tobacco smoke in the same category as asbestos, benzene, and radon. People may be affected most by ETS where they work, in public places (restaurants, shopping centers, public transportation, schools), and in the home.

The mechanisms used to create clean indoor air policies can be seen by looking at federal, state, and local legislation, and at private sector policy development. The legal foundation for regulating public smoking is based mainly on protecting the health of workers. Courts have ruled that employers must provide nonsmoking employees protection from the proven health hazards of ETS. In 1977, Berkeley, California, became the first community to pass local legislation that limited smoking in public places. By 1998, public smoking was restricted or banned in 820 localities in the United States. The most notable federal regulation was passed in 1988, and required domestic airline flights under two hours in length to be smoke free. In 1990, smoking was banned on longer flights. In 1997, President Bill Clinton signed an executive order establishing a smoke-free environment for federal employees and all members of the public visiting federally owned facilities. By December 1999, laws regulating smoking to some degree had been established in forty-five states and the District of Columbia. Utah, California, and Vermont completely prohibit smoking in restaurants.

The agencies most often responsible for enforcement of clean air ordinances are health departments. Clean air regulations or policies can also be implemented by private companies or organizations. Exemplifying nongovernment regulatory action is the adoption of an accrediting standard that prohibits smoking in hospital buildings. Among private companies, a survey by the Centers for Disease Control and Prevention (CDC) in 1995 found that 87 percent of worksites with fifty or more employees had a smoking policy. The impact of clean indoor air ordinances can be evaluated by the change in attitudes towards restrictions, the effects of restrictions on nonsmokers' exposure to ETS, and the effects of restrictions on smoking behaviors. Surveys among U.S. smokers show that between 82 and 100 percent support restrictions in public places. The effectiveness in reducing nonsmokers' exposure to ETS has been demonstrated by the reduction of nicotine levels in nonsmokers. Numerous studies have also shown that restrictions on smoking have reduced the number of smokers and reduced the number of cigarettes smoked among those who have not quit.

JON JENNEY

(SEE ALSO: *Air Quality Index; Ambient Air Quality [Air Pollution]; Clean Air Act; Environmental Tobacco Smoke; Lung Cancer; Tobacco Control*)

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CLEAN WATER ACT

During the 1960s, the Cuyahoga River in Ohio caught fire, Lake Erie was so polluted it was said to be dying, and human sewage and pollution commonly killed fish in the nation's rivers and streams. Public concern grew so overwhelming that the United States Congress enacted the Federal Water Pollution Control Act of 1972 over the veto of President Richard Nixon. The law, commonly known as the Clean Water Act, set two national goals: elimination of the discharge of pollutants into the nation's waters, and achievement of water quality to protect fishing and swimming. Pollutants from industrial and sewage treatment plants and runoff from city streets and farmlands can contain organic pollutants, including sewage and toxic substances such as heavy metals and chemicals. If poorly controlled, these pollutants can cause diarrhea, cancer, and other serious diseases.

Clean water is essential to the health of all Americans for drinking water, swimming, and other water recreation; as well as for the health of fish and all aquatic life. Between 1972 and 1998, the United States has doubled the amount of water clean enough for fishing and swimming. In addition, wetland losses have dropped dramatically and the number of people served by modern sewage treatment plants more than doubled, to 173 million, in 1998.

The U.S. Environmental Protection Agency (EPA), along with other federal, state, tribal, and local agencies administer programs that regulate the discharge of pollutants and the dredging and filling of waterways and wetlands. Wastewater discharge pipes from industrial or sewage treatment plants are *point sources*, and they require a permit based on available treatment technologies and water quality standards. As a result of amendments made to the Clean Water Act in 1977, limits have been established for over one hundred pollutants discharged by fifty-one different kinds of industry.

In 1998, pollution runoff became the leading cause of water pollution in the United States. These diffuse, *nonpoint sources* of water pollution may contain soil, pesticides, fertilizers, oil, grease, and animal wastes from farmlands, streets, parking lots, and construction sites. Since amendments to the Clean Water Act in 1987, the EPA has

expanded the number of these sources that require a permit.

In 1998, approximately 450,000 animal feeding operations existed throughout the United States, ranging from small livestock facilities to large, concentrated animal feeding operations for cattle, hogs, and chickens. Pollution from these sources can cause significant environmental and public health problems, including algae growth in surface water, contamination of drinking water supplies, fish kills, and odor problems. Ponds and lagoons that store manure and other liquid waste can overflow during heavy rainfalls or lagoon walls can break, sending bacteria, hormones, and antibiotics into waterways. The EPA is developing permit programs for the approximately 6,600 concentrated animal feeding operations.

The Watershed Approach Framework developed by the EPA in 1996 seeks to go beyond political, social, and economic boundaries by designing and applying programs to control the many sources of pollution in an area draining into a river or other body of water. One watershed approach involves calculating the maximum amount of pollutants that a body of water can receive from all contributing point and nonpoint sources. Agencies can use this "total maximum daily load" to allocate pollution limits among various sources. The nation's clean water laws have evolved from regulating direct discharges of organic and toxic pollutants to a system controlling diffuse, nonpoint sources of pollution. The watershed approach goes one step further by looking at all the sources of water pollution in a geographic area.

SHARON NEWSOME

(SEE ALSO: *Acid Rain; Drinking Water; Groundwater; Groundwater Contamination; Land Use; Municipal Solid Waste; PCBs; Pesticides; Wastewater Treatment; Water Quality*)

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CLERICAL WORK

The role of the clerical person in a public health setting is to set the tone for a client's positive experience. A thorough understanding of the workings of the specific public health agency and the local community is essential. Many questions asked may not pertain to the agency, but usually the person can be referred appropriately if the clerical person is knowledgeable about other governmental agencies and community services. By asking appropriate questions it is possible to ensure that an individual's needs are properly met.

SUE PHILLIPS

CLIMATE CHANGE AND HUMAN HEALTH

Human societies over the ages have depleted natural resources and degraded their local environments. Populations have also modified their local climates by cutting down trees or building cities. It is now apparent that human activities are perturbing the climate system at the global scale. Climate change is likely to have wide-ranging and potentially serious health consequences. Some health impacts will result from direct-acting effects (e.g., heatwave-related deaths, weather disasters); others will result from disturbances to complex ecological processes (e.g., changes in patterns of infectious disease, in freshwater supplies, and in food production).

WHAT IS CLIMATE CHANGE?

Global climate change is caused by the accumulation of greenhouse gases in the lower atmosphere. The global concentration of these gases is increasing, mainly due to human activities, such as the combustion of fossil fuels (which release carbon

dioxide) and deforestation (because forests remove carbon from the atmosphere). The atmospheric concentration of carbon dioxide, the main greenhouse gas, has increased by 30 percent since preindustrial times.

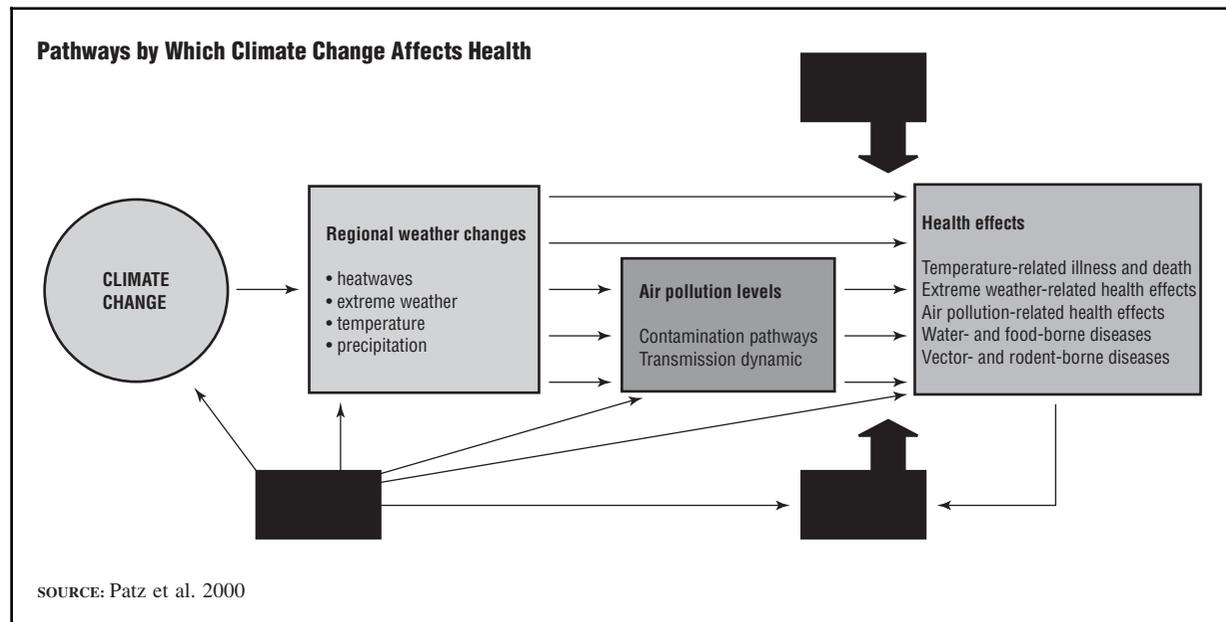
Projections of future climate change are derived from global climate model or general circulation model (GCM) experiments. Climatologists of the Intergovernmental Panel on Climate Change (IPCC) review the results of these experiments for global and regional assessments. It is estimated that global mean surface temperature will rise by 1.5° to 3.5° C by 2100. This rate of warming is significant. Large changes in precipitation, both increases and decreases, are forecast, largely in the tropics. Climate change is very likely to affect the frequency and intensity of weather events, such as storms and floods, around the world. Climate change will also cause sea level rise due to the thermal expansion of the oceans and the melting of the mountain glaciers. Global mean sea level is anticipated to rise by 15 to 95 centimeters by 2100. Sea level rise will increase vulnerability to coastal flooding and storm surges. The faster the climate change, the greater will be the risk of damage to the environment. Climatic zones (and thus ecosystems and agricultural zones) could shift toward the poles by 150 to 550 kilometers by 2100. Many ecosystems may decline or fragment, and individual species may become extinct. The *IPCC Second Assessment* report concludes that climate change has probably already begun.

IMPACTS ON HEALTH

To assess the potential impacts of climate change on health, it is necessary to consider both the sensitivity and vulnerability of populations for specific health outcomes to changes in temperature, rainfall, humidity, storminess, and so on. Vulnerability is a function both of the changes to exposure in climate and of the ability to adapt to that exposure (see Figure 1).

Science classically operates empirically, via observation, interpretation, and replication. However, having initiated a global experiment, it would not be advisable to wait decades for sufficient empirical evidence to describe the health consequences. Risk assessment must therefore be carried out in relation to future environmental scenarios. The traditional "top-down" approach is to

Figure 1



answer the question, “If climate changes like scenario X, then what will be the effect on specific health outcomes?” In contrast, “bottom-up” approaches begin with the question, “How much climate change can be tolerated?”

It is important to distinguish between “climate and health” relationships and “weather and health” relationships. Climate variability occurs on many time scales. Weather events occur at daily time scale and are associated with many health impacts (e.g., heatwaves and floods). Climate variability at other time scales also affects health. In particular, the El Niño Southern Oscillation has been shown to influence interannual variability in malaria, dengue, and other mosquito-borne diseases. Climate change is the long-term change in the average weather conditions for a particular location. Climate change will become apparent as a change in annual, seasonal, or monthly means. Thus, incremental climate change will be superimposed upon the natural variability of climate in time and space.

Natural Disasters. Climate change will increase the risk of both floods and droughts. Ninety percent of disaster victims worldwide live in developing countries, where poverty and population pressures force growing numbers of people to live in

harm’s way—on flood plains and on unstable hillsides. Unsafe buildings compound the risks. The vulnerability of those living in risk-prone areas is perhaps the single most important cause of disaster casualties and damage.

Water Quality and Quantity. Human health depends on an adequate supply of potable water. By reducing fresh water supplies, climate change may affect sanitation and lower the efficiency of local sewer systems, leading to increased concentrations of pathogens in raw water supplies. Climate change may also reduce the water available for drinking and washing. In developed countries, the anticipated increase in extreme rainfall events, which may be associated with the outbreaks of diarrheal diseases, may overwhelm the public water supply system. Flooding is likely to become more frequent with climate change and can affect health through the spread of disease. In vulnerable regions, the concentration of risks with both food and water insecurity can make the impact of even minor weather extremes (floods, droughts) severe for the households affected. The only way to reduce vulnerability is to build the infrastructure to remove solid waste and waste water and supply potable water. No sanitation technology is “safe” when covered by flood waters, as fecal matter

mixes with flood waters and is spread wherever the flood waters go.

Food Security. Current assessments of the impact of climate change indicate that some regions are likely to benefit from increased agricultural productivity while others may suffer reductions, according to their location and dependence on the agricultural sector. The IPCC has reviewed the results of many modeling experiments that project future changes in crop yields under climate change. Climate change may increase yields of cereal grains at high and midlatitudes but may decrease yields at lower latitudes. The world's food system may be able to accommodate such regional variations at the global level, with production levels, prices, and the risk of hunger being relatively unaffected by the additional stress of climate change. However, populations in isolated areas with poor access to markets may still be vulnerable to locally important decreases or disruptions in food supply.

Heat Waves and Milder Winters. Heat stress is a direct result of exposure to high temperatures. Stressful hot weather episodes (heat waves) cause deaths in the elderly, as well as heat related illnesses such as heat stroke and heat exhaustion. A change in world climate, including an increase in the frequency and severity of heat waves, would affect the quality of life in many urban centers. Heat waves are responsible for a significant proportion of disease-related mortality in developed countries such as the United States and Australia, where the impact of weather disasters has been significantly reduced. Milder winters under climate change would reduce the excess morbidity and mortality, such as the United Kingdom, the beneficial impact may outweigh the detrimental.

Air Pollution. The air is full of particles and gases that may affect human health, such as pollen, fungal spores, and pollutants from fossil fuel emissions. Weather conditions influence air pollution via pollutant (or pollutant precursor) transport and/or formation. Exposures to air pollutants have serious public health consequences. Climate change, by changing pollen production, may affect timing and duration of seasonal allergies.

Social Dislocation. The growth in the number of refugees and displaced persons has increased markedly. Refugees represent a very vulnerable

population with significant health problems. Large-scale migration is likely in response to flooding, drought, and other natural disasters. Both the local ecological disturbance caused by the extreme event and the circumstances of population displacement and resettlement would affect the risk of infectious disease outbreaks. Even displacement due to long-term cumulative environmental deterioration, including sea level rise, is associated with such health impacts.

Infectious Diseases. Vector-borne diseases are transmitted by insects (e.g., mosquitoes) and ticks that are sensitive to temperature, humidity, and rainfall. Climate change may alter the distribution of important vector species, and this may increase the risk of introducing disease into new areas. Temperature can also influence the reproduction and survival of the infective agent within the vector, thereby further influencing disease transmission in areas where the vector is already present. However, the ecology and transmission dynamics of vector-borne diseases are complex. The climate factors that could critically influence transmission need to be identified before the potential impact of a changing climate can be assessed.

Malaria is on the increase in the world at large, but particularly in Africa. In several locations around the world, malaria is reported in the twenty-first century at higher altitudes than in preceding decades, such as on the mountain plateaus in Kenya. The reason for such increases has not yet been confirmed but include population movement and the breakdown in control measures. Climate change may contribute to the spread of this major disease in the future in highlands and other vulnerable areas. Climate change impact models suggest that the largest changes in the potential for disease transmission will occur at the fringes—in terms of both latitude and altitude—of the potential malaria risk areas. The season transmission and distribution of many diseases that are transmitted by mosquitoes (dengue, yellow fever), sandflies (leishmaniasis), and ticks (Lyme disease, tick-borne encephalitis) may also be increased or decreased by climate change.

ADAPTATION AND MITIGATION

There are two responses to global climate change:

- Mitigation. Intervention or policies to reduce the emissions or enhance the sinks of greenhouse gases. The current international legal mechanism for countries to reduce their emissions is the United Nations Framework Convention on Climate Change (UNFCCC).
- Adaption. Responses to the changing climate (e.g., acclimatization in humans) and policies to minimize the predicted impacts of climate change (e.g., building better coastal defenses).

The key determinants of health—as well as the solutions—lie primarily outside the direct control of the health sector. They are rooted in areas such as sanitation and water supply, education, agriculture, trade, transport, development and housing. Unless these issues are addressed, it can be difficult to make improvements in population health and reduce vulnerability to the health impacts of climate change.

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(SEE ALSO: *Environmental Determinants of Health; Geography of Disease*)

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CLINICAL BREAST EXAMINATION

The clinical breast examination is an examination of the breast performed by a health care professional. The exam involves inspecting the breasts to look for asymmetry, skin dimpling, or masses. The breasts are subsequently palpated in both the upright and recumbent positions. The axillary and supraclavicular regions are palpated for the presence of abnormal lymph nodes. The American Cancer Society recommends a clinical breast examination by a health professional every three years for women between the ages of 20 and 39, and yearly for women aged 40 and older. Studies demonstrate increased breast cancer detection with a combination of clinical breast exam and mammography compared to mammogram alone. Despite this, no study has demonstrated a reduction in mortality resulting from the addition of the clinical breast exam to mammographic screening.

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(SEE ALSO: *Breast Cancer; Breast Cancer Screening; Breast Self-Examination; Mammography*)

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CLINICAL LABORATORIES IMPROVEMENT ACT

Laboratory tests are used to assist medical personnel in diagnosing disease, measuring treatment success, or evaluating the general health status of a person. All laboratories analyzing specimens taken from humans for chemical, biological, or microscopic testing are required to meet national quality standards. The impetus for developing these standards arose from accusations that certain laboratories were using untrained and overworked

employees to perform Pap smear testing. Women were dying of cervical cancer not identified until the disease had progressed; a comparison with previous test results showed abnormal cells that had been missed in the earlier tests. As the legislation addressing this public health concern developed in the United States Congress, testimony supported rules and standards for all human testing.

In 1988 Congress passed legislation entitled the Clinical Laboratory Improvement Amendments (CLIA), which required all laboratories doing human testing to meet standards which were verifiable by inspection and proficiency testing (i.e., specimens sent to grade laboratory performance). Prior to this law only laboratories that accepted specimens across state lines and those performing tests for Medicare/Medicaid-insured persons were regulated by the federal government. A small number of states had either personnel or laboratory licensing procedures addressing quality performance.

The Secretary of the U.S. Department of Health and Human Services was instructed to prepare rules outlining the requirements for certified laboratories. These rules set minimum standards for educational, training, and experience qualifications for directors and supervisors; specified required documentation of quality assurance and quality control programs; and defined adequate performance in proficiency testing. Between 1990 and 1998 additional rules were drafted and revised to state the specific laboratory quality and documentation requirements, categorization of test difficulty, rules for allowing states and private groups to accredit laboratories, and penalties for failing to meet the standards. The standards were geared toward addressing complexity of testing rather than location or size of laboratory. Previous regulations had emphasized education and training of laboratory analysts and technical managers rather than laboratory processes and quality monitoring of testing. A major difference between these rules and previous laboratory regulations was the segmentation of laboratories into levels of technical proficiency.

Congress recognized there were certain tests which could be performed with little danger of harm to the patient even if performed incorrectly, were simple and easy to use, or approved by the

U.S. Food and Drug Administration for home use. These were waived from the regulatory requirements. Most of these tests are performed in nonprofessional laboratories (e.g., nursing homes, small or rural clinics, and physician's offices). These testing sites were excused from meeting the standards only if they applied to do so and agreed to use the tests only as designed and marketed by the manufacturer.

Early expectations were that over 200,000 laboratories would apply for certification, but closings and consolidation limited that number to 150,000 by the mid-1990s. In 1999 there were nearly 170,000 laboratories certified to perform tests on humans. Over half of those were small laboratories doing limited procedures in clinics or small testing facilities. Concerns about restricted access to laboratory services as a result of this user-paid program were never realized.

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(SEE ALSO: *Assurance of Laboratory Testing Quality; Diagnostic Testing for Communicable Diseases; Laboratory Technician; Practice Standards for Communicable Diseases; Regulatory Authority*)

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CLINICAL PREVENTIVE SERVICES

Clinical preventive services are disease prevention and health promotion interventions delivered in the context of clinical care and provided to individual patients in ambulatory and hospital settings. Prevention interventions include primary prevention services, such as counseling about risk reduction, immunizations, and chemoprophylaxis (e.g., taking supplemental folic acid before and during pregnancy to prevent neural tube defects); and secondary prevention services, such as screening for early detection of asymptomatic disease to permit early intervention and promote improved outcomes. Clinical preventive services are recommended for asymptomatic individuals in all age

groups and risk categories and, while ideally delivered by all clinicians, are generally provided in primary-care settings.

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(SEE ALSO: *Prevention*; *Preventive Medicine*; *Primary Prevention*; *Secondary Prevention*; *Tertiary Prevention*)

CLINICAL TRIALS

See Epidemiology

COALITIONS, CONSORTIA, AND PARTNERSHIPS

“Rich together, poor if separated” (Laos); “One finger cannot lift a pebble” (Iran); “United we stand, divided we fall” (United States). These aphorisms and hundreds others like them suggest that the idea of people and groups forming alliances and coalitions, and the inherent value of such actions, is universal.

The concept of “community” has long been a fundamental component in the design and implementation of health and social programs. Funding agencies and researchers have learned that ignoring or downplaying community members’ perspectives can jeopardize an otherwise well-designed intervention. Similarly, ambitious strategies that have incorporated community strengths and engaged community members constitute some of public health’s most significant success stories.

The terms “community” and “community-based” have particular appeal in public health, where they are virtual shorthand for a number of basic tenets. First, they highlight public health’s emphasis on populations, as opposed to the medical system’s focus on individual health. Second, a community focus acknowledges that individual health behaviors are strongly influenced by the infrastructure and social norms that make healthful choices easier or harder to adopt. Finally, close examination of health-status indicators (e.g., infant mortality rates, the prevalence of HIV [human immunodeficiency virus] infection) quickly reveals

the connections between health problems and their social determinants, such as poverty, housing, and education. These determinants tend to cluster geographically—in communities or neighborhoods within communities.

THE TERMS—DIFFERENCES AND SIMILARITIES

The terms “consortia” and “coalition” are frequently used interchangeably in the context of public health, but there are subtle distinctions worth noting. A consortium is typically an alliance of organizations, usually with a common mission and purpose, that seeks to gain a benefit that could not be achieved independently. For example, several health clinics might form a consortium in order to jointly purchase equipment that would have been prohibitively expensive for any one clinic. Or, to enhance their ability to provide a seamless system of care, that same collection of clinics might develop a common case-management system to coordinate the children’s health services they provide.

In contrast, a coalition is usually an alliance of organizations with potentially diverse purposes and missions. Given a broad goal of mutual benefit, the central challenge faced by coalitions is to coordinate the diverse strengths of multiple partners. For example, given a broad goal of tobacco control, an effective coalition might try to influence policymakers on several fronts, including seeking to develop or enforce local ordinances banning smoking in public places, conducting campaigns to raise cigarette taxes, and enforcing laws making tobacco less accessible to children. Each individual member of the coalition might not pursue these initiatives (or might not pursue them effectively), but the coalition’s united front is its strength.

Perhaps more significant than the subtle differences between consortia and coalitions are the similarities they share. These similarities are captured in the more colloquial term—*partnership*. In the context of community health, partnership refers to the relationships among two or more organizations in which each has equal status and a certain independence, while maintaining a formal obligation toward a mutual goal they agree could not be achieved alone.

No matter how different their primary goals may be, consortia and coalitions often have common secondary goals. These include generating additional resources, raising community awareness, and the formation of alliances to support other community organizations or groups. Finally, most public health consortia and collaborations described in the literature are, at least in part, supported by funding from outside the coalition. (In many cases, outside funding was the catalyst for their formation in the first place.) Consequently, both consortia and coalitions share the challenges of working with one or more funding organizations and of matching collaborative activities to the funders' expectations.

COMMUNITY PARTICIPATION

Inherent in the spirit of a coalition is another assumption: that community participation mutually benefits both the community and the program. For example, there is evidence that community participation can lead to individual and community empowerment, as coalition members gain skills in assessing needs, setting priorities, and obtaining funding. At the same time, active community representation and participation reflects a sentiment that the coalition is being responsive and "true" to community needs that, in turn, can translate into increased credibility for the coalition's message or programs and, potentially, lead to more resources.

CHALLENGES

Not all coalition efforts are successful. Researchers have identified several factors that may help explain why some coalition efforts struggle to attain the outcomes they desire. A major source of difficulty seems to be that coalitions are too often held to unrealistic expectations. Collaboration among multiple organizations and the people who represent them is difficult, time-consuming, and often tedious work. Furthermore, because coalitions often rely on volunteer labor from their members, it is difficult to assign and complete basic planning and implementation tasks that many observers consider essential to the success of collaborative efforts.

Bringing together groups with diverse missions and interests is a task that requires a clear

vision, diplomacy, and considerably more time than is usually estimated. Failure to take these realities into account can lead to unrealistic time, resource, and outcome expectations, and, as a result, perceived failure. Accordingly, public health professionals would be well advised to think carefully about what is and is not feasible for collaborative mechanisms to accomplish, and if necessary, to scale back expectations.

Finally, some researchers have suggested that the efforts of coalitions have gone undetected because of inappropriate or weak evaluation plans. This is most likely to occur when: (1) the evaluation timeline is too short; (2) the evaluation strategy focuses on unrealistic, distant health outcomes instead of intermediate indicators influenced by coalition activity; (3) evaluation measures are incapable of detecting valid indicators of change; or (4) when alternative explanations for effects are not taken into account. For many coalition or partnership endeavors, a realistic scaling back of expectations will offer more opportunities for accountability and for holding collaborative efforts to mutually agreed upon standards of performance. For example, several investigators have demonstrated that it is quite feasible to establish a system to document changes in community systems and policies that are related to coalition activities. When these changes are documented cumulatively over time, they reflect a reasonable and appropriate reflection of a coalition's immediate impact and, although not necessarily directly, lead to changes in more distal outcomes.

SUCCESSSES

These challenges notwithstanding, the public health and social sciences literature is replete with well-documented reports showing that collaborative approaches are strongly associated with the achievement of targeted objectives and outcomes. Practitioners and researchers who have extensive experience with public health coalitions appear to be in general agreement on the question of what factors are repeatedly associated with coalitions that are deemed successful.

Clear Vision and Mission. The goal and intent of the coalition needs to be well understood and endorsed by coalition members. Coalitions

that frame their intended objectives with specificity (e.g., increasing childhood immunization or improving employment outcomes) appear to be more successful than those where the mission and objectives are vague.

A Plan of Action. Coalition members should agree on a plan or logic model that links the activities of the coalition to intermediate, measurable objectives that are, in turn, linked to the coalition's ultimate goals and mission. The plan also takes into account anticipated timelines, personnel (coalition members and staff) required to fulfill specific roles, and overall economic resource needs.

Leadership. It is important to have a respected individual or group of individuals who champion the cause of the coalition and ensure that the actions of the participants focus on the coalition's ultimate mission.

Documentation. A system is necessary to facilitate the routine and periodic recording of coalition activities and intermediate outcomes.

Communications. A systematic commitment should be made to keep coalition members and all stakeholders aware of the coalition's aims, activities, and progress. Systematic results from a documentation system are essential to a meaningful and effective communication plan.

Resources. Adequate personnel, staff and technical assistance, and economic resources are necessary to carry out and sustain coalition functions.

The notion of democratic participation can be powerfully compelling and even seductive. While unifying people to achieve a goal of shared communal interest is a powerful and often effective process, the difficulty and investment required to implement and sustain such collaborations should not be obscured. Successful collaborative efforts absorb time, resources, and goodwill. Often, these investments are worthwhile, either because coalitions achieve some of their outcomes or because their intermediate by-products (such as trust, participation, and goodwill) enhance the social norms for communitywide health improvement. Everyone involved in collaborative work—coalition or consortium members, their funders, and the members of the communities they serve—should be fully aware of the costs and benefits of the task they are undertaking and set fair expectations for this

participatory, inclusive way of organizing the ambitious and endless work of improving the health of communities.

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(SEE ALSO: *Citizens Advisory Boards; Community Health; Community Organization; Enabling Factors; Health Goals; Health Promotion and Education; Leadership; Participation in Community Health Planning; Social Networks and Social Support*)

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COCAINE AND CRACK COCAINE

Cocaine, extracted from the leaves of the coca plant (*Erythroxylon coca*), is the most potent naturally occurring central nervous system stimulant. Cocaine is classified as a Schedule II drug due to its high potential for abuse (U.S. Controlled Substance Act 21 U.S.C., Section 802 [1996]), but it can be administered by a doctor for legitimate medical reasons, such as a local anesthetic for some eye, ear, and throat surgeries. There are two primary forms of chemical cocaine: the hydrochloride salt form, a powdered form of cocaine that is approximately 99 percent pure cocaine, and the "freebase" form. Hydrochloride salt dissolves in water and can be taken intravenously or intranasally. The freebase form of cocaine has not been neutralized by an acid to make a hydrochloride salt and can be smoked. It is processed with ammonia or sodium bicarbonate (baking soda) and water, and heated to remove the hydrochloride.

Crack cocaine, or simply "crack," is essentially the same end product as freebase cocaine, but the result of a cheaper and safer chemical method of preparing a smokable form of cocaine. The term "crack" refers to the crackling sound heard when the mixture is heated or smoked.

DISTRIBUTION AND EFFECTS

Illicit cocaine is generally distributed on the street as a fine, white, crystalline powder or as an off-white chunky material. Street dealers most often dilute it with inert substances such as sugar, cornstarch, and/or talcum powder; or with other active drugs, including local anesthetics such as lidocaine or procaine, or other stimulants such as amphetamines. The primary routes of cocaine administration are oral, intranasal, intravenous, and inhalation. However, there is no safe way to use cocaine, and any route of administration can lead to absorption of toxic amounts of cocaine, resulting in acute cardiovascular or cerebrovascular emergencies that sometimes result in death. Cocaine-related deaths are commonly the result of cardiac arrest or seizures followed by respiratory arrest.

Small amounts of cocaine may make the user feel euphoric, energetic, talkative, and mentally alert, especially to sensations of sight, sound, and touch. The duration of these effects depends upon the route of administration. The faster the absorption, the more intense the high—but the shorter the duration of action. Short-term physiological effects of cocaine include constricted blood vessels, dilated pupils, and increased heart rate, blood pressure, and body temperature. Longer-term effects of cocaine use include tolerance and addiction, irritability and mood disorders, restlessness, paranoia, and auditory hallucinations. The most frequent medical consequences of cocaine use are cardiovascular effects, including disturbed heart rhythms and heart attacks; respiratory effects, including chest pain and respiratory failures; neurological effects, such as strokes, seizures, and headaches; and gastrointestinal complications, including abdominal pain and nausea.

The combination of cocaine and alcohol is especially potent and dangerous. When taken in combination, the body converts the two into cocaethylene, which has a longer duration of action in the brain and is more toxic than either drug

alone. The combination of alcohol and cocaine is the most common two-drug combination that results in drug-related deaths.

COCAINE USE

The United States witnessed a dramatic increase in cocaine use during the 1980s when, due to its high cost, it was glamorized as a symbol of status and material success by celebrities, the entertainment industry, and the media. The problem was further complicated when crack cocaine was introduced in 1985. A smokable and cheaper form of the drug, crack extended the problems of cocaine dependence to urban ghettos and to members of society who might not have been able to afford cocaine itself. Cocaine use in the United States peaked between 1982 and 1985, at which time between 5.7 and 10.4 million Americans (3 to 5.6 percent of the population) reported cocaine use. Since then, it has decreased, but remains a significant problem. According to the 1999 National Household Survey on Drug Abuse (NHSDA), there were 14.8 million illicit drug users in the United States in 1998. Of these 14.8 million, approximately 1.5 million people were using cocaine (0.7 percent of the household population over twelve years of age), and 413,000 people were using crack. According to the Office of National Drug Control Policy, by including data from additional sources that take into account users underrepresented by the NHSDA, the number of chronic cocaine users has recently been estimated at 3.6 million. The annual number of new users of any form of cocaine increased from 1994 to 1998, and data from both the NHSDA and the 1999 Monitoring the Future survey indicated increases in the rate of cocaine initiation among youths ages twelve to seventeen in particular.

Information about cocaine use outside the United States is less readily available, although the United Nations Drug Control Program estimates that approximately 13 million people worldwide abuse cocaine. Abuse remains highest in the United States, despite declines since the mid-1980s peak and increased levels of both cocaine and “bazuco” (coca paste) abuse in Latin American countries. Cocaine, along with other coca-derived substances, is the second most widely abused illicit drug in the

Americas, and accounts for a majority of the demand for treatment. Data from the Report of the International Narcotics Control Board for 1999 showed increased cocaine seizures in Europe, largely in Spain and the Netherlands. While an upward trend is apparent across nearly all of Europe, it is especially pronounced in Spain, Ireland, and the United Kingdom.

COCAINE PRODUCTION

Columbia, Peru, and Bolivia are the first, second, and third largest illicit coca producing countries in the world, respectively. The United Nations Office for Drug Control and Crime Prevention estimates that they collectively account for more than 90 percent of illicit coca. Interpol data suggests there was an increase in coca production in 1999, despite increased efforts of national drug services to break down and disable drug trafficking organizations. Interpol statistics indicate that nearly 50 percent of the cocaine seized in 1999 occurred in Central and South America and the Caribbean, approximately 40 percent in North America, and the remaining 10 percent in Europe.

COCAINE CONTROL PROGRAMS

The primary strategy for controlling the cocaine problem is a global effort to reduce the illicit drug supply, and thereby illicit drug demand, including cocaine. Coordinated by the United Nations Office for Drug Control and Crime Prevention, the three components of the drug supply strategy include law enforcement, alternative development, and crop monitoring. Regional and national law enforcement agencies each have their own legislative, administrative, and social measures to address illicit drug production, possession, and distribution. International organizations such as the UN and Interpol unify these national efforts to address the global issues of drug demand and supply.

Another tactic aimed at reducing drug supply is alternative development. As defined by the United Nations Drug Control Program, alternative development is “a process to prevent and eliminate the illicit cultivation of plants containing narcotic drugs and psychotropic substances through specifically

designed rural development measures in the context of sustained national economic growth and sustainable development efforts in countries taking action against drugs, recognizing the particular sociocultural characteristics of the target communities and groups, within the framework of a comprehensive and permanent solution to the problem of illicit drugs” (UN 1998). These programs focus on local knowledge, skills, interests, and needs to replace drug-crop cultivation with licit, sustainable, and profitable crops, offering farmers and communities an alternative means of survival.

The third component of the UN strategy is a global monitoring program of illicit crops. This program combines aerial surveillance, on-the-ground assessment, and satellite sensing, enabling governments to better target and assess the impact of programs directed at crop reduction, and provide feedback to the international community. The objective of the program is to apply the feedback internationally in order to gain insight and develop new strategies on how to curb the flow of drugs from region to region.

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(SEE ALSO: *Addiction and Habituation; Substance Abuse, Definition of*)

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CODES OF CONDUCT AND ETHICS GUIDELINES

Rules of conduct or ethical codes are often considered to be characteristic of professions, as opposed to craft and trade associations. They are particularly common within health care professions, where they set guidelines for how professionals should act in dealings with their patients and with each other in clinical care, in public health or epidemiological studies, and in experimental studies involving animals, humans, and social or population groups.

PURPOSES OF CODES AND GUIDELINES

Rules of conduct are enforced through ethics or professional conduct committees, which can impose sanctions such as withdrawal or suspension of professional group membership or of licenses to practice. They can also require practitioners to make reparations to those they have treated in breach of a code or to undertake instruction in professional ethics. Codes of conduct or ethics are becoming more widely adopted as various organizations seek to assure the public that their members are required to adhere to ethical practices. Health care professions, however, can also invoke the legacy of the physicians’ historic Hippocratic Oath to show that ethical conduct is the very foundation of their practice. Professionals and their interest groups have an incentive to develop ethical codes or guidelines to dissuade legislators from enacting more rigid, legally enforceable, and punitive laws.

The ethical principles that underlie codes of conduct and ethics guidelines are beneficence, or the duty to do good; nonmaleficence, or the duty

to do no harm; and the principle of justice. The principle of justice is popularly seen to be based on punitive or corrective justice, demonstrated in the liability of offenders against an institution's code to forfeit their membership or professional status and to make good the wrongs they have done. Another aspect of justice requires that like cases be treated alike, demonstrated in the expectation that those bound by the same code will observe the same standards of conduct and integrity.

Codes may also be prepared in order to require and facilitate adherence to a religious, spiritual, or philosophical tradition. For instance, membership in the Catholic Hospital Association, which is affiliated with the Roman Catholic Church, requires hospital administrations to adhere to Church teaching on such matters as nonperformance of abortions and sterilization procedures. The association may also limit the recruitment or promotion of divorced applicants to certain offices, based on the Church's views on divorce and local laws on hospital discrimination on the basis of marital status.

CODES, GUIDELINES, AND PREEXISTING PRACTICE

Codes of conduct and ethics guidelines that are prepared in order to standardize behavior within a profession or among practitioners of an occupation may relate to preexisting practice in various ways. Some guidelines may codify longstanding and approved practices, which are formally established to guard against dangers of laxity and changes in practice. For instance, it is a common rule that professionals not practice in collaboration with related commercial product manufacturers or service suppliers. Thus, physicians cannot participate in the profits of pharmacists who fill the prescriptions they write for their patients. This prevents vertical integration of business interests that might otherwise occur, and also protects patients against physicians having a conflict of interest that may lead them to overprescribe medications or prescribe unnecessary or unduly costly medications.

The celebrated Nuremberg Code, which addresses medical experimentation with human subjects, was adopted by the International War Crimes Tribunal in 1947, after the Second World War. Its function was to restore the standards of research

integrity in studies of human subjects, which had been grossly violated by physicians tried and condemned by the tribunal, and to protect vulnerable persons in such studies. The code incorporates the most basic ethical standards of conduct, which were drawn from the research guidelines of many countries, including prewar Germany.

Sometimes codes and guidelines are established to change preexisting practices, either to remedy faults or to keep practices or earlier codes up-to-date. For instance, in 1964 the World Medical Association adopted its Declaration of Helsinki, which deals with biomedical research involving human subjects. The purpose was to update and expand the Nuremberg Code, which addressed only the medical research outrages and inhumanities committed against powerless detainees of concentration camps under the Nazi administration. As such, the Nuremberg Code was so narrowly directed that it would have made much necessary, humanely conducted, and ethically conducted research impossible. For instance, the 1947 code provides only that "the voluntary consent of the human subject is absolutely essential," and that "the person involved should have legal capacity to give consent." These provisions omit and might seem to preclude research to advance health care for children, mentally impaired persons or unconscious head-injury patients. Research of this nature satisfies scientific standards only when such persons themselves are studied. The Helsinki Declaration proposed ethical guidelines under which such studies could be scientifically conducted. Further, the 1964 Declaration was amended in 1975, 1983, 1989 and 1996, and remains under continuing review.

Some codes and guidelines aim not to change preexisting practices, but to codify them in accessible, comprehensible language, or to reform those that have become antiquated in light of conceptual or technological developments. A conceptual reform has occurred, for instance, because research guidelines used to exclude women of reproductive age from pharmaceutical and other studies of unproven products, on the ground that these studies might cause harm to embryos or fetuses such women had conceived. This exclusion has resulted in many women of reproductive age, including some who are pregnant, taking products that have

never been tested for safety and efficacy on women who might be pregnant. In order to test products for safety and effectiveness in pregnancy, research guidelines now often require that women of reproductive age be included in studies, unless human experience or animal studies have shown that a product is likely to be harmful to pregnant women or their unborn children.

An earlier reconceptualization occurred in 1973 when the International Council of Nurses amended its Code for Nurses, originally adopted in 1953. The original code required a nurse's loyalty and obedience to the physician the nurse served, reflecting a culture of nursing dating to the time of Florence Nightingale, the founder of modern nursing. The code was amended in 1973, however, deleting this requirement and replacing it with a requirement of loyalty to the patient. Physicians, however, did not necessarily note any change in nurses' ethical priorities, including when physicians were members of nursing councils considering cases of nursing misconduct. This raised the unresolved issue of divided loyalties between physicians and patients, and whether the new concept should displace the earlier concept or coexist with it.

Codes that reflect a newer concept may also retain provisions that were part of earlier codes, and may not distinguish items that change earlier practice from items designed to maintain former practice. In this case a code may be understood only by exploring records of committee meetings or other discussions conducted while the code was being prepared, or by considering subsequent requests for clarification before tribunals such as institutional ethics review boards.

CODES, GUIDELINES, DECLARATIONS, AND PRINCIPLES

Documents designed to affect conduct have various names, which may indicate different purposes. A *code* may consolidate and systematize preexisting practices without changing them, or may prescribe new practices that differ from or supplement those in earlier codes. International documents tend not to be described as codes because in the legal tradition of continental Europe, which now extends into Central and South America and Africa,

a code, such as the *Code Napoléon*, is a legally binding document. Similarly, in the United States, the code of Federal Regulations, Title 45, Part 46 of which governs protection of human subjects of research, is legally enacted under authority of the Public Health Service Act. Documents called "guidelines" are usually understood to guide rather than to strictly govern practice. It is expected, however, that a deliberate departure from a guideline will have to be explained, and ethics review committees may say within what limits a departure is justifiable. For instance, many guidelines on ethical professional practice require that practitioners have no conflict of interests and serve patients with uncompromised loyalty. A conflict may arise, for instance, when a physician has a financial interest in a clinical laboratory to which a patient may be referred for testing. An alternative response to the prohibition of any conflict of interests, however, is that it be disclosed in advance to those seeking services. They may then decide for themselves whether or not to receive services. A client's knowing consent thus neutralizes an appearance of conflict.

Like a code, a "declaration" may articulate existing expectations, as was the case with the United Nations' Universal Declaration of Human Rights (1948). The Declaration of Helsinki, on the other hand, outlined principles intended for future application. It is, in fact, subtitled "Recommendations Guiding Physicians in Biomedical Research." It is, however, often applied quite strictly, and in some countries committees created according to its provisions are called "Helsinki committees." Inadequacies in the declaration are remedied by formal amendments, which may be the subject of intense reflection and debate.

Intergovernmental organizations whose agreements have no legally binding force in member countries may acknowledge this by naming their agreements "recommendations." The Council of Europe followed this practice, for instance, in its Recommendation Concerning Medical Research on Human Beings (1990), and in its Recommendation on Xenotransplantation (1997). The World Health Organization (WHO), however, whose conclusions on ethical practice are similarly unenforceable in member countries, usually describes its documents as guidelines, as in its Guidelines for

Good Clinical Practice for Trials on Pharmaceutical Products (1999) and the Guidelines for the Promotion of Human Rights of Persons with Mental Disorders (1996). Similarly described are conclusions of the Council for International Organizations of Medical Sciences, jointly constituted by WHO and UNESCO, including its International Guidelines for Ethical Review of Epidemiological Studies (1991).

Documents intended to influence conduct are also classified as “principles,” an example being the Council of Europe’s Ad Hoc Committee of Experts on Bioethics’ Principles in the Field of Human Artificial Procreation (1989); and “resolutions,” which include the United Nations Commission on Human Rights’ Resolution on Human Rights and Bioethics (1993 and 1997). These and other documents provide texts and concepts that are used in many ways: legislatures may embody them in law; funding agencies, universities, and hospitals may incorporate them into contracts for the funding of recipients, faculty members, and investigators; and ethics and discipline committees of professional and licensing authorities may refer to them in determining professional misconduct.

MINIMUM STANDARDS AND HIGHEST EXPECTATIONS

Codes and guidelines are used to establish common minimal standards of conduct that those bound by them must invariably observe. They also serve to improve standards to the highest attainable level and to demonstrate a profession’s most worthy aspirations. A code used to determine professional misconduct will set a minimum acceptable standard, or a floor, and condemn any practice that falls short. In contrast, a code that sets an aspirational target, or ceiling, is meant to inspire people to aim high, while recognizing that achievements will usually be at a lower level.

Some associations that perceive the dual roles of codes and guidelines may clearly separate standards that serve different functions. For instance, the Australian Nursing Council has both a Code of Ethics, and a Code of Professional Conduct. The Code of Ethics serves the purposes of identifying the moral commitments of the profession, providing nurses with an elevated basis for professional

reflection and a guide to ethical practice, and indicating to nurses and the community the values that inspire nursing practice. In contrast, the Code of Professional Conduct informs the profession and the public of the minimum standards of acceptable conduct and provides licensing, disciplinary, and other bodies with a basis for decisions regarding nursing misconduct.

BERNARD M. DICKENS

(SEE ALSO: *Adherence or Compliance Behavior; Ethics of Public Health; Hippocrates of Cos; Legal Liability of Public Health Officials; Legislation and Regulation; World Health Organization*)

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COHORT LIFE TABLES

Life tables are used to describe the mortality experience of a population. Several summary statistics can be calculated using life tables, such as life expectancy at birth, a summary statistic which estimates longevity. The basic unit of a life table is the probability of dying at specific ages. There are two types of life tables, which can be distinguished by the methods used to calculate age-specific probabilities of death. Life tables for which age-specific probabilities of death are calculated using the number of deaths and population size in the current year are known as current, or period, life tables. For cohort, or generational, life tables, age-specific probabilities of death are calculated using mortality data from a group of individuals born in the same year and followed until all cohort members have died.

Estimates of life expectancy obtained from period life tables are based on a hypothetical population. For example, the 1994 life expectancy at birth for Canadian women was estimated as eighty-three years, using a period life table. This life expectancy is interpreted as the average age of death for all women born in 1994, and this average is determined by assuming that these women will experience the same age-specific mortality rates as women who died in 1994. No similar assumptions are required when determining life expectancy using cohort life tables because the actual longevity of a population is being measured. The requirement that all cohort members have died, however, limits construction of cohort life tables to demographic data from one hundred or more years prior to construction of the tables.

An illustrative example is provided by F. Pelletier et al. (1997), who investigated mortality in Quebec, Canada, during the 1800s. Using Quebec mortality data from 1891 to construct a period life table, they estimated female life expectancy to be forty-five years. However, cohort life tables show that the life expectancy of Quebec women born in 1891 was, in fact, fifty-one years. The underestimation of life expectancy obtained using period life tables was largely a result of a decline in infant mortality over time. Estimates of life expectancy obtained using period life tables will match cohort life tables only when there has been no change in mortality over time, an extremely unlikely scenario.

Both period and cohort life tables are typically constructed by assuming a population at birth of 100,000 individuals, denoted by $l_0 = 100,000$. The estimated number of survivors by age X is then denoted by l_x .

Demographers have identified improvements in health in many countries. These improvements in health began during the 1800s and tended to be even more marked during the 1900s. Cohort life tables will therefore continue to prove valuable in the future both as a benchmark against which to compare period life tables and as an additional tool for investigating mortality trends.

NEIL KLAR

(SEE ALSO: *Cohort Study; Life Expectancy and Life Tables*)

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COHORT STUDY

In the analytic method of epidemiological study called a cohort study, subsets of a defined population are identified and categorized on the basis of exposure to known levels of a risk factor that is believed to be associated with a disease outcome such as coronary heart disease or cancer. The numbers of persons in the total population and the numbers in each subset are known. All are followed over a period, usually years or even decades, and the disease outcomes are recorded and counted at specified periods. These outcomes may be the incidence of diagnosed disease, and/or deaths certified due to the disease being studied, as well as deaths due to other causes. The total numbers, or the number of person-years of observation, must be large enough to generate stable rates, so that the rates can be compared in subsets of the total population that have been exposed to different levels of risk. Hypotheses about causes

and risk factors for disease are tested by comparing incidence and/or mortality rates of groups exposed to different levels of risk. This is a more powerful observational method of epidemiological study than a case-control study, but as the above account makes clear, it is a major undertaking, involving prolonged study of very large numbers. Cohort studies require considerable logistical support that must be maintained over a long period, often for many years or even decades. They are also expensive and require a large, dedicated staff. For these reasons, cohort studies are undertaken only when the investigators have good evidence to support their working hypothesis.

The effort and expense required to conduct cohort studies have been justified by the results of several well-known studies. One of these is the Framingham study, which began in 1948 and still continues. It is a study of samples of the population of Framingham, Massachusetts, in which several risk factors associated with coronary heart disease, other cardiovascular diseases, and more recently, several other chronic diseases, have been assessed. This and several other cohort studies have clarified our understanding of the principal risk factors for coronary heart disease, such as elevated serum lipids, high blood pressure, and cigarette smoking. Other well-known cohort studies include the long-term follow-up of a cohort of male British doctors who were first asked about their smoking habits in 1951. After 20 years, the death rates from lung cancer, other respiratory system cancers, chronic obstructive lung disease, and coronary heart disease all showed significant differences related to smoking habits among this large cohort (Doll and Peto 1976).

Several cohort studies of cancer risks associated with exposure to ionizing radiation have made use of existing data to shorten considerably the many years of observation that would otherwise be required to demonstrate and measure levels of risk. This has been made possible by the existence of good medical records of past diagnostic X-rays that exposed people to low doses of radiation. After case-control studies had revealed evidence suggesting that the use of diagnostic X-rays during pregnancy might increase the risk of cancer in childhood, several cohort studies were set up to confirm or refute this evidence. MacMahon and others used the medical records of over three

quarters of a million women in New England to determine the amount of diagnostic radiation to which they had been exposed during pregnancy, and ascertained the incidence and mortality rates from leukemia and other cancers, including cancers of the brain, bone, and kidney, in the first eight to ten years of their children's lives. They found a significantly higher rate among children who had been prenatally exposed to small doses of diagnostic X-rays, and also observed a dose-response relationship, meaning that there were higher rates among children whose mothers had two or more X-rays than in children whose mothers had only one X-ray. This method is known as an historical cohort study. Other historical cohort studies have shown that repeated chest X-rays (or fluoroscopic screenings) increase the risk of breast cancer many years later.

A by-product of cohort studies is the use of some of the persons studied to conduct one or more case-control studies that are "nested" within the total cohort population. This has the advantage of offering a more rapid answer to questions that have arisen in the course of the cohort study, and also eliminates some of the common biases, such as differential recall of relevant facts by cases and controls, encountered in other varieties of case-control study.

As noted above, cohort studies are more powerful than case-control studies but they have some disadvantages. Strengths include the following: complete data on cases, stages, exposures; can study more than one effect of exposure; can calculate and compare rates and risks; choice of factors available for study; quality control of data; can accommodate "nested" case-control study. Weaknesses include the following: must study large numbers; usually takes many years, even decades; circumstances may change during study; expensive in money, skilled staff required; incomplete control of extraneous factors; rarely possible to study disease mechanism.

Cohort studies are sometimes called prospective or longitudinal studies. It is important to emphasize that a cohort study, like a case-control study, is not an experiment, but merely observes the subjects of the study without intervening—except to ask questions or conduct physical examinations and laboratory tests at various intervals.

Obviously, the informed consent of all participants must be obtained, and in cohort studies of very long duration it is usually necessary to obtain informed consent before each subsequent phase of the study.

The analysis of results is generally a simple matter of calculating and comparing rates, which are commonly expressed in terms of person-years of observation—if one person is observed for ten years, this is ten person-years of observation; two years observation of five persons is also ten-person years. The use of person-years is a convenient way to generate larger numbers for calculation of rates that are more stable than with smaller numbers.

JOHN M. LAST

(SEE ALSO: *Case-Control Study*; *Cross-Sectional Study*; *Epidemiology*; *Mortality Rates*)

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COLD CHAIN

The term "cold chain" describes the techniques and procedures used to ensure that heat-sensitive biological products such as vaccines, sera, and antibiotics do not deteriorate in transit from the place where they are produced to the patients and others who ultimately receive them as part of a preventive or therapeutic regimen. Some important varieties of vaccine and sera are inactivated even at room temperature in temperate zones, and in hot tropical regions they are not only

inactivated, but some may even become toxic. Maintenance of an intact cold chain is particularly necessary in mass vaccination programs in tropical regions, where diseases such as measles and poliomyelitis can do much harm to vulnerable infants and children. Heat-sensitive vaccines and other biological products must be refrigerated immediately after they are produced; and they must stay refrigerated while in transit to distribution centers and to peripheral clinics where the target populations are located. During vaccination sessions the stored vaccines must be kept at a suitable low temperature at all times, and only enough for use on people actually awaiting vaccination should be removed from refrigeration at one time. Vaccines should be distributed to small peripheral clinics in insulated polystyrene boxes packed in dry ice. When vaccine failure is detected, either by serological studies of vaccinated populations or by the occurrence of cases in a supposedly vaccinated population, the cause is most likely to be a breakdown in the cold chain; and this most often happens at the periphery of the chain.

JOHN M. LAST

COLONOSCOPY

See Colorectal Cancer

COLORECTAL CANCER

Colorectal cancer is a malignant neoplasm that affects the larger, lower portion of the intestinal tract. About two-thirds of such cancers occur in the colon, mainly in the sigmoid portion, and one-third occur in the rectum or at the recto-sigmoid junction. The third-leading cause of cancer morbidity and the second leading cause of cancer mortality, colorectal cancer has recently declined among white persons in the United States but is almost 50 percent higher, and rising, among African Americans. Hispanics have only half the mortality rate of non-Hispanic white persons. An estimated 135,400 new cases and 56,700 deaths are anticipated during 2001 in the United States. Risk factors for the disease include being older and male; having had polyps, inflammatory bowel disease, or previous other cancers; being physically

inactive and obese; consuming excessive alcohol; and a low fiber diet. Five-year survival has recently been 62 percent among white persons and 53 percent among African Americans.

Worldwide, colorectal cancer amounts to about one-tenth of all cancers—almost 600,000 of the 6.35 million cases of cancer that occur. Migrants to the United States tend to develop colorectal cancer rates that are similar to those among long-term residents of their adoptive country—even during the first generation or within twenty years of living in the United States. This relatively rapid change suggests the importance of lifestyle in the causation of the disease. This inference is further supported by the fact that colorectal cancer rates throughout the world tend to be substantially higher in urban areas than in rural areas in various countries.

Polyps in the colon, particularly multiple polyps and those exceeding 1.0 cm in diameter frequently precede the occurrence of malignant neoplasm; they therefore constitute a major risk factor.

Control measures include diet, screening, and treatment. It appears that a low fat diet that includes large amounts of vegetables and fruit reduces the risk of colorectal cancer, although the evidence is equivocal, especially as to the extent of reduction. Efforts to control the disease (e.g., the National Colorectal Cancer Awareness Month, supported by the Centers for Disease Control and Prevention of the United States Public Health Services), have recently been emphasizing screening by digital rectal examination (DRE), which is used to detect malignancies that can be reached by that means: the fecal occult blood test (FOBT); and sigmoidoscopy. Barium enemas and proctoscopy have also been used for screening, as well as diagnostically. In 1999 only two-fifths of the American people over fifty years of age had ever received the FOBT or sigmoidoscopy, the latter term including a colonoscopy, which reaches farther into the colon, and a proctoscopy, which extends only into the rectum. The FOBT is recommended annually after age fifty and sigmoidoscopy every five years. Sigmoidoscopy is particularly intended to disclose polyps which may evolve into cancer as well as malignancies that are already present. Both tests are somewhat awkward for patients, but are now recognized as important tools for controlling

colorectal cancer. In several trials, biennial screening with FOBT among persons forty-five to eighty years of age reduced mortality from colorectal cancer by 15 to 21 percent; among persons over forty-five years of age, sigmoidoscopy reduced mortality in the distal colon by 59 to 79 percent.

The Office of Public Health and Science of the United States Department of Health and Human Services has set, as a goal for 2010, reduction of the colorectal mortality rate (age-adjusted) from 12.8 per 100,000 (in 1995) to 8.8 per 100,000.

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(SEE ALSO: *Cancer; Foods and Diet; Lifestyle; Screening*)

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COMMON COLD

See Acute Respiratory Diseases

COMMON VEHICLE SPREAD

The term common vehicle spread describes the mode of transmission of infectious pathogens from a source that is common to all the cases of a specific disease, by means of a medium, or “vehicle,” such as water, food, air, or the blood supply used by a transfusion service. Communicable diseases that are spread in this way do not characteristically manifest themselves in an epidemic of explosive onset with large numbers of cases all occurring at once. Instead, there is a steady or continuous occurrence of cases over a period that may last for weeks, months, or even years until the source of the infection or its mode of transmission is controlled. Cases may occur sporadically, and

perhaps infrequently, especially if there is a change in the nature of the vehicle. When water is the vehicle through which pathogenic organisms are disseminated, the frequency of cases may be low and intermittent if the water source is large and contamination occurs only from time to time, perhaps when rains flush pathogens into the water from cattle pastures.

Sometimes infections occur in very large numbers. A water-borne outbreak of cryptosporidiosis in Milwaukee, Wisconsin, in 1993 affected about 400,000 people. The common vehicle for diarrheal diseases was alliteratively summarized in an otherwise somber British War Office handbook on military hygiene in 1914: "Careless carriers, contact cases, chiefly cooks, dirty drinking water, the dust of dried dejecta, and the repulsive regurgitation, dangerous droppings, and filthy feet of fecal-feeding flies fouling food." Milk was a common vehicle for tuberculosis, scarlet fever, and sometimes typhoid fever until pasteurization rendered milk safe and rules for food safety mandated tuberculosis-free cows. The best known airborne common-vehicle infection is Legionnaires' disease, which is spread by moist air such as that from a poorly maintained air conditioning system or the steamy humid air in Turkish baths.

One of the great medical disasters of the late twentieth century occurred when supplies of blood and blood products for transfusion services in many nations were contaminated by HIV (human immunodeficiency virus) and hepatitis viruses. The principle victims were hemophiliacs being treated with factor VIII and patients undergoing open-heart surgery or other major operations that required the transfusion of multiple units of blood.

JOHN M. LAST

(SEE ALSO: *Communicable Disease Control; Emerging Infectious Diseases; Epidemics; Hepatitis A Vaccine; Hepatitis B Vaccine; HIV/AIDS; Viral Infections*)

COMMUNICABLE DISEASE CONTROL

A communicable disease is an illness caused by a specific infectious agent or its toxic products. It arises through transmission of that agent or its

products from an infected person, animal, or inanimate reservoir to a susceptible host, either directly or indirectly (through an intermediate plant or animal host, vector, or the inanimate environment). Control of disease is the reduction of disease incidence, prevalence, morbidity, or mortality to a locally acceptable level as a result of deliberate efforts; continued intervention measures are required to maintain the reduction. Control is to be contrasted with elimination (reduction to zero of the incidence of a specified disease in a defined geographic area as a result of deliberate efforts; continued intervention measures are required), eradication (permanent reduction to zero of the worldwide incidence of infection caused by a specific agent as a result of deliberate efforts; intervention measures are no longer needed), and extinction (the specific infectious agent no longer exists in nature or the laboratory).

Communicable diseases may be classified according to the causative agent, the clinical illness caused, or the means of transmission. Often all three characteristics are used (e.g., food-borne *Salmonella* gastroenteritis). Causative agents include bacteria, viruses, and parasites. Examples of bacterial diseases include pneumococcal pneumonia and gonorrhea. Viral diseases include influenza, measles, and ebola. Parasitic diseases include malaria and schistosomiasis. Other communicable diseases may be caused by other types of microorganisms such as fungi (e.g., histoplasmosis). The types of illness include pneumonia, diarrhea, meningitis, or other clinical syndromes.

Various categorizations of means of transmission have been used. The American Public Health Association uses these categories: direct transmission, indirect transmission, and airborne. Direct transmission refers to direct contact such as touching, biting, kissing, or sexual intercourse, or the direct projection of droplet spray into the eye, nose, or mouth during sneezing, coughing, spitting, singing, or talking. This projection usually is limited to a distance of 1 meter or less. Examples of direct contact transmission include rabies and sexually transmitted HIV (human immunodeficiency virus). Direct projection is responsible for transmission of diseases such as measles and influenza.

Indirect transmission may occur through a vehicle or an arthropod vector. The causative agent

may or may not multiply or develop in or on the vehicle. Examples of possible vehicles include water, food, biological products, or contaminated articles (such as syringe needles). Water-and food-borne diseases have the potential for causing outbreaks involving thousands of persons. Before the causative agent was identified, many cases of HIV resulted from blood transfusion. Since all donor blood in the United States is now screened for HIV, this is no longer a significant means of transmission. However, sharing of needles by injection drug users remains an important factor in the AIDS (acquired immunodeficiency syndrome) epidemic. Arthropod vectors can spread disease mechanically (as a result of contamination of their feet or passage of organisms through the gastrointestinal tract) or biologically (in which the agent must multiply or go through one or more stages of its life cycle before the arthropod becomes infective). Mechanical spread by arthropod vectors is uncommon. However, arthropod-borne diseases such as malaria (in which the parasite develops within the mosquito vector) are still responsible for millions of cases and hundreds of thousands of deaths each year in tropical countries.

Some infectious agents can be spread through the air over long distances. Airborne spread requires that infectious particles are small enough to be suspended in the air and inhaled by the recipient. Tuberculosis and histoplasmosis are bacterial and fungal diseases spread in this fashion. Airborne transmission could also be used to disseminate agents of biological warfare or bioterrorism. Anthrax and smallpox have been considered among the most likely biological weapons.

Diseases of animals that can be spread to humans are called zoonoses. Some zoonotic diseases include rabies, plague, and tularemia (rabbit fever).

METHODS OF CONTROL

Communicable diseases occur only when the causative agent comes into contact with a susceptible host in a suitable environment. Prevention and control efforts for communicable diseases may be directed to any of these three elements. Communicable diseases affect both individuals and communities, so control efforts may be directed at both.

Treatment of persons with communicable diseases with antibiotics typically kills the agent and renders them noninfectious. Thus, treatment is also prevention. A simple way to prevent the occurrence of communicable diseases is to eliminate the infectious agent through, for example, cooking food, washing hands, and sterilizing surgical instruments between use. Assuring the safety of drinking water through filtration and chlorination and treating sewage appropriately are other important means of preventing the spread of communicable diseases.

For most communicable diseases there is an interval between infection and occurrence of symptoms (the incubation period) in which the infectious agent is multiplying or developing. Some persons who are infected may never develop manifestations of the disease even though they may be capable of transmitting it (inapparent infection). Some persons may carry (and transmit) the agent over prolonged periods (carriers) whether or not they develop symptoms. Treatment during the incubation period may cure the infection, thereby preventing both disease and transmission. This preventive treatment (chemoprophylaxis) is often used in persons who have been exposed to sexually transmitted diseases such as syphilis and gonorrhea. It also is effective in persons who have been infected with tuberculosis, although the preventive treatment must be given for several months.

The susceptibility of the host to a specific infectious agent can be altered through immunization (e.g., against measles) or through taking medications that can prevent establishment of infection following exposure (chemoprophylaxis). Since malnutrition and specific vitamin deficiencies (such as vitamin A) may increase susceptibility to infection, ensuring proper nutrition and administering vitamin A can be more general ways of increasing host resistance. If persons survive a communicable disease, he or she may develop immunity that will prevent the disease from recurring if re-exposed to the causative agent.

The environment may be rendered less suitable for the occurrence of disease in a variety of ways. For example, food can be kept hot or cold (rather than warm) to prevent multiplication of organisms that may be present. Individuals can use mosquito repellents or mosquito nets to prevent

being bitten by infected mosquitoes. Breeding places can be drained or insecticides used to eliminate vectors of disease. Condoms can be used to prevent sexually transmitted diseases by providing a mechanical barrier to transmission. Reduction of crowding and appropriate ventilation can reduce the likelihood of droplet or airborne transmission. Respiratory protective devices can be used to prevent passage of microorganisms into the respiratory tract.

The sociocultural environment is also important in affecting the occurrence of communicable diseases. For example, in the 1980s there was a change in the social norms in men who have sex with other men on the West Coast of the United States, where unprotected anal intercourse had been the norm and was responsible for considerable transmission of HIV. As a result of a variety of educational and social marketing approaches, the social norm changed to the use of condoms and the rate of new HIV infections (and of rectal gonorrhea) declined. Similarly, aggressive social marketing of condom use in Uganda has led to a change in sexual practices and a decline in new HIV infection rates. Other societal approaches to control of communicable diseases include safe water and food laws, provision of free immunization and chemoprophylaxis through public health departments, enactment and enforcement of school immunization requirements, isolation of individuals with communicable diseases to prevent transmission, and quarantine of individuals exposed to communicable diseases to prevent disease transmission during the incubation period if they have been infected.

IMPACT OF COMMUNICABLE DISEASES

The gathering of humans in settlements (and subsequently cities) resulted in the development of periodic epidemics of communicable diseases, often with devastating impact. In the fourteenth century, for example, bubonic plague (carried by rats and transmitted to humans by fleas) swept through Europe, killing approximately one-quarter of the population of the continent. Epidemics of "crowd" diseases such as measles and influenza resulted from person-to-person transmission, and inadequate water and sewage management led to epidemics of diseases such as cholera and typhoid.

Milk- and food-borne diseases also were common. Until the end of the nineteenth century, communicable diseases were the leading cause of death throughout the world.

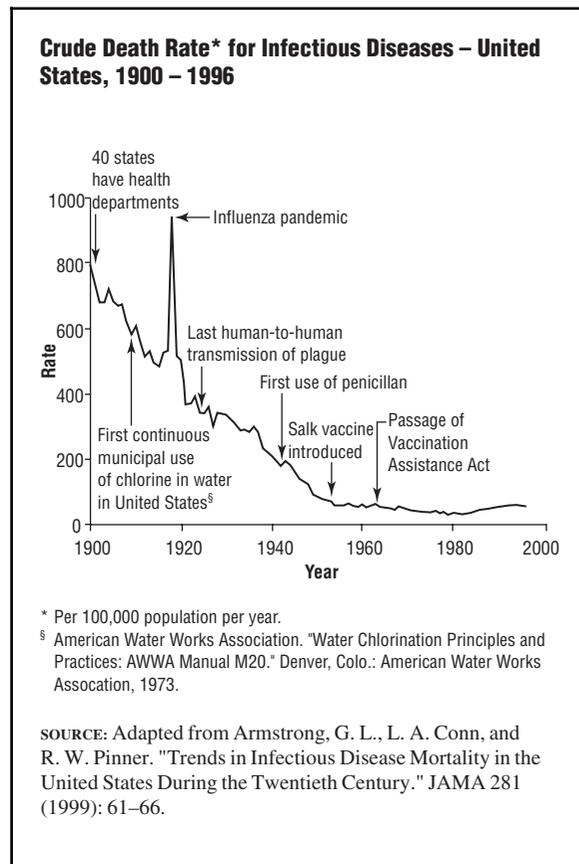
In the United States in 1900, tuberculosis was the leading cause of death, followed by pneumonia and diarrhea. Along with diphtheria (in tenth place), these conditions accounted for more than 30 percent of all deaths in the country. Major reductions in morbidity and mortality from communicable diseases have resulted from improvements in sanitation, housing, and nutrition as well as introduction and use of vaccines and specific therapies.

Improvements in sanitation have dramatically reduced the burden of water- and food-borne diseases. Improvements in housing have also played an important role in reducing transmission of tuberculosis, and improvements in nutrition have made persons with infectious diseases less likely to die from their infections. The introduction and use of vaccines have resulted in global eradication of smallpox, significant progress toward eradication of poliomyelitis, and a marked reduction in illness and death due to diseases such as diphtheria, whooping cough (pertussis), and measles. Specific therapies such as antibiotics and antiparasitic drugs have had a significant impact on deaths due to infectious diseases as well as having some impact on the occurrence of the diseases by shortening the period in which an infected person is infectious to others.

The most dramatic improvements have been seen in the United States and other developed nations (see Figure 1). Although significant progress has also been made in developing nations, the *World Health Report 2000* reports that 14 million deaths (25 percent of all deaths in the world in 1999) resulted from infectious diseases or their complications. There is a marked disparity in the importance of infectious diseases in high-income countries compared to middle- and low-income countries. In high-income countries, infectious diseases accounted for only 6 percent of all deaths, whereas in middle- and low-income countries they accounted for 28 percent of all deaths.

Worldwide, lower respiratory infections (e.g., pneumonia) and diarrhea are the leading infectious causes of death; each of these conditions can be caused by a variety of microorganisms. AIDS

Figure 1



was the single leading infectious cause of death in 1998, with an estimated 2.2 million deaths, followed by tuberculosis, with nearly 1.5 million deaths, and malaria, with 1.1 million deaths. Nearly 900,000 children died as a result of measles in 1998, even though an effective vaccine against measles was introduced in 1963 and has had a major impact in developed nations. Half of the children who died from measles lived in sub-Saharan Africa.

Much of the continuing toll of communicable diseases could be reduced by more effective use of existing vaccines and other tools for control of infectious diseases. For example, more effective use of measles vaccine and administration of vitamin A could prevent most of the deaths from measles. More widespread use of oral rehydration therapy in diarrhea (to combat the dehydration that is one of the major causes of death) could dramatically reduce current mortality. More effective use of bed nets, anti-mosquito strategies, and

appropriate treatment could dramatically reduce malaria deaths. However, new tools will be needed to bring about maximum control of some diseases. Because microorganisms are continually evolving, they may change enough so that prior experience (infection) with the infectious agent does not provide protection. For example, influenza viruses may undergo dramatic changes with the result that pandemics (worldwide epidemics) may occur. In 1918–1919, pandemic influenza killed millions of people worldwide, more than 500,000 in the United States alone (see Figure 1).

PREVENTIVE MEASURES

Vaccine-Preventable Diseases. Some communicable diseases can be prevented by the use of vaccines. The word vaccine comes from *vaccinia*, the Latin name for cowpox. The first vaccine was developed by Edward Jenner, an eighteenth-century English physician and naturalist who noticed that milkmaids who had acquired cowpox (a condition that caused lesions to appear on the udders of cows) on their hands did not seem to be affected by smallpox. He believed that infection with cowpox would protect against smallpox, a serious, often fatal epidemic disease. In 1796 he took material from a skin lesion on the hand of a milkmaid and inoculated it into the arm of a young boy. The boy was subsequently exposed to smallpox and did not become ill. Thus began the vaccine era.

It was nearly one hundred years until the next vaccine (rabies) was developed by Louis Pasteur. In the twentieth century, a number of vaccines were developed; many more are under development as a result of the biotechnology revolution. Widespread use of vaccines in children has had a dramatic impact on the occurrence of the diseases.

Because smallpox has been eradicated, smallpox vaccination is no longer carried out. The last case of naturally occurring smallpox in a human was in 1977, and in 1980 the World Health Assembly certified that smallpox had been eradicated from the face of the earth. Stocks of smallpox virus have been maintained (under security) in both the United States and Russia, though the debate continues whether they should be destroyed. Concerns have arisen about the possibility that some groups or nations have retained the smallpox virus

and developed it for use in biological warfare or bioterrorism.

Chemoprophylaxis. Chemoprophylaxis refers to the practice of giving anti-infective drugs to prevent occurrence of disease in individuals who are likely to be exposed to an infectious disease or who might have already been infected but have not developed disease. For example, individuals traveling to areas where malaria is common can take anti-malarial drugs before arriving, during their stay, and for a few weeks after leaving and thus protect themselves against malaria. Similarly, persons who have been exposed to syphilis can be given penicillin to prevent the possibility of their developing syphilis, and persons who have been infected with tuberculosis can be given six months of treatment to prevent the development of tuberculosis.

Antibiotics and Resistance. Antibiotics are compounds that are produced by microorganisms that kill or inhibit the growth of other microorganisms. Those that kill bacteria are called bactericidal; those that prevent multiplication (and rely on the body's defense mechanisms to deal with the limited number of living organisms) are called bacteriostatic. Some antibiotics are effective against a limited number of microorganisms, others may have more widespread effect.

Because microorganisms are continually in a state of evolution, strains may evolve that are resistant to a particular antibiotic. In addition, resistance characteristics can be transferred from some microorganisms to others (this is particularly true of organisms that inhabit the gastrointestinal tract). The likelihood that resistance will develop is increased if antibiotics are used in an indiscriminate manner and in inadequate amounts (either in terms of individual dosage or in length of therapy). Antimicrobial resistance is a growing problem: organisms that once were exquisitely sensitive to a particular antibiotic may now have developed significant (or total) resistance to it. This necessitates either increasing the dose of the antibiotic administered (in the case of partial resistance) or developing totally new drugs to treat the infection (in the case of total resistance). A few microorganisms (such as *enterococcus*, an organism that lives in the intestinal tract and is particularly likely to cause infections in gravely ill patients with compromised immune systems) have developed

such widespread resistance that it is a real challenge to treat them effectively, resulting in a need to develop even more antibiotics.

EMERGING AND RE-EMERGING INFECTIOUS DISEASES

New infectious diseases continue to be recognized and others, once thought under control, are reemerging as significant problems. To cite a few examples of "new" diseases, the following have been recognized for the first time since 1975: legionnaire's disease, ebola virus, HIV/AIDS (acquired immunodeficiency syndrome), toxic shock syndrome, *Escherichia coli* O157:H7 (cause of hemolytic-uremic syndrome), Lyme disease, *Helicobacter pylori* (major cause of peptic ulcer), hepatitis C, and hantavirus. Some of these are conditions previously known but without a known infectious cause (e.g., peptic ulcer) while others represent apparently new clinical syndromes that have not occurred or have not been recognized in the past.

Old diseases, such as tuberculosis and malaria, are reemerging in areas where they were once under control. This may be a result of the lack of continued application of known effective interventions but also may result from ecological changes. Some of the factors involved in the increase in infectious diseases, whether new or old, include population shifts and growth (and encroachment on previously unpopulated areas); changes in behavior (e.g., injection drug use, sexual practices); urbanization, poverty, and crowding; changes in ecology and climate; evolution of microbes; inadequacy of the public health infrastructure to deal with the problems; modern travel and trade; and the increasing numbers of persons with compromised immune systems (whether as a result of HIV/AIDS, chemotherapy for cancer, or immunosuppressive therapy for organ transplants). Many of these factors are interrelated.

In addition to these new and reemerging diseases, there may be specific interactions between diseases. This is particularly true with HIV and tuberculosis (TB), in which each infection is a very potent co-factor for worsening the other: Persons with HIV infection who become infected with TB are more likely to develop TB disease that is

serious and rapidly progressive than persons without HIV infection, and persons with TB who contract HIV infection are very likely to have a rapid progression to full-blown AIDS.

In the United States, the incidence of food-borne disease has received increasing attention in the past several years. This relates in part to improved surveillance but also relates to changes in patterns of food production, distribution, and consumption. With modern transportation, it is possible to get fresh vegetables and fruits at all times of the year. This means that salad ingredients purchased at a modern supermarket (and eaten raw) may have been grown in a developing country, where the average American traveler would not eat raw vegetables. The consolidation of producers of prepared foods makes possible large interstate outbreaks of food-borne disease such as the 1994 outbreak of *Salmonella* infections associated with ice cream that affected an estimated 224,000 persons nationwide. It is currently estimated that food-borne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the United States each year.

EPIDEMIC THEORY AND MATHEMATICAL MODELS OF INFECTIOUS DISEASES

Based on observed characteristics of infectious diseases, epidemiologists have attempted to construct mathematical models that would make it possible to predict the pattern of spread of a condition within the population. Some diseases have constant features, which make mathematical modeling particularly attractive. Measles, for example, has a predictable incubation period (ten to fourteen days) and limited duration of infectivity of a given patient (four to seven days). In addition, it is highly infectious (nearly every susceptible person who comes in contact with an infectious person will become infected), and nearly everyone who is infected develops clinical illness. Lifelong immunity follows infection. There is no nonhuman reservoir. Given these relatively constant parameters, it is possible to predict the pattern of transmission if measles is introduced into a population, using different estimates for the proportion of susceptible persons in the population, the distribution of these susceptibles (e.g., randomly dispersed, clustered together), and the likelihood of

contact between the infectious patient and the susceptibles. Because of the extreme infectiousness of measles, models indicate that it is necessary to reach very high levels of immunity in a population (on the order of 95 percent or greater) in order to prevent sustained transmission of measles. Given the fact that measles vaccine is approximately 95 percent effective, this indicates that, to eradicate measles, it will be necessary to reach 100 percent of the population with a single dose of the vaccine or to reach 90 percent of the population on each of two rounds of vaccination (assuming that the second round will reach 90 percent of those who were not reached by the first round). Since babies are being born all the time, this also must be an ongoing process. The major reason for continuing debate over whether measles eradication is an achievable goal using current vaccines is the necessity to achieve and maintain such high levels of immunity.

ALAN R. HINMAN

(SEE ALSO: *Emerging Infectious Diseases; Food-Borne Diseases; Immunizations; Sexually Transmitted Diseases; Vector-Borne Diseases; Waterborne Diseases; Zoonoses; and articles on specific diseases mentioned herein*)

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COMMUNICATION FOR HEALTH

Communication has long been an important tool in health promotion, and during the closing decades of the twentieth century it became an essential part of public health programs. Although its roots date back hundreds of years (to Cotton Mather's smallpox vaccination campaign during Colonial American times), if not thousands of years (to Aristotle's theories of persuasion), the field of public health communication is very much an outgrowth of contemporary social conditions.

Demographic, social, and technological trends that developed over the second half of the twentieth century fostered conditions in which the value of good health information, and thus the value of effective health communication, became increasingly clear. Throughout the twenty-first century, public health communication is likely to become increasingly integrated with the core public health disciplines, especially health education and health promotion. Other public health disciplines, including epidemiology, health policy, occupational health, environmental health, international health, and health services research, are coming to appreciate both the fundamental importance of communication processes and the potential of effective communication to improve the public's health.

COMMUNICATION RESEARCH, THEORIES, AND INTERVENTIONS

Public health communication includes a continuum of activities that span from research to interventions. Communication theory can and should be used to inform the research and intervention activities along this spectrum.

The purpose of health-communication research is to understand the processes of communication, how communication can help to improve health, and the effects of communication itself on health outcomes. Research questions that have attracted considerable interest include: Does violence in the media cause violent behavior? Is the increasing rate of childhood obesity the result of an increase in electronic media use? Does bias in news media coverage lead the public to worry excessively about rare health risks while ignoring more prevalent

health risks? Do people process health information in systematically biased ways that contribute to "irrational" decision making? Does the news media tend to "frame" public health issues in a manner that obscures the true nature of the problem (and thereby obscuring the most promising solutions)?

Answers to these and other research questions are used to develop communication interventions that effectively improve health outcomes. For example, the National Institutes of Health (in partnership with health professional associations, voluntary health agencies, and pharmaceutical companies) has conducted a communication campaign that has contributed to more than a 60 percent reduction in the death rate from stroke. Sudden infant death syndrome (SIDS) campaigns conducted around the globe during the 1990s led to rapid and dramatic (50–80%) reductions in death rates from SIDS. In 1998 and 1999, the state of Florida conducted a mass media and grassroots youth antismoking campaign (the "Truth" campaign) which reduced rates of smoking among middle school students by 40 percent and among high school students by 18 percent. The "Truth" campaign was funded through Florida's financial settlement with the tobacco industry. Florida's settlement, and the settlement signed by most other states was in large measure the result of successful public health communication efforts to reframe the tobacco issue. Previously, the media tended to frame smoking as an issue of individual choice. Communication efforts of the Campaign for Tobacco-Free Kids and other organizations during the mid-1990s succeeded in reframing the issue in terms of the tobacco industry's persistent unethical business practices and attempts to entice children to become addicted smokers.

Communication theory (which draws from a broad range of other social science and behavioral science disciplines) is the interface between health communication research and health communication interventions. Communication research is used to develop and test theories of communication, information processing, and human behavior. These theories attempt to explain how and why people process health information, the impact of communication and information on behavior, and how factors in the social and physical environment mediate the relationship between communication

and behavior. Theories that have been shown to have useful predictive and prescriptive power (such as social cognitive theory, the theory of reasoned action, stages of change theory, theories of risk perception, and framing theory) are a powerful asset in planning successful public health communication interventions.

OBJECTIVES FOR COMMUNICATION INTERVENTION

Although many distinctions can be made between the various types of public health communication activities, the most important distinctions pertain to differences in objectives. Two fundamental distinctions can be made with regard to communication interventions based on their objectives. The first distinction pertains to whether the intervention seeks to influence the actions of individuals and small groups or the actions of larger groups such as workplaces, communities, states, or nations. The objectives of communication interventions at these larger levels (which are often referred to as “advocacy” interventions) are focused on bringing about changes in policies. Examples include improved safety policies in the workplace, and more rigorous DUI (driving under the influence) laws at the state or federal level. These interventions seek to improve health by improving the health capacity of the environment in which people live.

The second important distinction is among interventions at the individual (or small group) level. Informed decision-making interventions seek to inform people for the purpose of enabling them to make better health decisions, while persuasion-oriented interventions seek to persuade people to change their behaviors or beliefs. Situational factors determine which of these two approaches is most appropriate.

Persuasion-oriented interventions are appropriate when there is clear evidence that the behavior change is likely to benefit the individual, and when society is able to reach consensus about the worthiness of the behavior as a societal goal. Examples include promotion of mammograms for women over the age of forty, teen substance-abuse prevention, and promotion of bicycle helmet use by children.

Informed decision-making interventions are indicated in situations when persuasion would be inappropriate, such as when the evidence is not sufficiently clear to support one behavior over another (e.g., surgical removal versus watchful waiting for men with a diagnosis of prostate cancer), when an individual’s values must be taken into consideration to determine the optimal behavior (e.g., prevention of sexual assault), and when society has been unable to reach consensus about the optimal recommended behavior (e.g., prevention of teen pregnancy).

PRINCIPLES FOR EFFECTIVE PUBLIC HEALTH COMMUNICATION

Public health communication is inherently pragmatic. It embraces theories, organizing frameworks, and implementation tactics from many different professional and academic disciplines. Four of the more important aspects of public health communication are: media campaigns, social marketing, risk communication, and media advocacy. While these differ considerably, particularly with regard to their organizing frameworks, they do share some underlying principles of effective communication.

Know Your Audience. The first and most important step in communication planning is to gain as much insight as possible into the target audience. This is done primarily by conducting original audience research (e.g., focus groups, surveys), assessing the results of previous communication efforts, and drawing from theories of communication and behavior change.

Focus on the Right Objective. The strategies and tactics of a communication intervention will differ depending on the stated objective (e.g., informed decision-making, persuasion, policy change advocacy). A clear statement of objectives focuses and enhances all other elements of the communication planning process.

Determine What Information Is of Greatest Value. For a variety of reasons, public health communication campaigns will always be limited in the amount of information they can successfully convey. Therefore, a critical step in communication planning is to determine what information has the greatest value in helping to achieve the stated objective of the campaign. The ideal (albeit rare)

scenario is when a single powerful idea is sufficient to motivate and enable members of the target audience to embrace the campaign's objective.

Convey Simple, Clear Messages, Many Times, through Many Sources. After the information with the greatest value has been identified, communication planners must determine how to convey that information simply and clearly, often, and by many trusted sources. Message repetition is an important element of program success. Audiences tend to process information incrementally over time. When the message is stated simply and clearly, when it is repeated often enough, and when it is stated by many trusted sources, audience members are more likely to learn and embrace the message.

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(SEE ALSO: *Communications as a Career; Communication Theory; Counter-Marketing of Tobacco; Health Promotion and Education; Mass Media; Social Marketing*)

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COMMUNICATION THEORY

Communication is the production and exchange of information and meaning by use of signs and symbols. It involves encoding and sending messages, receiving and decoding them, and synthesizing information and meaning. Communication permeates all levels of human experience and it is central to understanding human behavior and to nearly all public health efforts aimed at fostering health behavior change among individuals, populations, organizations, communities, and societies.

Communication may be studied empirically and critically at different levels of interaction. These levels, often described on a "micro-to-micro" continuum are "intra-personal" (how individuals process information), "inter-personal" (how two individuals interact to influence one another), group (how communication dynamics occur among many individuals), formal and informal "organizations" (how communication occurs and functions in the context of organizations such as hospitals, schools, or public health agencies), and "community" and "society" (how communication builds or changes the agenda of important issues).

Empirical study means applying scientific methods to the study of communication; as in the study of behavior change resulting from exposure to a communication campaign. Critical study means applying methods of cultural, literary, or normative criticism to the study of communication; as in the analysis of how media content creates health-related meaning and influences behavioral norms through commercial advertising or entertainment.

Many fields emphasize the importance of communication theory as a basis for understanding human behavior. For the field of public health, the use of applied communication perspectives involves how communication activity positively or

negatively contributes to health behavior, and how the planned use of communication influences health behavior within the context of health education and health promotion.

ORGANIZATION OF COMMUNICATION STUDIES

Communication scholar George Gerbner describes three main branches of communication study. The first is “semiotics,” the study of signs and symbols and how they combine to convey meaning in different social contexts. This branch is mainly concerned with how verbal, nonverbal, visual, and aural signs and symbols combine to create messages.

The second branch, media effects, is the study of behavior and interaction through exposure to messages. It emphasizes measuring, explaining, and predicting communication effects on knowledge, perceptions, beliefs, attitudes, and public opinion. It is strongly influenced by scientific methods from the fields of psychology and social psychology.

The third branch, message production, is the study of the large-scale organization of communications through social institutions and systems (mass media, political organizations, government, advocacy groups), their history, regulation, and policy-making impact. It is strongly influenced by scientific methods from the field of sociology, but also by the methods of political science, history, and public affairs.

Just as no single behavioral theory explains and predicts all human behavior, no communication theory explains and predicts all communication outcomes. Some view this as a *fragmentation* in understanding the role of a communication in human affairs. Others view this as a productive theoretical diversity, conducive to the understanding of human activity in many complex dimensions. Communication researchers have increasingly sought to connect and to integrate effects across levels of analysis, from the “micro” to the macro. For example, health campaign planners may study the effects of a media campaign in generating interpersonal discussion. They might look at media story about a new drug or treatment to see if it causes patients to raise the issue with their health care providers.

COMMUNICATION THEORY AND HEALTH BEHAVIOR CHANGE STRATEGIES

How does communication theory inform health behavior change strategies?

Major theories of health behavior change all include communication processes. Value expectancy theories such as the *health belief model* and the *theories of rational behavior and planned behavior* depend on communication processes to catalyze health behavior change. The health belief model holds that individuals will be more likely to change their health-related behavior if they recognize a health risk or condition as important, if they view themselves as susceptible to the risk or condition and if they regard the benefits of change as outweighing barriers to making change. Communication strategies play a key role in influencing these perceptions. Similarly, communication plays an important role in influencing perceptions critical to the *theories of reasoned action and planned behavior*. In these theories, behavior is principally influenced by intentions to change. Intentions are influenced by people’s attitudes toward a specific behavior as well as their perceptions of what important referent groups think about the behavior. Communication may play a key role in influencing perceptions on both counts and thereby raise the likelihood of behavior change.

While communication dynamics in these theories are aimed principally at catalyzing health behavior change among individuals, other theories include the use of communication to affect change at the level of the community and society as well. The *social cognitive theory* of Albert Bandura (1986) and the *transtheoretical model* of Jams Prochaska et al. (1994), for example, recognize that an individuals’ behavior is formed in the context of the larger community and social environment. Therefore planned interventions must include efforts to change the larger environment as well. From this perspective, communication has a role to play in influencing community and societal change in areas such as building a community agenda of important public health issues, changing public health policy, allocating resources to make behavior change easier, and legitimizing new norms of health behavior.

Community-based approaches to public health interventions and campaigns gained currency in

public health during the last quarter of the twentieth century. This approach recognizes the need to seek change in health behavior across multiple levels of human experience—from the individual to the community level. Campaigns are planned efforts that seek different dimensions of change that will lead to health improvement throughout the population.

THE ROLE OF MEDIA COMMUNICATION

Because public health is interested primarily in populations, media communication is a key part of multistrategy, community-based campaigns. This is the case whether the object is to build a community's agenda for prevention, to change public policy, to educate individuals about specific health behavior changes, or all of these. Media institutions play a crucial role in health behavior change because of their role in disseminating information. As agents of socialization, like other major institutions, they also have a powerful impact in legitimizing behavioral norms. Popular and academic perspectives both hold that media communication plays a powerful role in promoting, discouraging, or even inhibiting healthy behaviors.

One type of research with applied implications for public health deals with message production. It seeks to understand the social and organizational factors that may impinge on the creation of media messages. Public health interest in this research centers around how it may influence message production processes in ways more conducive to creating messages about healthful behavior. The definition of a public health problem influences how the public understands it, the actions individuals or communities are likely to take to affect the problem, and the attention given the problem by different groups. The same processes may be used to influence entertainment content as well. The Harvard School of Public Health, for example, mounted a successful campaign to persuade television producers to include messages about the importance of the designated driver in reducing alcohol-related traffic accidents in their programs.

The second type of research studies the consequences of media exposure on individuals, groups, institutions, and social systems. The focus here is on major media effects hypotheses and their relevance to health behavior change. At the level of the

individual, for example, researchers have studied learning hierarchies in which knowledge change affects attitudes, which in turn affects behavior. Others have noted different hierarchies, including *dissonance-attribution*, in which behavior change precedes attitude change, which in turn affects knowledge, and the *low-involvement* hierarchy, in which knowledge change precedes behavior, which in turn affects attitudes. Researchers, such as S. Chaffee and C. Roser (1986), have suggested that there are not three distinct hierarchies of effects, but a single continuum. The order of effects depends on where individuals or groups are positioned on this continuum with respect to a given outcome. In public health campaign settings, intervention and communication strategies will depend on an assessment of audience characteristics and needs, and on the development of appropriate messages.

Similarly, persuasion studies have focused on the chain of individual-level communication processes leading to behavior change. Early studies focused on opinion or attitude change in the context of such variables as the credibility of the information source, fear, organization of arguments, the role of group membership in resisting or accepting communication, and personality differences. Since the 1960s, however, research has emphasized cognitive processing of information leading to persuasion. This change occurred partly because of the interest Latin American scholars shown in developing new approaches to the use of mass communication in order to guide social change projects in developing countries.

Social structure has played an increasingly important role in the application of communication strategies to health behavior change. A continuing and perplexing issue involves the influence of social structure on communication and media use, and how this affects health behavior change. Epidemiological studies suggest, for example, that the health "gap" between higher and lower socioeconomic status groups in the United States is worsening rather than improving. Communication contributes to these circumstances insofar as structural barriers of access and exposure are frequently ignored or overlooked. Research has long demonstrated that knowledge and information are not equally distributed across populations. Early studies, such as those of Hyman and Sheatsley (1947), and Mosteller and Moynihan

(1972), showed that people with more formal education learned and knew more about many issues, including health, than people with less formal education. These findings were formally presented as the *knowledge gap hypothesis* by Minnesota researchers P. J. Tichenor, G. A. Donohue, and C. N. Olien (1970). They proposed that increasing flow of information into a social system is more likely to benefit groups of higher socioeconomic status. The disturbing implications were, of course, that public campaigns would only perpetuate inequities. Because this called into question the entire basis of guided social change efforts, it attracted the attention of scholars and policy makers alike. Fortunately, subsequent studies found that knowledge gaps were not intractable. Researchers discovered a variety of contributory conditions that could reduce knowledge gaps. These conditions include content domains (some subjects are intrinsically more relevant to people, such as their health), channel influence (some channels are used more, and have greater impact, on certain groups), social conflict and community mobilization, the structure of communities, and individual motivational factors.

FUTURE DIRECTIONS

The use of communication to achieve health behavior change is now a staple of public health intervention methods, and will continue to be influential in the twenty first century. Researchers are interested in how communication at each level of analysis may influence or link to communication at other levels to affect health outcomes. Social cognitive theorist Albert Bandura recently suggested that the “power” of any single channel of communication (mass media or interpersonal) may depend on the complexity of the behavior change being sought. The less complex the change, the more the influence of a single channel may lead to performance of the behavior. On the other hand, the more complex the behavior, the greater the individuals’ need for multiple exposure to multiple sources.

The emergence of new communication technologies also provides opportunities and challenges to public health. The World Wide Web, newsgroups, and other Internet innovations offer information on an array of topics from diverse sources. The nature of the medium also permits

information to be available “on demand” to users. Thus, it appears that users can exert a greater degree of control in obtaining the information they seek. However, there is a potentially serious problems that warrant closer examination. New media technologies have the potential to widen the gap between those who can pay for access and gain the necessary skills, and those who cannot. If so, a significant portion of the population may once again be “out of the loop” of important health information and consequently health behavior change.

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(SEE ALSO: *Advertising of Unhealthy Products; Health Educator; Health Promotion and Education*)

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COMMUNICATIONS AS A CAREER

Communication graduates help public health professionals by creating persuasive messages to reach goals. They offer practical application of communication theories to improve the sending and receiving of verbal and nonverbal messages between and among target audiences. The audiences include the public, health providers, families, community groups, organizations, and policy makers. Some graduates create and produce public relations, television, radio, print, and Internet campaigns to educate the public on problems such as drug abuse and HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome). Others train health professionals and patients in communication skills to make informed choices on preventing diseases and treating illnesses.

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(SEE ALSO: *Careers in Public Health*)

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COMMUNITY AND MIGRANT HEALTH CENTERS

Community Health Centers (CHCs) were first funded by the United States government as part of the War on Poverty in 1966 by Congress under Section 314(e) of the Comprehensive Health Planning and Public Health Service Act. By the early 1970s, about one hundred neighborhood health centers had been established under the Economic Opportunity Act (OEO). These centers were designed to provide accessible, dignified personal health services to low-income families. The U.S. Public Health Service (PHS) began funding neighborhood health centers in 1969. With the phase-out of OEO in the early 1970s, the centers supported under this authority were transferred to the PHS. Currently, the CHC federal grant program is authorized under section 330 of the PHS Act and is administered by the U.S. Department of

Health and Human Services, through its Health Resources and Services Administration's Bureau of Primary Health Care (BPHC).

BPHC's mission is to increase access to comprehensive primary and preventive health care and to improve the health status of underserved and vulnerable populations. CHCs exist in areas where economic, geographic, or cultural barriers limit access to primary health care for a substantial portion of the population; they tailor services to the needs of the community.

Section 330-funded programs include Community and Migrant Health Centers, Health Care for the Homeless projects, and Public Housing Primary Care programs. These programs build community-based primary care infrastructure and provide family-oriented, culturally competent primary care, which is also linked to social services in rural and urban medically underserved communities.

CHCs offer primary and preventive care, outreach, and dental care. Essential ancillary services such as laboratory tests and X-ray, environmental health, pharmacy, health education, transportation, translation, and prenatal services are provided or arranged for. Links to welfare, Medicaid, substance abuse treatment, Special Supplemental Food Program for Women, Infants, and Children, known as the WIC program, and related services are also provided. Personnel within the centers include physicians, advanced practice nurses, physician assistants, dentists, nurses, pharmacists, as well as administrators and supportive services staff such as medical records personnel, social workers, family health workers, laboratory technicians, and nutritionists.

In fiscal year (FY) 1996, the community and migrant health center appropriation was consolidated to include the homeless and public housing programs. Funding for CHCs represents approximately 85 percent of the consolidated appropriations:

- FY 1997 \$802.0 million
- FY 1998 \$825.0 million
- FY 1999 \$925.0 million

Ten million of the nation's neediest people receive primary health care through the more than

3,000 primary-care delivery sites supported by the BPHC. These community-based programs emphasize prevention as well as early detection and timely intervention in health problems. The CHCs generate significant economic activity in financially depressed communities, but they are in fiscal trouble themselves. Per Mary McCrory of the *Washington Post*, "the CHCs, which take care of four out of every ten poor children in America, are up against it these days. Of the 650 in operation, 45 percent are in severe financial trouble; 7 percent have declared bankruptcy."

The U.S. health-care system is rapidly changing. The numbers of uninsured persons are increasing and disparities in health outcomes are widening. The BPHC has recognized that broad action is necessary if it is to fulfill its mission. In 1999, the BPHC declared that its aim was to achieve 100 percent access and zero disparities in health status so that every person in every underserved community would have access to primary and preventive care; and through improving the delivery of care and patient self-management of disease, there would be no disparities in health status related to race, ethnicity, or income. Since undertaking this endeavor, more than one hundred communities have committed to this 100 percent access zero disparity vision.

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(SEE ALSO: *Decentralization of Community Health; Immigrants; Medicaid; Minority; Rural Health*)

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COMMUNITY ASSESSMENT

See Community Health

COMMUNITY DENTAL PREVENTIVE PROGRAMS

The dental diseases and problems that pose the greatest burden to most communities are dental caries (tooth decay), periodontal (gum) diseases, oral cancer, and trauma. These can be largely prevented through a combination of community, professional, and individual strategies. Community preventive programs, particularly community water fluoridation and school-based dental sealant programs, have proven highly effective in reducing dental caries. The effectiveness of programs to prevent other oral health problems has not been demonstrated, but common sense and indirect evidence indicate that continued efforts to develop and implement such programs are warranted.

The first use of fluoride for caries prevention occurred in 1945 in the United States and Canada, when the fluoride concentration was adjusted in the drinking water supplies of four communities. This public health approach followed a long period of epidemiologic studies of the effects of naturally occurring fluoride in drinking water. Observation of dramatic declines in dental caries in the cities conducting the studies, compared to similar cities with low levels of fluoride in the water, led to fluoridation of water supplies in many other cities. The Centers for Disease Control and Prevention (CDC) has recognized water fluoridation as one of the great public health achievements of the twentieth century, since it provides an inexpensive means of substantially improving oral health that benefits all residents of a community, without regard to their interest in, or ability to receive, dental care.

In spite of its well-documented effectiveness and safety, 100 million persons in the United States remained without fluoridated water at the beginning of the twenty-first century. Adoption of water fluoridation can require political processes that make institution of this public health measure difficult, and opponents often make unsubstantiated claims about adverse health effects of fluoridation in attempts to influence public opinion. These barriers present serious challenges to expanding fluoridation in the United States.

Fluoride prevents tooth decay by making tooth surfaces more resistant to the demineralization

caused by the acids produced by bacteria in dental plaque as they metabolize carbohydrates. It also remineralizes the enamel surface of teeth weakened by the decay process, reversing the cavity-producing process. Through these effects on the surfaces of teeth, fluoride prevents dental caries in both children and adults. The success of fluoridation led to the development of other fluoride-containing products, most notably fluoride-containing dentifrices (toothpastes) and high strength gels for professional use. Promotion of regular use of fluoride dentifrices by their manufacturers and the dental profession through commercial advertising and health education in schools has proven to be another effective community intervention. By the year 2000, drinking of fluoridated water and the self-care habit of regular use of fluoride toothpaste by most persons had reduced dental caries markedly compared to levels that existed at the middle of the twentieth century.

Dental sealants are plastic coatings that can be professionally applied to pits and fissures, primarily on the chewing surfaces of molar (posterior) teeth, to protect them from dental caries. Without sealants, as much as 90 percent of all dental caries in schoolchildren occurs in pits and fissures. To be most effective, sealants should be placed on teeth soon after they erupt, but they can be applied across a wide age range. Community programs generally target vulnerable populations less likely to receive private dental care, such as children eligible for free or reduced-cost lunch programs (or from low-income families). These school-based programs select classes of schoolchildren at high risk and seek parental permission for referral to an off-site private practice or clinic, or for receipt of services provided in the school by dental professionals using portable equipment. School-based sealant delivery programs are strongly recommended on the basis of strong scientific evidence of their effectiveness in reducing caries on the chewing surfaces of permanent molars.

Other community dental-disease prevention and oral-health promotion efforts include those directed toward the public, practitioners, and policymakers to create a healthy environment, reduce risk factors, inform groups at risk, and improve knowledge and behaviors. There is evidence that comprehensive application of community approaches can reduce the use of tobacco,

which is a risk factor for both oral cancer and periodontal diseases (gum infections and the inflammatory reaction that leads to loss of bone support for the teeth). Periodontal disease is a significant cause of tooth loss among adults, and approximately half of the cases of periodontal disease in the United States are attributable to cigarette smoking. Oral cancer is diagnosed in 30,000 Americans each year, and it causes about 8,000 deaths annually. Detection of oral cancer at an early stage is believed to improve the likelihood of successful treatment, but the success of community-based interventions for early detection of oral cancers has not been demonstrated. Nevertheless, it is prudent for all persons to seek regular oral examinations and for health practitioners to be particularly proactive in assuring that tobacco users receive annual oral examinations.

The promotion of oral hygiene by manufacturers of toothbrushes and dentifrices is likely responsible for improvements in oral hygiene practices, including the current common practice of brushing teeth at least twice per day and the regular use of dental floss by many persons. The extent to which this has reduced periodontal diseases is not clear, but many people who attend to these daily practices are able to maintain their teeth for a lifetime.

Finally, the use of mouth guards and face guards while participating in contact sports is prudent practice, and is mandatory in many amateur sports and professional boxing. Examples of community-based interventions to prevent sports-related trauma include the development of rules and regulations; efforts to alert players, parents, and officials to the potential for injury; and better product designs.

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(SEE ALSO: *Caries Prevention; Community Water Fluoridation; Dental Fluorosis; Dental Sealants; Oral Cancer; Oral Health; Tobacco Control*)

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COMMUNITY HEALTH

The term "community health" refers to the health status of a defined group of people, or community, and the actions and conditions that protect and improve the health of the community. Those individuals who make up a community live in a somewhat localized area under the same general regulations, norms, values, and organizations. For example, the health status of the people living in a particular town, and the actions taken to protect and improve the health of these residents, would constitute community health. In the past, most individuals could be identified with a community in either a geographical or an organizational sense. Today, however, with expanding global economies, rapid transportation, and instant communication, communities alone no longer have the resources to control or look after all the needs of their residents or constituents. Thus the term "population health" has emerged. Population health differs from community health only in the scope of people it might address. People who are not organized or have no identity as a group or locality may constitute a population, but not necessarily a community. Women over fifty, adolescents, adults twenty-five to forty-four years of age, seniors living in public housing, prisoners, and blue-collar workers are all examples of populations. As noted in these examples, a population could be a segment of a community, a category of people in several communities of a region, or

workers in various industries. The health status of these populations and the actions and conditions needed to protect and improve the health of a population constitute population health.

The actions and conditions that protect and improve community or population health can be organized into three areas: health promotion, health protection, and health services. This breakdown emphasizes the collaborative efforts of various public and private sectors in relation to community health. Figure 1 shows the interaction of the various public and private sectors that constitute the practice of community health.

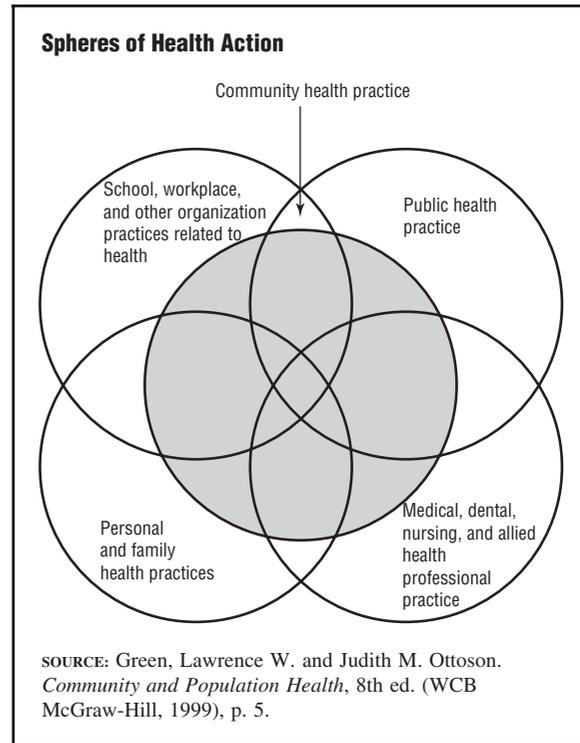
Health promotion may be defined as any combination of educational and social efforts designed to help people take greater control of and improve their health. Health protection and health services differ from health promotion in the nature or timing of the actions taken. Health protection and services include the implementing of laws, rules, or policies approved in a community as a result of health promotion or legislation. An example of health protection would be a law to restrict the sale of hand guns, while an example of health services would be a policy offering free flu shots for the elderly by a local health department. Both of these actions could be the result of health promotion efforts such as a letter writing campaign or members of a community lobbying their board of health.

FOUNDATIONS OF COMMUNITY HEALTH

The foundations of community health include the history of community health practice, factors that affect community and population health, and the tools of community health practice. These tools include epidemiology, community organizing, and health promotion and disease prevention planning, management, and evaluation.

History of Community Health Practice. In all likelihood, the earliest community health practices went unrecorded. Recorded evidence of concern about health is found as early as 25,000 B.C.E., in Spain, where cave walls included murals of physical deformities. Besides these cave carvings and drawings, the earliest records of community health practice were those of the Chinese, Egyptians, and Babylonians. As early as the twenty-first century B.C.E., the Chinese dug wells for drinking.

Figure 1



Between the eleventh and second centuries B.C.E., records show that the Chinese were concerned about draining rainwater, protecting their drinking water, killing rats, preventing rabies, and building latrines. In addition to these environmental concerns, many writings from 770 B.C.E. to the present mention personal hygiene, lifestyle, and preventive medical practices. Included in these works are statements by Confucius (551–479 B.C.E.) such as “Putrid fish . . . food with unusual colors . . . foods with odd tastes . . . food not well cooked is not to be eaten.” Archeological findings from the Nile river region as early as 2000 B.C.E., indicate that the Egyptians also had environment health concerns with rain and waste water. In 1900 B.C.E., Hammurabi, the king of Babylon, prepared his code of conduct that included laws pertaining to physicians and health practices.

During the years of the classical cultures (500 B.C.E.–500 C.E.), there is evidence that the Greeks were interested in men’s physical strength and skill, and in the practice of community sanitation. The Romans built upon the Greek’s engineering and built aqueducts that could transport water

many miles. Remains of these aqueducts still exist. The Romans did little to advance medical thinking, but the hospital did emerge from their culture.

In the Middle Ages (500–1500 C.E.), health problems were considered to have both spiritual causes and spiritual solutions. The failure to account for the role of physical and biological factors led to epidemics of leprosy, the plague, and other communicable diseases. The worst of these, the plague epidemic of the fourteenth century, also known as the Black Death, killed 25 million people in Europe alone. During the Renaissance (1500–1700 C.E.), there was a growing belief that diseases were caused by environmental, not spiritual, factors. It was also a time when observations of the sick provided more accurate descriptions of the symptoms and outcomes of diseases. Yet epidemics were still rampant.

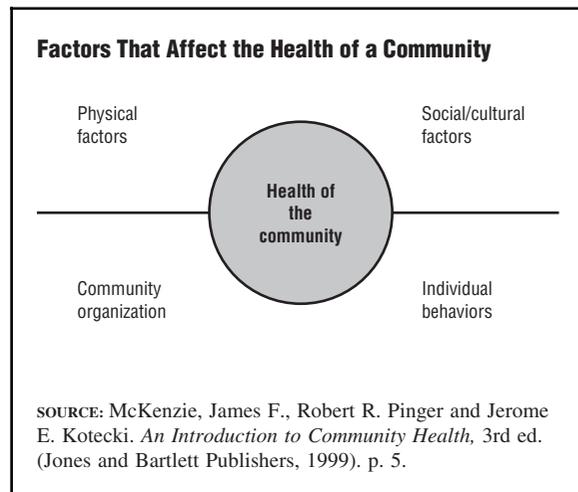
The eighteenth century was characterized by industrial growth, but workplaces were unsafe and living conditions in general were unhealthful. At the end of the century several important events took place. In 1796 Dr. Edward Jenner successfully demonstrated the process of vaccination for smallpox. And, in 1798, in response to the continuing epidemics and other health problems in the United States, the Marine Hospital Service (the forerunner to the U.S. Public Health Service) was formed.

The first half of the nineteenth century saw few advances in community health practice. Poor living conditions and epidemics were still concerns, but better agricultural methods led to improved nutrition. The year 1850 marks the beginning of the *modern era of public health* in the United States. It was that year that Lemuel Shattuck drew up a health report for the Commonwealth of Massachusetts that outlined the public health needs of the state. This came just prior to the work of Dr. John Snow, who removed the handle of the Broad Street pump drinking well in London, England, in 1854, to abate the cholera epidemic. The second half of the nineteenth century also included the proposal of Louis Pasteur of France in 1859 of the germ theory, and German scientist Robert Koch's work in the last quarter of the century showing that a particular microbe, and no other, causes a particular disease. The period from 1875 to 1900 has come to be known as the *bacteriological era of public health*.

The twentieth century can be divided into several different periods. The years between 1900 and 1960 are known as the health resources development era. This period is marked by the growth of health care facilities and providers. The early years of the period saw the birth of the first voluntary health agencies: the National Association for the Study and Prevention of Tuberculosis (now the American Lung Association) was founded in 1904 and the American Cancer Society in 1913. The government's major involvement in social issues began with the Social Security Act of 1935. The two world wars accelerated medical discoveries, including the development of penicillin. In 1946, Congress passed the National Hospital Survey and Construction Act (Hill-Burton Act) to improve the distribution and enhance the quality of hospitals.

The *social engineering era* (1960–1975) included the passage of amendments to the Social Security Act that set up Medicare (payment of medical bills for the elderly and certain people with disabilities) and Medicaid (payment of medical bills for the poor). The final period of the twentieth century is the *health promotion era* (1974–1999). During this period it was recognized that the greatest potential for improving the health of communities and populations was not through health care but through health promotion and disease prevention programs. To move in this direction, the U.S. government created its “blueprint for health” a set of health goals and objectives for the nation. The first set was published in 1980 and titled *Promoting Health/Preventing Disease: Objectives for the Nation*. Progress toward the objectives has been assessed on a regular basis, and new goals and objectives created in volumes titled *Healthy People 2000*, and *Healthy People 2010*. Other countries, and many states, provinces, and even communities, have developed similar goals and targets to guide community health.

Factors that Affect Community and Population Health. There are four categories of factors that affect the health of a community or population. Because these factors will vary in separate communities, the health status of individual communities will be different. The factors that are included in each category, and an example of each factor, are noted here.

Figure 2

1. Physical factors—geography (parasitic diseases), environment (availability of natural resources), community size (overcrowding), and industrial development (pollution).
2. Social and cultural factors—beliefs, traditions, and prejudices (smoking in public places, availability of ethnic foods, racial disparities), economy (employee health care benefits), politics (government participation), religion (beliefs about medical treatment), social norms (drinking on a college campus), and socioeconomic status (number of people below poverty level).
3. Community organization—available health agencies (local health department, voluntary health agencies), and the ability to organize to problem solve (lobby city council).
4. Individual behavior—personal behavior (health-enhancing behaviors like exercising, getting immunized, and recycling wastes; see Figure 2).

Three Tools of Community Health Practice.

Much of the work of community health revolves around three basic tools: epidemiology, community organizing, and health education. Though each of these is discussed in greater length elsewhere in the encyclopedia, they are mentioned here to emphasize their importance to community and population practice. Judith Mausner and Shira

Kramer have defined *epidemiology* as the study of the distribution and determinants of diseases and injuries in human populations. Such data are recorded as number of cases or as rates (number per 1,000 or 100,000). Epidemiological data are to community health workers as biological measurements are to a physician. Epidemiology has sometimes been referred to as population medicine. Herbert Rubin and Irene Rubin have defined *community organizing* as bringing people together to combat shared problems and increase their say about decisions that affect their lives. For example, communities may organize to help control violence in a neighborhood. *Health education* involves health promotion and disease prevention (HP/DP) programming, a process by which a variety of interventions are planned, implemented, and evaluated for the purpose of improving or maintaining the health of a community or population. A smoking cessation program for a company's employees, a stress management class for church members, or a community-wide safety belt campaign are examples of HP/DP programming.

COMMUNITY AND POPULATION HEALTH THROUGH THE LIFE SPAN

In community health practice, it is common to study populations by age group and by circumstance because of the health problems that are common to each group. These groupings include mothers, infants (less than one year old), and children (ages 1–14); adolescents and young adults (ages 15–24); adults (ages 25–64); and older adults or seniors (65 years and older).

Maternal, infant, and child (MIC) health encompasses the health of women of childbearing age from prepregnancy through pregnancy, labor, delivery, and the postpartum period, and the health of a child prior to birth through adolescence. MIC health statistical data are regarded as important indicators of the status of community and population health. Unplanned pregnancies, lack of prenatal care, maternal drug use, low immunization rates, high rates of infectious diseases, and lack of access to health care for this population indicate a poor community health infrastructure. Early intervention with educational programs and preventive medical services for women, infants, and children can enhance health in later years and reduce the

necessity to provide more costly medical and/or social assistance later in their life.

Maternal health issues include family planning, early and continuous prenatal care, and abortion. Family planning is defined as the process of determining and achieving a preferred number and spacing of children. A major concern is the more than 1 million U.S. teenagers who become pregnant each year. About 85 percent of these pregnancies are unintended. Also a part of family planning and MIC is appropriate prenatal care, which includes health education, risk assessment, and medical services that begin before the pregnancy and continue through birth. Prenatal care can reduce the chances of a low-birthweight infant, and the poor health outcomes and costs associated with it. A controversial way of dealing with unintended or unwanted pregnancies is with abortion. Abortion has been legal in the United States since 1973 when the Supreme Court ruled in *Roe v. Wade* that women have a constitutionally protected right to have an abortion in the early stages of pregnancy. According to the Centers for Disease Control and Prevention (CDC), approximately 1.6 million legal abortions were being performed in the United States each year during the late 1990s.

Infant and child health is the result of parent health behavior during pregnancy, prenatal care, and the care provided after birth. Critical concerns of infant and childhood morbidity and mortality include proper immunization, unintentional injuries, and child abuse and neglect. Though numerous programs in the United States address MIC health concerns, one that has been particularly successful has been the Special Supplemental Food Program for Women, Infants, and Children, known as the WIC program. This program, sponsored by the U.S. Department of Agriculture, provides food, nutritional counseling, and access to health services for low-income women, infants, and children. Late-twentieth-century figures indicate that the WIC program serves more than seven million mothers and children per month, and saves approximately three dollars for each tax dollar spent.

The health of the adolescent and young adult population sets the stage for the rest of adult life. This is a period during which most people complete their physical growth, marry and start families, begin a career, and enjoy increased freedom

and decision making. It is also a time in life in which many beliefs, attitudes, and behaviors are adopted and consolidated. Health issues that are particularly associated with this population are unintended injuries; use and abuse of alcohol, tobacco, and drugs; and sexual risk taking. There are no easy, simple, or immediate solutions to reducing or eliminating these problems. However, in communities where interventions have been successful, they have been comprehensive and communitywide in scope and sustained over long periods of time.

The adult population represents about half of the U.S. population. The health problems associated with this population can often be traced to the consequences of poor socioeconomic conditions and poor health behavior during earlier years. To assist community health workers, this population has been subdivided into two groups: ages twenty-five to forty-four and ages forty-five to sixty-four. For the younger of these two subgroups, unintentional injuries, HIV (human immunodeficiency virus) infection, and cancer are the leading causes of death. For the older group, noncommunicable health problems dominate the list of killers, headed by cancer and heart disease, which account for almost two-thirds of all deaths. For most individuals, however, these years of life are the healthiest. The key to community health interventions for this population has been to stress the quality of life gained by good health, rather than merely the added years of life.

The senior population of the United States has grown steadily over the years, and will continue to grow well into the twenty-first century. In 1900 only one in twenty-five Americans was over the age of sixty-five, in 1995 it was one in seven, and by 2030 it is expected to be one in five. Such growth in this population will create new economic, social, and health concerns, especially as the baby boomers (those born between 1946 and 1964) reach their senior years. From a community and population health perspective, greater attention will need to be placed on the increased demands for affordable housing, accessible transportation, personal care created by functional limitations, and all segments of health care including adult day care and respite care. Though many communities have suitable interventions in place

to deal with the issues of seniors (including meal services like congregate meals at senior centers, and Meals-on-Wheels), the demands will increase in all communities.

HEALTH PROMOTION

The three strategies by which community health practice is carried out are health promotion, health protection, and the provision of health services and other resources. Figure 3 presents a representation of these strategies, their processes, their objectives, and anticipated benefits for a community or population.

As noted earlier, health promotion includes educational, social, and environmental supports for individual, organizational, and community action. It seeks to activate local organizations and groups or individuals to make changes in behavior (lifestyle, selfcare, mutual aid, participation in community or political action) or in rules or policies that influence health. Community health promotion lies in the areas in which the spheres of health action, as shown in Figure 1, overlap.

Two areas in which communities employ health promotion strategies are mental and social health, and recreation and fitness. Though both of these health concerns seem to be problems of individuals, a health concern becomes a community or population health concern when it is amenable to amelioration through the collective actions noted above. Action to deal with these concerns begins with a community assessment, which should identify the factors that influence the health of the subpopulations and the needs of these populations. In the case of mental and social health, the need will surface at the three levels of prevention: *primary prevention* (measures that forestall the onset of illness), *secondary prevention* (measures that lead to an early diagnosis and prompt treatment), and *tertiary prevention* (measures aimed at rehabilitation following significant pathogenesis).

Primary prevention activities for mental and social health could include personal stress management strategies such as exercise and meditation, or school and workplace educational classes to enhance the mental health of students and workers. A secondary prevention strategy could

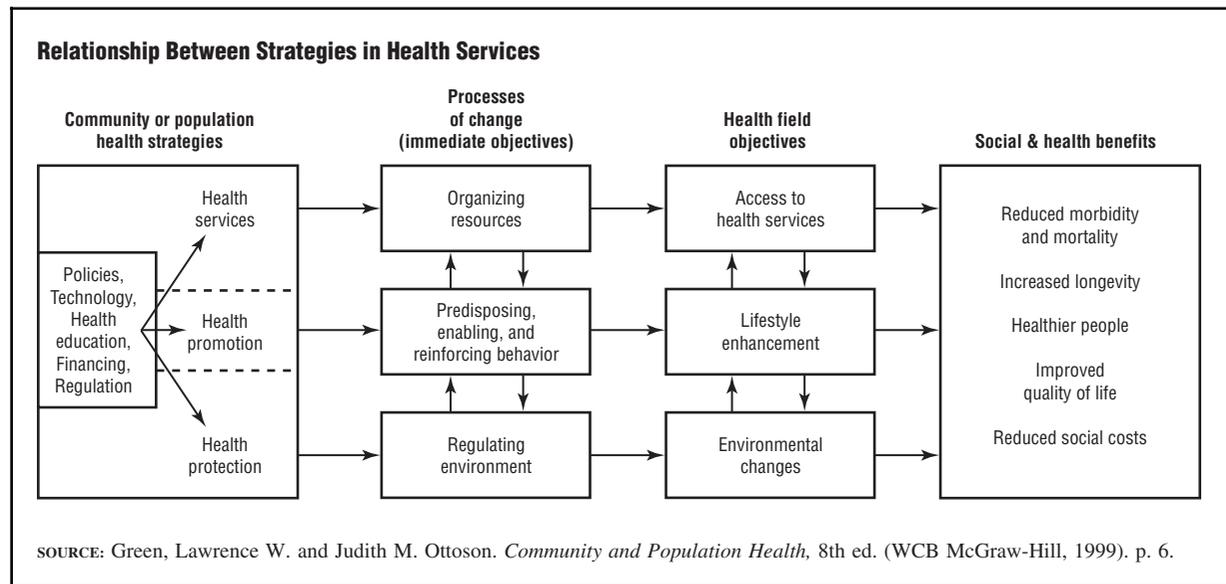
include the staffing of a crisis hot line by local organizations such a health department or mental health center. Tertiary prevention might take the form of the local medical and mental health specialists and health care facilities providing individual and group counseling, or inpatient psychiatric treatment and rehabilitation. All of these prevention strategies can contribute to a communitywide effort to improve the mental and social health of the community or population. During and after the implementation of the strategies, appropriate evaluation will indicate which strategies work and which need to be discontinued or reworked.

As with mental and social health promotion, community recreation and fitness needs should be derived via community assessment. The community or population enhances the quality of life and provides alternatives to the use of drugs and alcohol as leisure pursuits by having organized recreational programs that meet the social, creative, aesthetic, communicative, learning, and physical needs of its members. Such programs can provide a variety of benefits that can contribute to the mental, social, and physical health of the community, and can be provided or supported by schools, workplaces, public and private recreation and fitness organizations, commercial and semipublic recreation, and commercial entertainment. As with all health-promotion programming, appropriate evaluation helps to monitor progress, appropriate implementation of plans, and outcomes achieved.

HEALTH PROTECTION

Community and population health protection revolve around environmental health and safety. Community health personnel work to identify environmental risks and problems so they can take the necessary actions to protect the community or population. Such protective measures include the control of unintentional and intentional injuries; the control of vectors; the assurance that the air, water, and food are safe to consume; the proper disposal of wastes; and the safety of residential, occupational, and other environments. These protective measures are often the result of educational programs, including self-defense classes; policy development, such as the Safe Drinking Water Act or the Clean Air Act; environmental changes,

Figure 3



such as restricting access to dangerous areas; and community planning, as in the case of preparing for natural disasters or upgrading water purification systems.

HEALTH SERVICES AND OTHER RESOURCES

The organization and deployment of the services and resources necessary to plan, implement, and evaluate community and population health strategies constitutes the third general strategy in community and population health. Today's communities differ from those of the past in several ways. Even though community members are better educated, more mobile, and more independent than in the past, communities are less autonomous and more dependent on those outside the community for support. The organizations that can assist communities and populations are classified into governmental, quasi-governmental, and nongovernmental groups. Such organizations can also be classified by the different levels (world, national, state/province, and local) at which they operate.

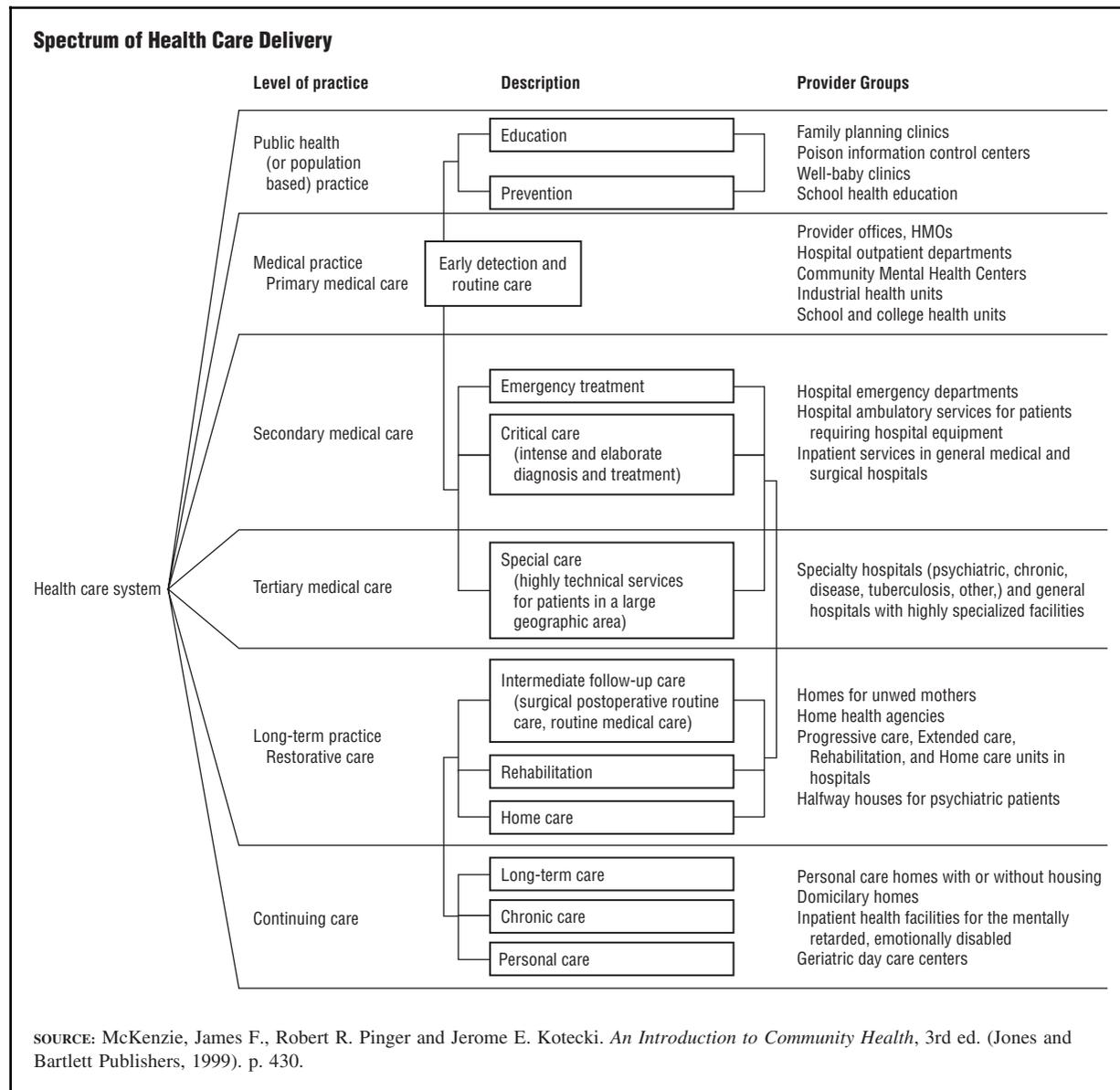
Governmental health agencies are funded primarily by tax dollars, managed by government officials, and have specific responsibilities that are outlined by the governmental bodies that oversee

them. Governmental health agencies include: the World Health Organization (WHO), the U.S. Department of Health and Human Services, the various state health departments, and the over three thousand local health departments throughout the country. It is at the local level that direct health services and resources reach people.

Quasi-governmental health organizations have some official responsibilities, but they also operate in part like voluntary health organizations. They may receive some government funding, yet they operate independently of government supervision. An example of such a community health organization is the American Red Cross (ARC). The ARC has certain official responsibilities placed on it by the federal government, but is funded by voluntary contributions. The official duties of the ARC include acting as the official representative of the U.S. government during natural disasters and serving as the liaison between members of the armed forces and their families during emergencies. In addition to these official responsibilities, the ARC engages in many nongovernmental services such as blood drives and safety services classes like first aid and water safety instruction.

Nongovernmental health agencies are funded primarily by private donations or, in some cases, by membership dues. The thousands of these organizations all have one thing in common: They

Figure 4



arose because there was an unmet need for them. Included in this group are voluntary health agencies; professional health organizations and associations; philanthropic foundations; and service, social, and religious organizations.

Voluntary health organizations are usually founded by one or more concerned citizens who felt that a specific health need was not being met by existing government agencies. Examples include the American Cancer Society, Mothers

Against Drunk Driving (MADD), and the March of Dimes. Voluntary health agencies share three basic objectives: to raise money from various sources for research, to provide education, and to provide services to afflicted individuals and families.

Professional health organizations and associations are comprised of health professionals. Their mission is to promote high standards of professional practice, thereby improving the health of the community. These organizations are funded

primarily by membership dues. Examples include the American Public Health Association, the British Medical Association, the Canadian Nurses Association, and the Society for Public Health Education.

Philanthropic foundations have made significant contributions to community and population health in the United States and throughout the world. These foundations support community health by funding programs or research on the prevention, control, and treatment of many diseases, and by providing services to deal with other health problems. Examples of such foundations are the Robert Wood Johnson Foundation, the Henry J. Kaiser Family Foundation, and the W. K. Kellogg Foundation.

Service, social, and religious organizations have also played a part in community and population health by raising money and funding health-related programs. For example, the Lions Clubs has worked to help prevent blindness, Shriners have helped to provide free medical care through their hospitals, and many religious organizations have worked to feed, clothe, and provide shelter for those in need.

The health services and resources provided through the organizations discussed above are focused at the community level. However, a significant portion of the resources are aimed at personal health care. Figure 4 presents the spectrum of health care delivery in the United States. Some refer to this as the U.S. health care system; others would debate whether any system really exists, referring to this network of services as an array of informal communications between health care providers and health facilities. The spectrum of care begins with public health (or population-based) practice, which is a significant component of community and population health practice. It then moves to four different levels of medical practice. The first level is primary, or front-line or first-contact, care. This involves the medical diagnosis and treatment of most symptoms not requiring a specialist or hospital. Secondary medical care gives specialized attention and ongoing management for both common and less frequently encountered medical conditions. Tertiary medical care provides even more highly specialized and technologically sophisticated medical and surgical care, including the long-term care often associated with rehabilitation. The final level of practice in the

spectrum is continuing care, which includes long-term, chronic, and personal care.

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(SEE ALSO: *Behavior, Health-Related; Boards of Health; Citizens Advisory Boards; Community Health Report Cards; Community Organization; Decentralization and Community Health; Environmental Movement; Health Promotion and Education; Healthy Communities; Participation in Community Health Planning; Personal Health Services; Planning for Public Health; Policy for Public Health; Population Policies; Practice of Public Health*)

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COMMUNITY HEALTH REPORT CARDS

There is growing interest at the local, state, and national levels in developing and disseminating profiles of community health. Public health agencies and their community partners use community health profiles to monitor and track health conditions; define community health problems; set priorities; educate professionals, planners, and the public about the health status of the community; initiate policy and delivery system change; facilitate advocacy by local groups; and as a mechanism for social marketing. The production of periodic "community health report cards" is one method used to profile multiple health issues, and their broader determinants, in geographically defined populations. The term "community health report card" refers to a variety of reports, variously termed community health profiles, needs assessments, scorecards, quality of life indices, health status reports, and progress reports. In their various forms, these reports are increasingly cited as critical components of community-based approaches to improving the health and quality of life of communities.

Initiatives to generate report cards proliferated at the national, state, county, and community levels during the 1990s. A noteworthy example at the national level is the Community Health Status Indicator (CHSI) Project, which is a collaborative effort between the Health Resources and Services Administration (HRSA), the Association of State and Territorial Health Officials (ASTHO), the National Association of County and City Health Officials (NACCHO) and the Public Health Foundation. In 2000, the project published and disseminated community health status reports for all 3,082 U.S. counties. These reports provide county-level

data, including peer county and national comparisons, for every county in the country. They are designed to support health planning by local health departments, local health planners, community residents, and others interested in community health improvement.

Another example of a national report card is the Annie E. Casey Foundation's *KIDS COUNT Data Book*. The Casey Foundation has produced the national *KIDS COUNT Data Book* annually since 1990, using the best available data to measure the educational, social, economic, and physical well being of children and families. In 1991, the Casey Foundation began supporting state-level KIDS COUNT projects, and by 1996 there were KIDS COUNT projects in all fifty states and in the District of Columbia. The vision of KIDS COUNT is to raise the nation's awareness and accountability about the condition of children and families in two ways: first, by measuring and reporting on the status of children at the state and local levels; and second, by using the data creatively to inform the public debate and to strengthen public action on behalf of children and families.

In addition, the 1990s saw an explosion of local community health report card projects around the country, both in large cities and small towns, and often as an integral part of local community health improvement initiatives. These community health improvement initiatives have grown out of three major trends: (1) an increasing recognition of the importance of local community action to solve local problems, (2) an increasing emphasis on outcomes and accountability, and (3) the Healthy Cities/Healthy Communities movement. Community health report cards can be a useful tool in efforts to help identify areas where change is needed, to set priorities for action, and to track changes in population health over time.

One of the earliest, best known, and continuous community health report card projects is in Jacksonville, Florida: *Quality of Life in Jacksonville: Indicators for Progress* is coordinated by the Jacksonville Community Council, Inc (JCCI). Jacksonville has published a report on seventy-one indicators every year since 1985, and those reports have served as a model for subsequent report cards produced in other cities. Moreover, the JCCI team has extended its work to link the indicators with performance-based budgeting for the city. Several

other well-known and exemplary community health report cards that are linked to local community health improvement initiatives include: *The Quality of Life in Pasadena, 1998: An Index for the 90s and Beyond* (Pasadena, CA), the *Santa Cruz County Community Assessment Project* (Santa Cruz, CA), the *Spokane Community Report Card* (Spokane, WA), and *Pathways to a Coordinated System of Health Care and Human Services for Children and Families* (Rochester, NY). A directory of sixty-five community health report card projects from around the country can be found in *The National Directory of Community Health Report Cards*, produced by the UCLA Center for Healthier Children, Families, and Communities.

A community health report card is a profile of a community's "health" in the broadest sense of the term. More comprehensive report cards include a set of indicators that describe not only the health status and health-risk factors of the total population, but also address quality-of-life issues, the broader determinants of health, and community assets and resources. Many community health improvement efforts, particularly those in the Healthy Cities/Healthy Communities movement, view community health and its determinants broadly, and they use a set of indicators (to track their progress) that reflects this broad definition. These indicators might include:

- Physical and mental health status;
- Educational achievement;
- Economic prosperity;
- Public safety;
- Adequate housing and transportation;
- A clean and safe physical environment;
- Recreational and cultural opportunities.

NATIONAL STUDY OF COMMUNITY HEALTH REPORT CARDS

A 1996–1997 study by the UCLA Center for Healthier Children, Families, and Communities surveyed sixty-five community health-report card projects from across the country. The study sought to better understand: (1) the report card development process, including community participation; (2) report card design and content; and (3) the

links between report cards and community health improvement activities. The study found that three quarters of the report card projects were initiated in 1992 or later. Most of the projects planned to produce report cards on an ongoing basis, many at least every one to two years. The purpose of the report cards ranged from increasing public awareness to improving the community health planning and evaluation process and facilitating policy formulation. In three-fifths of the communities, the report cards were part of a larger community health improvement process.

In the study sample, the largest number of report cards (43%) were produced at the county level; others consisted of data from state (22%), regional, or multi-county areas (12%), city, (22%), or, occasionally, a more local neighborhood level. A little over half (54%) included only health indicators, while about one quarter (23%) included a broader set of indicators reflecting multiple aspects of quality of life, including crime, transportation, education, and the environment. Another 25 percent focused on a particular subpopulation such as children, adolescents, Latinos, or elders.

The content and quality of the community health report cards surveyed varied tremendously. Increasingly, communities are using more creative approaches to translate raw data into meaningful and attention-getting information formats designed to appeal to a broader audience and to serve as a catalyst for action. More and more, report-card development draws on the skills of graphic designers and social marketing specialists to communicate messages more effectively.

In the study, problems with data collection and the lack of existing data were the most frequently identified barriers in report-card production. Nearly two-thirds of the projects collected both primary and secondary data to include in their report. Primary data focused mainly on perceived needs, behaviors, and health status, and it was most often collected by survey research firms or the local health department. The most frequent sources of secondary data were the state (62%) and local (31%) health departments and local social service agencies (23%). In fact, local health departments were most likely to initiate and be involved in every stage of the report-card development process. Other partners in the process included hospitals, local governments, state health

departments (especially for data collection), local colleges and universities, community residents, nonprofit civic organizations, and social service agencies. The factors most frequently cited as contributing to successful report-card production included: collaboration among different community groups and organizations, community participation, strong leadership, adequate funding, and local/state government support. However, while collaboration and community participation are important in creating an effective report card, about one-fifth of the communities reported that the time and effort required to get all the stakeholders together was their greatest challenge.

The UCLA study also found that community health report card production is a relatively long and resource-intensive process, usually requiring between six and eighteen months from the first organizational meeting to production of the report card. The average cost of report-card production in the UCLA sample was \$60,000, with costs ranging from \$0 to \$1 million.

The following are characteristics of effective community report cards:

- The format is clear, well-organized, and “user-friendly.”
- Multiple forms of data presentation are used, including text, graphs, charts, maps, and quotations.
- A geographic/demographic profile of the population is included.
- Both primary and secondary data are presented.
- There is a clear, balanced interpretation of the data.
- There is a clear presentation of community assets as well as needs.
- The link between the data and opportunities for action is articulated.
- Comparisons to peer communities (counties, states, etc.) are made.
- Comparisons to other benchmarks (e.g., state/national data, Healthy People objectives) are made.
- Trend data is presented.

- Data sources are identified.
- Graphic design features are used, including photographs.
- Multiple products are developed for different audiences.
- Broad and participatory community effort is involved.

THE FUTURE OF COMMUNITY HEALTH REPORT CARDS

The development of community health report cards, for the most part, has been highly local in nature and dependent on local sociopolitical conditions and data constraints. To enhance the effectiveness of community health report cards, there is a clear need for a more supportive infrastructure, including innovative data systems that can provide more data at the local level, more information on disparities in health among different subpopulations, as well as data on community assets and resources. There is also a need for more primary-data collection. Communities also need support with indicator selection. The wide variation in indicators used argues for the development of a conceptual framework to facilitate the selection of indicators that, as a set, present a contextual view of community health and its determinants. Both the Institute of Medicine report, *Improving Health in the Community*, and the RAND/UCLA report, *California Health Report*, provide examples of frameworks that use a broad definition of health and account for the role of multiple determinants in health outcomes.

Community health report cards will also benefit from efforts to enhance their presentation and accessibility, including the use of social marketing expertise to create effective messages. Report cards can also make use of technology to communicate to a broader audience. Mapping techniques such as geographic information systems (GIS) and Internet access are two such methods.

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COMMUNITY MENTAL HEALTH CENTERS

Prior to the nineteenth century, mental illnesses were often regarded as moral, spiritual, or supernatural problems. The accepted treatment involved, at best, isolation in mental asylums. Dramatic changes took place internationally in public attitudes about the mentally ill in the nineteenth and twentieth centuries. Several prominent mental health professionals developed and applied fresh

ideas about public health, bringing about the evolution of an improved, state-controlled psychiatric hospital system. The concepts of disease prevention and cure were considered in psychiatry for the first time, and several powerful mental health advocacy groups were born. In the United States, an influx of experienced doctors returning home after treating combat-related mental disorders in World War II, combined with the discovery of effective psychiatric medicines like chlorpromazine, spurred the belief that severe mental illnesses could be cured.

The modern community mental health movement emerged in the 1960s in an effort to improve the psychiatric treatment of a particular group of patients, known as the severely and persistently mentally ill (SPMI). By the early 1960s, state hospitals had become a financially burdensome system of warehouses for the SPMI. In 1963, President John F. Kennedy invited "a bold new approach" to the treatment of the SPMI. Congress developed a plan for deinstitutionalization, or depopulation of the state psychiatric institutions, in favor of a federally funded system of community-based mental health centers (CCMHC).

According to the plan, government funding would be reduced over eight years. As the eight-year deadline approached, it became clear that the clinics could not function without federal funds, and the deadline was extended. In the 1980s, the Reagan administration passed a law to fund the clinics with federal block grants that would ultimately expire, leaving the CMHCs without federal funding. In contrast to the optimistic projections endorsed by the Reagan administration, it seems clear that the cost of caring for the SPMI will always be, to some extent, the responsibility of the government. What remains unclear is to what degree public funds will be used in this endeavor.

CMHC treatment applies several basic concepts.

- 1) *Fixed responsibility*. The CMHC remains active in the long-term care of its assigned patients, regardless of whether the patient is hospitalized, in crisis, temporarily lost to follow-up, or stable.
- 2) *Community collaboration*. The success of the CMHC depends on the ability of staff members to collaborate with local law

enforcement officials, social service providers, government agencies, hospitals and clinics, and community leaders.

- 3) *Outreach.* CMHCs employ diverse methods to introduce services to the homeless and other difficult-to-reach groups.
- 4) *Integration of services.* The multiple needs of the SPMI require an active, organized, multiagency treatment system, with the CMHC serving as a central manager for this system of services.
- 5) *Continuity of care.* Consistent, effective treatment relationships can be established by pairing patients with treatment teams on a long-term basis in which the same staff members directly provide outreach, evaluation, and follow-up care.
- 6) *Respect for patients' civil rights.* Decisions regarding patients' medications and overall psychiatric care are made with the patient's input and consent whenever possible, including the concept of least restrictive alternatives, which recognizes patients' rights to receive treatment in a setting that balances individual freedom with the safety of the individual and the community.

Several functional elements comprise the CMHC, each addressing particular needs of the SPMI in specific ways. Crisis and emergency services are necessary to evaluate patients when they are acutely ill or suffering from overwhelming symptoms and to direct them to crisis treatment resources. Some CMHCs have mobile teams that can be dispatched to assess patients at home or on the streets. Brief hospital treatment is reserved for patients who are suddenly unable to deal with their symptoms in the community environment despite CMHC support. The main goal of acute hospitalization is to rapidly stabilize patients until they can safely return to the community. Rarely, usually after multiple brief hospitalizations in a limited time period, long-term hospital treatment may be recommended for some patients.

Long-term treatment in the CMHC system is provided in an outpatient clinic setting. Several professions are involved in providing treatment, but the main specialties represented are psychiatry, social work, and nursing. These disciplines

provide medications, emotional support, personal advocacy, and organization of social networks. Although CMHCs are effective for many populations, the homeless SPMI remain a particularly complex group to treat. The size of this group is difficult to compute accurately, but estimates suggest that at least one-third of homeless people suffer from mental illnesses. Providing services remains a difficult challenge for society.

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(SEE ALSO: *Substance Abuse, Definition of*)

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COMMUNITY MENTAL HEALTH SERVICES

HISTORICAL OVERVIEW

The history of mental health services in the United States is one of good intentions followed by poor execution; of promises to deliver better services for less cost; and of periodic revolutionary change with neither the evidence to support the new programs or the financial investment to see if the new approach could be effective if carried out adequately. While it can be argued that community mental health services date back to the beginnings of American history, until the mid-1950s, public mental health in the United States was largely institutionally based and entirely state supported. Early in U.S. history, local communities either served the mentally ill with family-centered care or expelled individuals who came from elsewhere. However, with the massive population growth of the United States in the nineteenth century, mentally ill individuals came to be concentrated, and for the most part poorly served, in local jails, prisons, poorhouses, and almshouses. Appalled by these circumstances, Dorothea Dix, a teacher, undertook a crusade to create mental hospitals in the United States modeled after the York Retreat in England. These family-like asylums

would provide “moral treatment,” which was believed to be curative at the time. Dix’s attempt to get the federal government to take responsibility for the mentally ill in America was ultimately thwarted by a veto from President Franklin Pierce. Dix then turned to the states and was remarkably effective in getting all states to establish hospitals for state-of-the-art treatment of the mentally ill. A federal role in supporting mental health services would wait another one hundred years until the development of Medicaid, Medicare, and Supplemental Security Income.

While state hospitals started out with great promise, in many places they had deteriorated by the mid-1950s into little more than human warehouses. In post-World War II America, a new crusade began to replace state hospitals with community-based care. The experience of World War II psychiatrists with care at the front lines, the exposure of the dismal conditions of state hospitals by conscientious objectors and journalists, the development of antipsychotic medications with the discovery of the effectiveness of chlorpromazine, and the states’ interests in shifting costs for caring for the mentally ill to the federal government all contributed to what, after the fact, came to be known as deinstitutionalization.

The community mental health era in the United States was launched with the 1963 passage of the Community Mental Health Centers Act, signed into law in by President John F. Kennedy. This law provided federal funding, which ultimately led to the establishment of more than 750 community mental health centers (CMHC) throughout the United States. However, the CMHCs tended to care for people with mental health problems (i.e., problems in living) much more than for those people with serious mental illness who were historically cared for by the states.

DEFINITION OF COMMUNITY MENTAL HEALTH SERVICES

Mental illness, as described in the 1999 *Surgeon General’s Report on Mental Health*, “is the term used to define all diagnosable mental disorders. Mental disorders are health conditions characterized by alterations in thinking, mood or behavior (or some combination thereof) associated with distress and/or impaired functioning” (p. 5). While many service systems do not consider alcohol and other

drug-related disorders (e.g., alcohol dependence) to be mental disorders, and many service systems do not include the dementias and what historically have been called organic mental disorders as disorders subject to treatment in the “mental health system,” the surgeon general includes these disorders, which are clearly diagnosed within the framework of the *Diagnostic and Statistical Manual (DSM-IV)* of the American Psychiatric Association. Mental health problems, signs, or symptoms that do not meet the intensity or duration to meet criteria for a mental disorder can also warrant active intervention, according to the surgeon general.

Mental health services are diverse and variable, depending on the sector where the services are being provided and the profession and training of the person providing the services. While in the past there tended to be strong divisions between a “medical model” and a “rehabilitation model” for service provision, most providers now accept an integrated bio-psycho-social (some add a spiritual component as well) model. The notion of recovery, in which the individual with the disorder self-determines how best to cope with and overcome the limitations of the disorder, is gaining ascendancy as well. Other key principles in community mental health are continuity of care and the need to assertively bring services to those reluctant or unable to seek them on their own. These principles have led to the development of multidisciplinary teams, case management services, and assertive community treatment teams.

ORGANIZATION

As the *Surgeon General’s Report* indicates, treatment for mental illness and mental health problems is scattered and loosely coordinated into what can best be considered a de facto mental health system. The report indicates that there are actually four major components of this de facto system from which mental health services can be received: the specialty mental health sector, consisting of psychiatrists, psychologists, psychiatric nurses, and social workers trained to treat persons with mental disorders; the general medical/primary care sector, consisting of general health care professionals (nonpsychiatric physicians and nurse practitioners); the human services sector, consisting of nonmedical social services, school-based counseling, vocational rehabilitation, residential

rehabilitation, criminal justice–based services, and religious professional counseling; and the volunteer support network sector, with self-help and other groups such as Alcoholics Anonymous, peer counseling, and support services. According to the surgeon general, about ten percent of the adult population in the United States use mental health services in the health sector in any one year, about evenly divided between the general health and mental health specialty sectors. About five percent receive services from social service sector agencies, schools, religious, or self-help groups.

The organization of specialized mental health services has included a private system and a public system. The private system was comprised of psychiatric hospitals, both free-standing and units located within acute care hospitals, and psychiatrists, psychologists, social workers, and counselors practicing individually or in groups. The public system was made up primarily of state- or county-operated or not-for-profit organizations. The private system served persons with employer-provided health insurance coverage or those who could afford to pay for the services themselves. The public system served persons who were considered medically indigent.

The public and private systems have become more and more defined by reimbursement than by setting or organization. State and local funding provide the majority of financial support for mental health services, with the federal government assuming a growing role. Federal funding includes the Community Mental Health Block Grant, Medicaid (approximately 60 percent federal and 40 percent state or local), plus other specialized funding programs.

Over time, the distinction between private and public clients has become blurred, as it has become increasingly difficult to distinguish public mental health services from those delivered by the private system. The surgeon general suggests that public system services refer both to services directly provided by government agencies (e.g., state or county hospitals) and to those services supported by government resources. Thus, any service supported by Medicaid would be considered a public system service. Such services are increasingly provided by private sector agencies or practitioners. The growth of managed care in the private

system has produced interest on the part of states to experiment with managed care models for the public system. As managed care practices evolved within the private sector, limiting scope, duration, and frequency of services, and subsequently limiting or reducing payment, private providers have become more interested in populations and reimbursement sources historically served by the public system (e.g., clients with Medicaid).

SOURCES OF FUNDING

According to the *Surgeon General's Report*, the period of 1986 through 1996 experienced slower growth in spending for mental health treatment (over 7 percent per year) than general health care expenditures (over 8 percent per year). Medicare, Medicaid, and other federal program spending for mental health services grew more slowly than overall program spending during this same period. A number of reasons for the slower growth rate may be possible, including the influence of managed care cost containment methods on mental health treatment (improving efficiency while increasing the risk of imposing barriers to service access); policy changes at the federal and state level, limiting spending in state hospitals and emphasizing outpatient care delivered in community settings; and increasing service delivery in nonspecialty sectors, such as nursing homes and criminal justice settings (i.e., jails and prisons).

The significance of federal participation has made Medicaid policy, along with state mental health authorities, an increasingly important influence in the delivery of mental health care. Private health care insurance has historically been more limited in its coverage for mental illness than for general health care. Those private insurers that did not simply refuse to cover treatment for mental illness limited coverage for acute care services in particular and other services in general by placing annual and lifetime limits on care and by increasing deductibles and co-payments. The public sector's historical role as the provider of "catastrophic care" for the uninsured and the underinsured provided a means for the private sector to minimize its financial risk and focus on the care of less impaired persons, most of whom had health insurance coverage through their employers. As late as 1988, the model of "unmanaged

fee-for-service” was used by the majority of private insurance companies as the payment mechanism. However, in the past decade this model was used by only 15 percent of companies, giving way to managed care arrangements and techniques fundamentally changing the way in which health care resources are allocated.

While managed care may be able to effectively reduce the cost of mental health services, great care must be taken to assure that efforts to contain costs do not have adverse effects. That is, incentives that are part of prepaid contracts can result in inadequate care for those suffering from a mental illness. Particularly at risk are persons with less severe mental health problems, who may be completely denied access to services, and the most seriously mentally ill, who may be undertreated. In addition, private HMOs, because of the limitations on scope, duration, and frequency of services inherent to managed care, routinely refer individuals to public sector agencies who are assessed as inappropriate for time-limited service or upon the exhaustion of benefits for a particular episode of care. This effectively results in cost shifting of substantial expenses to already challenged public budgets. In order to know whether or not access and quality of care can be improved or at least maintained with managed care, development or improvement of the capacity to assess functional improvements is necessary.

Parity in the coverage of mental health care would require all insurance companies to offer the same coverage for mental illness as for all other disorders. Parity legislation along with managed care may actually result in reduced costs; however, the ability to measure access and quality should be integral to any well-designed plan.

ADEQUACY OF MENTAL HEALTH SERVICES

The *Surgeon General’s Report* disclosed that only about one-third of those with a diagnosable mental disorder receive treatment in a one-year period. This is believed to reflect both problems with access and availability of services as well as the problem of the stigma still associated with receiving mental health care. The availability of adequate mental health services throughout the United

States is highly variable. Depending on how services are organized and funded, there is marked variation even within a given city, county, or state.

The state of mental health practice clearly lags behind the state of knowledge. A striking example of this is the treatment of schizophrenia, probably the prototype serious mental disorder. The Schizophrenia PORT study in 1998 describes several scientifically proven interventions effective in the treatment of schizophrenia. Yet, when actual practices are examined, few communities adequately provide any of the effective treatments. Even the use of antipsychotic medication was woefully inadequate in the systems studied.

As many states have downsized and closed state hospitals, there has been an infusion of funds from the institutions into community-based programs. However, even in states with a coherent and well-considered plan to shift funding to community sites, the transfer has not been dollar for dollar. In Ohio, for example, with a financing plan where dollars were to follow patients as hospitals were downsized, only approximately fifty cents of every dollar transferred from the hospitals actually made it to the communities.

The effect of inadequately funded and sub-optimally delivered mental health services are the shames of deinstitutionalization: co-morbidity, homelessness, and criminalization. Increasing numbers of people with serious mental disorders struggle with substance abuse disorders. Despite estimates that half or more of seriously mentally ill patients have co-morbid substance abuse disorders, few systems of care provide integrated behavioral health treatment for both problems. Only integrated treatment has been shown to be effective.

It is estimated that 30 to 40 percent of the homeless have serious mental disorders (and many more have substance use disorders). A more recent phenomenon is the criminalization of the mentally ill. A report from the U.S. Department of Justice estimated that by mid-1998 there were 283,800 mentally ill offenders in the nation’s jails and prisons, representing 16 percent of state prison inmates, 7 percent of federal inmates, and 16 percent of jail inmates. This represents more than four times the number of individuals in the nation’s state hospitals. It has been frequently pointed out that the largest institution for the mentally ill

in the United States is the Los Angeles County Jail. As this problem has been increasingly recognized by the criminal justice system, creative efforts have begun to move patients back from the criminal justice (punishment) system to the mental health (treatment) system. Diversion programs are being examined in a number of communities around the country. Pre-arrest diversion programs such as the Memphis Crisis Intervention Team facilitate interactions between police officers and the mental health system that make referral for treatment preferable to arrest, especially for nonviolent acts related to symptomatic mental illness. Post-arrest diversion, like the mental health court program started in Broward County, Florida, attempts to use the court therapeutically to persuade mentally ill individuals to accept treatment in lieu of criminal prosecution. While these and other programs show great promise, they are not likely to be successful unless the treatment system to which people are diverted is adequately funded and organized. This is the challenge facing the public mental health system in the new millennium.

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WILLIAM ZUMBAR

(SEE ALSO: *Dementia; Depression; Dix, Dorothea; Homelessness; Managed Care; Mental Health; Prison Health; Schizophrenia; Substance Abuse, Definition of*)

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COMMUNITY ORGANIZATION

The community organizing process has been widely used in developed and developing countries to assist communities to recognize and address local health and social problems. In public health work, many disease prevention and health promotion goals can only be realized through the active involvement of community citizens, leaders, and organizations. Community organization is "a planned process to activate a community to use its own social structures and any available resources to accomplish community goals decided primarily by community representatives and generally consistent with local attitudes and values. Strategically planned interventions are organized by local groups

or organizations to bring about intended social or health changes” (Bracht 1999, p. 86). It is sometimes referred to as community empowerment, capacity building, and partnership development.

An important outcome of this dynamic process is community ownership (i.e., by community leaders and institutions), which allows citizens to build skills and resources to effect community health change and to sustain such efforts over time. Experienced public health facilitators or community organizers often assist in this process, but control remains with local groups. The use of community organization strategies is not new in public health. In the early 1900s, for example, the National Citizens Committee on the Prevention of Tuberculosis worked closely with public health professionals and communities to control this infectious disease. In the twenty-first century, hundreds of community partnership groups are working locally to reduce the incidence of HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome), heart disease, child and spouse abuse, and other threats to community health. T. Lasater et al. (1984) have described the use of church groups in mobilizing interventions for heart health. S. Verblen-Mortensen et al. (1999) illustrated a multistage process of community organizing to empower citizens to enforce alcohol sale ordinances for minors in rural communities. Community participation requirements are often mandated by both public and private health-funding agencies.

COMMUNITYWIDE CHANGE

One helpful way to think about effecting change at the community level is to consider the community as a dynamic system composed of several major sectors (business, government, schools, media). The people within each of these sectors interact with and influence each other, and when a change or alteration occurs in one sector it will have an impact on other sectors. A prohibition against secondhand smoke in public buildings, for example, may lead to a ban on smoking in restaurants. When health-oriented interventions are incorporated into many sectors of the community, the likelihood of a positive change increases. This focus on the total community system and its population is the hallmark of modern health-promotion

programs. Mittelmark (1999) has summarized the results of diverse international community health-improvement programs and has found that community organization strategies are commonly utilized. Such techniques work regardless of whether the goal is behavioral in nature (e.g., to increase daily exercise among special groups) or whether the goal is to achieve health-policy changes (e.g., to eliminate tobacco billboard advertising near schools).

THE FIVE STAGES OF COMMUNITY ORGANIZATION

In many community organization strategies, a five-stage process can be identified. What follows is a summary of the key factors and tasks in each stage. It should be noted that these stages are dynamic and overlapping. In addition, some tasks from an early stage may need to be repeated in later stages (e.g., updating a community resources inventory).

Stage One: Conducting Community Analysis. A commitment to community participation in health campaigns requires above all else a knowledge of the assets, capacity, and history of a local community. This is accomplished by a careful “mapping” of the community to document its unique qualities, issues, and modes of decision making. This will provide the basis of an informed approach that realistically matches health goals with citizen readiness, expectations, and resources. Analysis is a critical first step in shaping the design of campaign interventions, and it is important to involve members of the community at this stage. The product of community analysis is an accurate profile that blends health and illness statistics with demographic, political, and sociocultural factors.

Stage Two: Design and Initiation of a Campaign. Following a community analysis and the identification of local priorities, the design aspects for a collaborative community campaign begin to emerge. A core group of citizens and professionals (with both public and private sectors represented) will usually begin the process of establishing a permanent organizational structure and making preliminary decisions about campaign objectives and interventions. This group may also write a mission statement and select a project coordinator. In organizing community partnerships, several structural forms (e.g., coalition, lead agency,

citizen network) can be considered. B. Thompson (1999) provides a helpful discussion of the pros and cons of using various structures.

Stage Three: Campaign Implementation. Implementation turns theory and ideas into action, translating a mission into an effectively operating program. At this stage, organizations and citizens are mobilized and involved in the planning of a sequential set of activities aimed at accomplishing campaign objectives. Written plans with specific timelines have been shown to be a critical forerunner of success. Cost estimates should be included in the plan, along with monitoring and feedback strategies to measure progress. The key element in this stage is the careful determination and selection of priority intervention activities that can achieve maximum impact.

Stage Four: Program Refinement and Consolidation. During this stage both successes and problems in implementation are reviewed. Task forces of the local citizen organization need to determine any new directions or modifications for the program, including activities to maintain high levels of volunteer involvement. Efforts of organizers to have health program elements and interventions become more fully incorporated into the established structures of the community (e.g., exercise programs becoming a regular part of worksite culture) should continue in this phase as well.

Stage Five: Dissemination and Durability. In this last stage the strategic dissemination of information on project results and the finalization of plans for the durability of intervention efforts are the key considerations. Communities and citizens need to receive clear, succinct messages describing what has been accomplished and what continuing effort may be required. Such messages are reinforced when community leaders and local advocates are involved in their presentation. The local durability plan should include a vision for future health and social improvements and lay out a strategy to identify, recruit, and involve new people in current or future projects and community activities.

A common set of essential planning and organizing tasks has emerged from the many community mobilization and health promotion experiences of recent decades. These tasks include

selecting broadly representative community participants and clearly identifying their decision-making authority, establishing an effective organizational structure, achieving mission clarity and realistic objectives, identifying community assets as well as resistance factors, establishing evaluation and tracking mechanisms early, managing and reinforcing volunteer involvement, conducting ongoing training for citizen intervention skills, recruiting a community organizer/facilitator with appropriate competencies and experience, and securing the necessary resources for the durability of program results.

NEIL BRACHT

(SEE ALSO: *Assessment of Health Status; Community Health; Health Goals; Health Promotion and Education; Mobilizing for Action through Planning and Partnerships; Participation in Community Health Planning*)

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COMMUNITY PSYCHOLOGY

Community psychology (CP), as a discipline, began in 1965 in Swampscott, Massachusetts, during a meeting of psychologists discussing training for community mental health. This group identified CP to be distinct from clinical psychology and community mental health. The original focus was on social and cultural influences on mental health, and it has since widened, with CP now being a discipline within psychology that examines ecological issues beyond the individual level, explores the value of diversity, challenges narrow unidimensional measures of health, and validates psychologists as agents of social changes. A public health approach was used to help provide the burgeoning field with an alternative to the medical model used in clinical psychology that focuses on illness, treatment, and recovery. This helped establish prevention as a founding principle of the field. CP has become a science of prevention, community intervention, and social epidemiology. Themes of the field include ecological perspectives, cultural relevance and diversity, and empowerment. Ecological perspectives emphasize social and environmental contexts at the individual, organizational, and community levels of analysis, and apply principles of resource mobilization, interdependence, and adaptation.

The following intervention and evaluation projects exemplify efforts in community psychology that have contributed to public health and welfare. The community lodge system was an alternative community living and employment setting for individuals with serious mental illness. The setting provided residents an opportunity to progressively operate and own their lodge including their own janitorial business. Another example is the Juvenile Diversion project. This project provided an

alternative program for youth who would have otherwise entered the juvenile court system or a social service agency. The youth in the program were connected to a college student who worked with each youth to help them with school, social relations (peer and family), and accessing community resources. These projects are two examples within the field of community psychology designed to encourage consumer participation, build on their strengths and competencies, and promote health. Other research in community psychology has also helped provide public health with an empirical and theoretical basis for much of its work on community involvement and lay helpers, empowerment, and social capital.

COMMUNITY PSYCHOLOGY AND PUBLIC HEALTH

Community psychology has many methods, topics, theories, and values in common with public health. Both fields emphasize skill development and utilize an approach that involves participants in program planning, implementation, and evaluation. They also employ qualitative and quantitative methods for process and outcome evaluation. Methods such as advocacy, community organizing, policy influence, and dissemination are used by both fields. Community psychologists focus on social determinants of health, including interpersonal support, stress and coping, citizen participation, social capital, wellness and health promotion, and social change in individuals, families, schools, churches, workplaces, and communities. Mutual and self-help approaches also overlap the two fields.

Community psychology and public health apply similar theories and conceptual models, including empowerment theory, social change theories, dissemination of innovation, and ecological theory. CP addresses cultural issues and diversity in both the application of theory and research and in intervention design. This is consistent with public health approaches because programs are developed and modified to match the values, norms, and beliefs of the audience, whether the focus is on ethnic, behavioral (e.g., homosexual, intravenous drug use), gender, or cultural differences. Both CP and public health consider social relationships, involve diverse community members, and study

factors outside the individual when looking at the problems of individuals, so as to avoid blaming individuals solely for their problems.

Community psychology also differs from traditional public health in some ways. Much of the focus of CP is on mental health issues while public health stresses more traditional health concerns such as communicable diseases, cardiovascular disease, asthma, diabetes, and cancer. CP tends to focus more on behavioral aspects of health such as alcohol and drug use, risky sexual behavior, teen pregnancy, and violence. CP also includes topics that are considered fringe public health topics, such as homelessness, school dropout, and unemployment. Public health has a more practice-oriented approach to social problems, while CP emphasizes theory and social research. Both CP and public health, however, stress prevention, empowerment, promotion of healthy behaviors and contexts, and creating settings for community involvement and improvement.

COMMUNITY PSYCHOLOGY VERSUS HEALTH PSYCHOLOGY

Community psychology differs from health psychology in several ways. CP focuses on social change and social factors related to health outcomes, and pays more attention to context and change at organizational and community levels, while health psychology emphasizes individual health behavior and change. Theories applied in health psychology also focus on factors that predict behavior change, such as the health belief model, the theory of reasoned action, and stages of change. CP examines multiple determinants of health and the context in which behavioral choices are made, while health psychology focuses on individual motivation and cognitive factors associated with health behavior. Health psychology also tends to use approaches to intervention where participants are passive recipients of programs. CP approaches, like public health approaches, are more participatory in nature and involve program recipients in the design, implementation, and evaluation of programs. These two fields, however, overlap in some ways. Health psychology and community psychology include studies of social support and interventions to enhance support, and they both

stress skill building, competence, and self agency. They also examine similar topics, but community psychology includes a broader array of issues that may extend beyond traditional definitions of health.

MARC ZIMMERMAN

(SEE ALSO: *Antisocial Behavior; Behavioral Determinants; Community Health; Community Mental Health Services; Ecosystems; Environmental Determinants of Health; Health Belief Model; Prevention; Social Determinants; Transtheoretical Model of Stages of Change*)

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COMMUNITY WATER FLUORIDATION

Community water fluoridation is the process of adjusting the concentration of fluoride that occurs naturally in a community's water supply to a level that is best for preventing dental decay. A key word in this definition is "adjusting" because all water supplies contain some fluoride; fluoridation merely adjusts the natural amount to a level that results in a minimal amount of dental decay.

Many epidemiologic surveys conducted in the late 1930s and early 1940s showed that children who lived in communities with optimal levels of fluoride occurring naturally in their drinking water had about 50 percent to 65 percent fewer

decayed teeth than did children who lived in communities with negligible concentrations of fluoride. These studies showed that about one part fluoride to one million parts of water (1 ppm) produced maximal protection against dental decay and only minimal amounts of dental fluorosis, a cosmetic condition of teeth that may occur from the chronic ingestion of excessive fluoride during the period when permanent teeth are forming. In January 1945, Grand Rapids, Michigan, became the first city in the world to adjust the fluoride concentration in its municipal water supply. Recommended concentrations for community water fluoridation in the U.S. range from 0.7 ppm in hot climates where people consume more water to 1.2 ppm in cold climates where less water is consumed.

Fluoride works to prevent dental decay in several ways: When ingested, it is incorporated into developing teeth, making them more resistant, after they erupt, to acids that are produced by bacteria when sugars are consumed; when applied to teeth directly, fluoride produces many antibacterial effects and fosters the repair (remineralization) of enamel that has been demineralized by bacterial acids. More than one of these mechanisms of fluoride action may operate simultaneously.

Most recent estimates indicate that 145 million persons or 56 percent of the U.S. population live in approximately 10,000 communities with sufficient concentrations of fluoride in their drinking water. The population with fluoridated water as a percentage of those who live in areas with central water supplies is approximately 62 percent. At least 40 countries practice controlled water fluoridation. Large segments of populations are covered in Australia, Brazil, Chile, Ireland, Malaysia, New Zealand, and Singapore. Community water fluoridation has attributes that make it an ideal public health disease-preventive method. It is inexpensive and eminently safe. It benefits children and adults for a lifetime if consumption continues. Costs of dental treatment are reduced. It is socially equitable because everyone in a community benefits and no individual effort or direct action is required by those who will benefit.

Opponents of fluoridation are a small, heterogeneous group who cannot easily be categorized by any single characteristic. They include

right-wing extremists, misguided environmentalists, some chiropractors, persons concerned with the costs of fluoridation, food faddists, antiscience "naturalists," and those who believe strongly in individual rights. Vocal opponents to fluoridation have attempted to link various adverse health effects with fluoridation. Claims that fluoride is harmful have been amply reviewed by international, national, state, and local authorities. Many committees or commissions of experts in medicine, epidemiology, pathology, pharmacology, and toxicology have reaffirmed the safety of community water fluoridation.

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(SEE ALSO: *Caries Prevention*)

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COMPLETE BLOOD COUNT

The clinical laboratory test that evaluates the three main cellular components of peripheral blood (red cells, white cells, and platelets) is called the "complete blood count" (CBC). It is used commonly to assess whether a patient is anemic (low red cell count), has an infection (increased white blood cells), or has abnormal blood coagulation (platelet levels). The CBC examines the total number of red blood cells (RBC) and the RBC indices, including: the mean corpuscular volume (MCV); the concentration of hemoglobin, measured by the mean corpuscular hemoglobin (MCH)

and its concentration (MCHC); and the hematocrit, which is the mean packed-cell volume of red cells. The total white blood cell (leukocyte) count, the various types of leukocytes (lymphocytes, monocytes, neutrophils, eosinophils, and basophils), and platelets are also measured.

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(SEE ALSO: *Hematocrit; Hemoglobin; Laboratory Services*)

COMPLIANCE

See Adherence or Compliance Behavior

COMPUTER PROGRAMMING

Computer programming has evolved from the development of programs that run on big main-frame computers to ones that run on desktop personal computers (PCs) and small local area networks. Individuals working in public health, therefore, have had to become versed in a variety of different PC applications, such as Access and SPSS. They are charged with the responsibility of determining which programs available on the open market are the best suited to the individual needs of a specific health agency. Decisions are based on the information required to be stored and accessed and the skill level of the staff that will utilize the programs. These individuals are then charged with updating and maintaining these systems for optimum performance.

NEIL CASEY

(SEE ALSO: *Biostatistics; Information Systems; Information Technology; Statistics for Public Health*)

COMPUTER SYSTEMS

See Information Technology

CONDOMS

A condom is a prophylactic sheath that is used to cover the male penis. It acts as a barrier to prevent

sperm from entering a sexual partner, as well as to prevent transmission of disease-causing bacteria or microorganisms between partners during sexual activity. The first condoms, invented hundreds of years ago, were probably made of lambskin. Although effective in blocking sperm transmission, their relatively large pores did not impede the transmission of sexually transmitted infections. Most contemporary condoms are made of latex, which effectively impedes the transmission of both sperm and disease-causing agents.

CHRIS H. PARTIS

(SEE ALSO: *Contraception; Sexually Transmitted Diseases*)

CONFIDENTIALITY

Confidentiality relates to the duty to maintain confidence and thereby respect privacy. People's right to privacy is enshrined in Article 12 of the United Nations (UN) Universal Declaration of Human Rights (1948). UN member countries are morally, if not legally, bound by such declarations. Privacy relates to personal information that a person would not wish others to know without prior authorization. Under the ethical principle of respect for a person's autonomy, public health workers have an obligation to respect privacy. Privacy relates to a person's right to be free from the attention of others. What a person regards as private is a personal choice, and it can change throughout one's life. For example, illicit drug use in youth may be something about which one boasts. Later in life, however, one might prefer that such information not be known to others.

When people agree to participate in research, they are expected to provide personal information, and researchers must commit to respecting and maintaining the confidentiality of their subjects. When people disclose private information for any public health purpose it is expected that the information will be held in confidence. Only with this trust can public health programs succeed.

Anonymity differs from confidentiality, in that the name of a person is not known. However, where certain characteristics of a person are known, it could be possible for others to establish who the person is. For example, if it were said that a person

of color's income exceeded a certain amount, and there is only one person of color being described in the community, then that person's privacy is no longer protected. The unauthorized disclosure of personal information provided in confidence would be deemed a breach of confidentiality. The public health system depends on the public's confidence and trust in the system's ability to maintain confidentiality.

COLIN L. SOSKOLNE

(SEE ALSO: *Codes of Conduct and Ethics Guidelines; Privacy; Record Linkage*)

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CONFLICTS OF INTERESTS

A conflict of interest is "a conflict between the private interests and the official responsibilities of a person in a position of trust." A conflict of interest thus arises when a person has to play one set of interests against another. For example, a practicing physician is obligated to work in the best interests of his or her patients. Recommending a new drug in return for financial compensation would represent a conflict of interest. This is especially so when the new drug is not any more effective than existing drugs, or may cost more. The physician is in conflict by virtue of the potential to increase income at the expense of his or her patients.

Even the perception by others of a conflict of interest can render suspect the work conducted by a public health professional. For instance, if funding for research is provided by the tobacco industry, there is evidence to suggest that the researcher could be inclined to conduct research and provide results that would be supportive of the tobacco industry's interests. The findings from such research could be contrary to the findings from other research indicating strong associations between smoking cigarettes and the development of various cancers and heart disease. Perceptions of conflicting interests can thus be as harmful to the

researcher as real conflicting interests. Many scientific journals now require that the sponsors of research be made known at the time that manuscripts containing research findings are submitted for peer review and also at the time the manuscript is published.

COLIN L. SOSKOLNE

(SEE ALSO: *Codes of Conduct and Ethics Guidelines*)

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**CONFOUNDING,
CONFOUNDING FACTORS**

The word *confounding* has been used to refer to at least three distinct concepts. In the oldest and most widespread usage, confounding is a source of bias in estimating causal effects. This bias is sometimes informally described as mixing of effects of extraneous factors (called confounders) with the effect of interest. This usage predominates in nonexperimental research, especially in epidemiology and sociology. In a second and more recent usage originating in statistics, confounding is a synonym for change in an effect measure upon stratification or adjustment for extraneous factors (a phenomenon called noncollapsibility or Simpson's paradox). In a third usage, originating in the experimental-design literature, confounding refers to inseparability to main effects and interactions under a particular design. The three concepts are closely related and are not always distinguished from one another. In particular, the concepts of confounding as a bias in effect estimation and as noncollapsibility are often treated as equivalent, even though they are not. Only the former concept will be described here.

**CONFOUNDING AS A BIAS
IN EFFECT ESTIMATION**

A classic discussion of confounding in which explicit reference is made is to "confounded effects"

is found in John Stuart Mill's *A System of Logic*, although Mill lays out the primary issues and acknowledges Francis Bacon as a forerunner in dealing with them. Mill lists a requirement for experiment intended to determine causal relations: ". . .none of the circumstances [of the experiment] that we do know shall have effects susceptible of confounded with those of the agents whose properties we wish to study [emphasis added]."

In Mill's time, the world *experiment* referred to an observation in which some circumstances were under the control of the observer, as it still is used in ordinary English, rather than to the notion of a comparative trial. Nonetheless, Mill's requirement suggests that a comparison is to be made between the outcome of one's "experiment" (which is essentially, an uncontrolled trial) and what one would expect the outcome to be if the agents one wished to study had been absent. If the outcome is not as one would expect in the absence of the study agents, then Mill's requirement ensures that the unexpected outcome was not brought about by extraneous "circumstances" (factors). If, however, those circumstances do bring about the unexpected outcome, and that outcome is mistakenly attributed to effects of the study agents, then the mistake is one of confounding (or confusion) of the extraneous effects with the agent effects.

Much of the modern literature follows the same informal conceptualization given by Mill. Terminology is now more specific, with "treatment" used to refer to an agent administered by the investigator and "exposure" often used to denote an unmanipulated agent. The chief development beyond Mill is that the expectation for the outcome in the absence of the study exposure is now almost always explicitly derived from observation of a control group that is untreated or unexposed. For example, D. Clayton and M. Hills (1993) state of observational studies:

there is always the possibility that an important influence on the outcome . . . differs systematically between the comparison [exposed and unexposed] groups. It is then possible [that] part of the apparent effect of exposure is due to these differences, [in which case] the comparison of the exposure groups is said to be confounded [emphasis in the original].

In fact, confounding is also possible in randomized experiments owing to systematic imperfections in treatment allocation, administration, and compliance. A further and somewhat controversial point that confounding (as per Mill's original definition) can also occur in perfect randomized trials due to *random* differences between comparison groups.

THE COUNTERFACTUAL APPROACH

Various mathematical formalizations of confounding have been proposed for use in statistical analyses. Perhaps the one closest to Mill's concept is based on the counterfactual model for causal effects. Suppose one wishes to consider how a health-status (outcome) measure of a population would change in response to an intervention (population treatment). More precisely, suppose one's objective is to determine the effect that applying a treatment x_1 had or would have on an outcome measure μ relative to applying treatment x_0 to a specific target population A. For example, A could be a cohort of breast-cancer patients, treatment x_1 could be a new hormone therapy, x_0 could be a placebo therapy, and the measure μ could be a five-year survival probability. The treatment x_1 is sometimes called the index treatment; and x_0 is sometimes called the control or reference treatment (which is often a standard or placebo treatment).

The counterfactual model posits that, in population A, μ will equal μ_{A1} if x_1 is applied, μ_{A0} is applied; the causal effect of x_1 relative to x_0 is defined as the change from μ_{A0} to μ_{A1} , which might be measured as $\mu_{A1} - \mu_{A0}$ or μ_{A1}/μ_{A0} . If A is given treatment x_1 then μ will equal μ_{A1} and μ_{A1} will be observable, but μ_{A0} will be unobserved. Suppose, however, we expect μ_{A0} to equal μ_{B0} , where μ_{B0} is the value of the outcome μ observed or estimated for a population B that was administered treatment x_0 . The latter population is sometimes called the control or reference population. Confounding is said to be present if in fact $\mu_{A0} \neq \mu_{B0}$, for then there must be some difference between populations A and B (other than treatment) that is affecting μ .

If confounding is present, a naïve (crude) association measure obtained by substituting μ_{B0} for μ_{A0} is an effect measure will not equal the effect measure, and the association measure is said to be

confounded. For example, if $\mu_{B0} \neq \mu_{A0}$ then $\mu_{A1} - \mu_{A1}$, which measure the association of treatments with outcomes across the populations, is confounded for $\mu_{A1} - \mu_{A0}$, which measures the effect of treatment x_1 on population A. Thus, saying an association measure such as $\mu_{A1} - \mu_{B0}$ is confounded for an effect measure such as $\mu_{A1} - \mu_{A0}$ is synonymous with saying the two measures are not equal.

The preceding counterfactual approach to confounding gradually emerged through attempts to separate effect measures into a component due to the effect of interest and a component due to the effect of interest and a component due to extraneous effects. One noteworthy aspect of this approach is that confounding depends on the outcome measure. For example, suppose populations A and B have a different five-year survival probability μ under placebo treatment x_0 ; that is, suppose $\mu_{B0} \neq \mu_{A0}$, so that $\mu_{A1} - \mu_{B0}$ is confounded for the actual effect $\mu_{A1} - \mu_{B0}$ of treatment on five-year survival. It is then still possible that ten-year survival, μ , under the placebo would be identical in both populations; that is, μ_{A0} could equal μ_{B0} , so that $\mu_{A1} - \mu_{B0}$ is not confounded for the actual effect of treatment on ten-year survival. (We should generally expect no confounding for 200-year survival, since no treatment is likely to raise the 200-year survival probability of human patients above zero.)

A second noteworthy point is that confounding depends on the target population of inference. The preceding example, with A as the target, had different five-year survivals μ_{A0} and μ_{B0} for A and B under placebo therapy, and hence $\mu_{A1} - \mu_{B0}$ was confounded for the effect $\mu_{A1} - \mu_{A0}$ of treatment on population A. A lawyer or ethicist may also be interested in what effect the hormone treatment would have had on population B. Writing μ_{B1} for the (unobserved) outcome of B under treatment, this effect on B may be measured by $\mu_{B1} - \mu_{B0}$. Substituting μ_{A1} for the unobserved μ_{B1} yields $\mu_{A1} - \mu_{B0}$. This measure of association is confounded for $\mu_{B1} - \mu_{B0}$ (the effect of treatment x_1 on five-year survival in population B) if and only if $\mu_{A1} \neq \mu_{B1}$. Thus, the same measure of association, μ_{A1} , may be confounded for the effect of treatment on neither, one, or both of populations A and B, and may or may not be confounded for the effect of treatment on other targets.

CONFOUNDERS (CONFOUNDING FACTORS)

A third noteworthy aspect of the counterfactual formalization of confounding is that it invokes no explicit difference (imbalances) between populations A and B with respect to circumstances or covariates that might influence μ . Clearly, if μ_{A0} and μ_{B0} differ, then A and B must differ with respect to factors with influence μ . This observation has led some authors to define confounding as the presence of such covariate differences between the compared populations. Nonetheless, confounding is only a consequence of these covariate differences. In fact, A and B may differ profoundly with respect to covariates that influence μ , and yet confounding may be absent. In other words, a covariate difference between A and B is a necessary but not sufficient condition for confounding. This is because the impact of covariate differences may balance each other out, leaving no confounding.

Suppose now that populations A and B differ with respect to certain covariates, and that these differences have led to confounding of an association measure for the effect measure of interest. The responsible covariates are then termed *confounders* of the association measure. In the above example, with $\mu_{A1} - \mu_{B0}$ confounded for the effect $\mu_{A1} - \mu_{A0}$, the factors responsible for the confounding (i.e., the factors that led to $\mu_{A0} \neq \mu_{B0}$) are the confounders. It can be deduced that a variable cannot be a confounder unless it can effect the outcome parameter μ within treatment groups and it is distributed differently among the compared populations. These two necessary conditions are sometimes offered together as a definition of a confounder. Nonetheless, counterexamples show that the two conditions are not sufficient for a variable with more than two levels to be a confounder.

PREVENTION OF CONFOUNDING

Perhaps the most obvious way to avoid confounding in estimating $\mu_{A1} - \mu_{A0}$ is to obtain a reference population B for which μ_{B0} is known to equal μ_{A0} . Among epidemiologists, such a population is sometimes said to be comparable to or exchangeable with A with respect to the outcome under the

reference treatment. In practice, such a population may be difficult or impossible to find. Thus, an investigator may attempt to construct such a population, or to construct exchangeable index and reference populations. These constructions may be viewed as design-based methods for the control of confounding.

Perhaps no approach is more effective for preventing confounding by a known factor than restriction. For example, gender imbalances cannot confound a study restricted to women. However, there are several drawbacks: Restriction on enough factors can reduce the number of available subjects to unacceptable low levels and may greatly reduce the generalizability of results as well. Matching the treatment populations on confounders overcomes these drawbacks, and, if successful, can be as effective as restriction. For example, gender imbalances cannot confound a study in which the compared groups have identical proportions of women. Unfortunately, differential losses to observation may undo the initial covariate balances produced by matching.

Neither restriction nor matching prevents (although it may diminish) imbalances on unrestricted, unmatched, or unmeasured covariates. In contrast, randomization offers a means of dealing with confounding by covariates not accounted for by the design. It must be emphasized, however, that this solution is only probabilistic and subject to severe constraints in practice. Randomization is not always feasible or ethical, and (as mentioned earlier) many practical problems, such as differential loss and noncompliance, can lead to confounding in comparisons of the groups actually receiving treatments x_1 and x_0 . One somewhat controversial solution to noncompliance problems is intent-to-treat analysis, which defines the comparison groups A and B by treatment assigned rather than treatment received. Confounding may, however, affect even intent-to-treat analyses, and (contrary to widespread misperceptions) the bias in those analyses can be away from the null (exaggerating an effect). For example, the assignments may not always be random, as when blinding is insufficient to prevent the treatment providers from protocol violations. And, purely by bad luck, randomization may itself produce allocations with severe covariate imbalances between the groups (and consequent confounding), especially if the study size is small.

Blocked (matched) randomization can help ensure that random imbalances on the blocking factors will not occur, but it does not guarantee balance of unblocked factors.

ADJUSTMENT FOR CONFOUNDING

Design-based methods are often infeasible or insufficient to prevent confounding. Thus, there has been an enormous amount of work devoted to analytic adjustments for confounding. With a few exceptions, these methods are based on observed covariate distributions in the compared populations. Such methods can successfully control confounding only to the extent that enough confounders are adequately measured. Then, too, many methods employ parametric models at some stage, and their success may thus depend on the faithfulness of the model to reality. These issues cannot be covered in depth here, but a few basic points are worth noting.

The simplest and most widely trusted methods of adjustment begin with stratification on confounders. A covariate cannot be responsible for confounding within internally homogeneous strata of the covariate. For example, gender imbalances cannot confound observations within a stratum composed solely of women. More generally, comparisons within strata cannot be confounded by a covariate that is unassociated with treatment within strata. This is so regardless of whether the covariate was used to define the strata. Thus, one need not stratify on all confounders in order to control confounding. Furthermore, if one has accurate background information on relations among the confounders, one may use this information to identify sets of covariates sufficient for control of confounding.

Some controversy has occurred about adjustment for covariates in randomized trials. Although Fisher asserted that randomized comparisons were “unbiased,” he also pointed out that they could be confounded in the sense used here. Resolution comes from noting that Fisher’s use of the word unbiased referred to the design and was not meant to guide analysis of a given trial. Once the trial is underway and the actual treatment allocation is completed, the unadjusted treatment-effect estimate will be biased if the covariate is associated

with treatment, and this bias can be removed by adjustment for the covariate.

SANDER GREENLAND

(SEE ALSO: *Bias*)

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CONGENITAL ANOMALIES

A congenital anomaly may be viewed as a physical, metabolic, or anatomic deviation from the normal

pattern of development that is apparent at birth or detected during the first year of life. Under this definition, Mendelian genetic disorders (e.g., phenylketonuria), chromosomal abnormalities (e.g., Down syndrome), tumors (e.g., Wilms' tumor), infections (e.g., rubella, toxoplasmosis, herpes virus, cytomegalovirus, HIV, and syphilis), exposure to teratogenic agents (e.g., cocaine, tobacco, or alcohol), maternal disease (e.g., maternally transmitted autoantibodies, phenylketonuria), and pure bad luck or accident (e.g., a twisted umbilical cord) can all contribute to the development of a congenital anomaly. It is important to determine which of these predisposing conditions have led to the anomaly, because knowledge of the etiologic agent or agents influence not only therapy, but also prevention in the case of future pregnancies.

In the United States in 1998, of nearly 4 million live births, just over 45,000 babies (1.15 percent of births) had congenital anomalies of significant enough severity to be recorded on their birth certificates. Musculoskeletal anomalies (e.g., cleft lip/palate, polydactyly, clubfoot) were most common (465 per 100,000 live births), followed by cardiovascular and respiratory malformations (250 per 100,000 live births), urogenital malformations (e.g., malformed genitalia, renal agenesis; 193 per 100,000 live births), central nervous system malformations (e.g., anencephaly, spina bifida, hydrocephalus, microcephalus; 83 per 100,000 live births), gastrointestinal malformations (e.g., rectal atresia/stenosis, tracheo-esophageal fistula, omphalocele; 83 per 100,000 live births), and multiple malformations attributable to chromosomal anomalies (77 per 100,000 live births).

Prevention is the best approach to congenital anomalies. A teratogen can be defined as an agent or factor (e.g., infectious agents, physical agents such as radiation and heat, drug and chemical agents, and maternal metabolic and genetic factors) that can produce abnormalities of form and function in an exposed fetus. As a general rule, organ systems are created during the first trimester of life, structured during the second trimester, and undergo maturation in the third trimester. Thus, teratogens tend to exercise their most destructive effect during the first and second trimesters, underscoring the importance of avoiding exposures to known teratogens from the point a

decision is made to consider pregnancy. Prophylaxis can also be practiced, for example, by fortifying the diet with folic acid to reduce the risk of neural tube defects.

Abnormal development of major organ systems is readily apparent before the end of the second trimester, making examination of the fetus by ultrasound the simplest form of screening. Some conditions such as obstruction of the urinary tract, are treatable in *utero*. Evaluation for specific disorders is also available for mothers at risk as a result of genetic background, ethnicity, age, history of exposure, or other routine screening tests. The potential benefits from a given procedure must be balanced against the expected risk. For example, the vast majority of babies with Down syndrome are born to mothers between the age of twenty and thirty; however, the risk of having a baby with Down syndrome begins to increase exponentially after age thirty. Definitive diagnostic procedures, such as chorionic villous sampling and amniocentesis, carry the risk of abortion, hence most physicians discourage these procedures for younger women, where the risk of complications is greater than the prevalence of the suspected anomaly, if the parents have already decided that an induced abortion is out of the question.

Gross abnormalities are obvious at birth, whereas many metabolic abnormalities are not immediately apparent and represent a significant, and possibly preventable, hazard to the health and well-being of the patient. In general, neonatal screening is advisable when the incidence of the disease is sufficient to warrant mass screening of the population; when the test is sufficiently sensitive to detect the disease while specific enough to minimize the stress incurred in ruling out the diagnosis; and when the disease is not only treatable, but early diagnosis is critical. Examples include phenylketonuria and congenital hypothyroidism, both of which lead to preventable and relatively silent forms of mental retardation and where delay in diagnosis can lead to irreparable loss of intelligence. In contrast, galactosemia may also result in mental retardation, but the gastrointestinal distress experienced by the infant typically leads to early diagnosis, and long-term results of treatment have been disappointing—the IQ is low

in many patients despite early and seemingly adequate therapy.

HARRY W. SCHROEDER, JR.

(SEE ALSO: *Birth Certificates; Birthrate; Genes; Genetic Disorders; Genetics and Health; Maternal and Child Health; Medical Genetics; Newborn Screening; Perinatology; Phenylketonuria; Pregnancy; Prenatal Care; Teratogens*)

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CONTACT

A contact is a person or animal that has been in association with a disease-infected person or animal in such a way as to have had an opportunity to acquire the infection and be capable of transmitting it. A contact may not be ill or have any overt signs or symptoms of infection, yet may nevertheless transmit the infection to others who are susceptible to the infection. The word also describes the mode of transmission of infection, which may be either by direct (person-to-person) or indirect contact. Indirect contact includes transmission of infection via contaminated clothing or utensils, through an intermediary living creature such as a rat or domestic animal, or by insect vectors in which the infectious pathogen passes part of its life cycle.

Symptomless, and apparently healthy, infected individuals are a very important category of contacts. Many sexually transmitted diseases, many food-borne gastrointestinal infections, and several of the common infectious diseases are spread by apparently healthy contacts. Contact tracing is therefore an essential part of the process of surveillance and control of communicable diseases, especially sexually transmitted diseases. Quarantine was once a common method of restricting the movements of known contacts of contagious diseases such as diphtheria, and of diseases erroneously believed to be contagious, notably poliomyelitis.

JOHN M. LAST

(SEE ALSO: *Carrier; Communicable Disease Control; Contagion; Cordon Sanitaire; Quarantine*)

CONTAGION

The theory that certain diseases can be transmitted by contact between a person carrying an infection and a susceptible host is solidly based in empirical observations that date back at least three millennia. In the Bible, mention is made of lepers being required to wear distinctive clothing and carry a bell to warn others of their presence, a practice that implies contagion as the cause of leprosy. The Bible also describes the use of lazarettos, where people with what were believed to be contagious diseases could be incarcerated. Persons suffering from diseases believed to be contagious have been isolated and shunned in this way for thousands of years. Tuberculosis and other diseases, including some that are not contagious but can be disfiguring, such as psoriasis, have long carried a social stigma.

The concept of contagion was described in *De Contagione et Contagiosis Morbis* (1546) by Hieronymus Fracastorius (1478–1553). He distinguished three types of contagious disease: direct (spread by person-to-person contact); droplet (spread by, for instance, sneezing, coughing); and by way of contaminated clothing, cooking utensils, and other items. Such objects that harbor disease agents are known as *fomites*.

The concept of contagion antedates the germ theory of disease and the first microscopic observations by Antoni van Leeuwenhoek (1632–1723) of tiny living creatures, later called germs or microbes, that were shown by Robert Koch (1843–1910) and others to be the causal agents for many diseases. Nowadays the word “contagious” is usually reserved for diseases that are both dangerous and highly infectious. Most other transmittable diseases are simply called either communicable, or infectious. Diseases referred to as infectious are sometimes considered more readily transmitted to others than diseases that are communicable, but usage of these words is loose and inconsistent. It is ironic that leprosy, the most feared contagious disease of antiquity, is actually among the least communicable; it is transmitted by a bacillus that behaves so sluggishly it requires prolonged close contact for transmission to occur.

JOHN M. LAST

(SEE ALSO: *Contact; Communicable Disease Control; Koch, Robert; Leeuwenhoek, Antoni van; Leprosy*)

CONTAMINATION

See Pollution

CONTINGENCY TABLE

A contingency table is a display of data in columns and rows, arranged to facilitate the discovery of any relationship that may exist between different sets of data. The simplest type of contingency table displays two sets of data, one each in the columns and rows. The simplest of all is a fourfold, or 2 x 2, table. More complex contingency tables can be constructed with a further subclassification of data in the columns or rows, or in both columns and rows. Many varieties of data exist that can be arranged in this sort of table.

Some of the common variables that contingency tables show are: dichotomous (either-or); nominal (i.e. unordered, qualitative, classes, races); and ordinal (i.e. arranged along a scale that may or

may not be continuous from zero to infinity, have defined upper and lower limits, or a defined mathematical relationship). Sometimes a relationship between columns and rows is intuitively obvious merely from inspection, and may show that the values in the columns and those in the rows vary either directly or inversely—that is, as the numbers increase across the rows, they also increase down the columns, or vice versa. At other times there may be no obvious relationship, but one may be revealed by appropriate statistical tests for association or correlation among the variables displayed in the table.

JOHN M. LAST

(SEE ALSO: *Data Sources and Collection Methods; Epidemiology; Statistics for Public Health*)

CONTINUOUS QUALITY ASSESSMENT

Continuous quality assessment is a systematic, ongoing cycle of collecting and analyzing evidence of a program's effectiveness. The information collected is used to evaluate how well the program's goal is being achieved, and decide what may be done to better achieve the goal. Multiple methods and sources are generally used to gather the data necessary to measure performance and outcomes, and these efforts are repeated in a cyclic manner. Continuous quality assessment is often a component of continuous quality improvement.

AMY F. LEE

(SEE ALSO: *Continuous Quality Improvement; Mobilizing for Action through Planning and Partnerships*)

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CONTINUOUS QUALITY IMPROVEMENT

Continuous quality improvement is a concept originally taken from business literature. It is a management philosophy of ensuring that the needs of those who use the services and products of an organization are continually being met. This is accomplished by constantly searching for opportunities to improve all processes. Continuous quality improvement principles are now being used in areas of medical and public health practice in an effort to increase the efficiency and effectiveness of services. These principles include strong leadership, employee empowerment to address problems, and the use of visual tools such as bar charts or histograms to analyze and evaluate progress. In addition, efforts are made to achieve standards of excellence rather than minimum standards.

AMY F. LEE

(SEE ALSO: *Continuous Quality Assessment; Peer Review*)

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CONTRACEPTION

Contraception is the use of any of various methods to prevent pregnancy. Family planning, in contrast, involves the use of contraception or other measures to limit the number of children and plan the timing and spacing of births. Contraception has been used throughout history. Early methods, however, were ineffective (drinking potions or douching) or dangerous and not available to all people. By the middle of the twentieth century, only 13 percent of couples worldwide used effective methods of contraception. By the year 2000, UNICEF estimated that this figure had risen to 50 percent.

Contraceptive use is not equally distributed throughout the world. Most of western Europe,

the United States, parts of Latin America, and Oceania demonstrate high levels of use. India, Pakistan, Nigeria, Sudan, Oman, Yemen, Haiti, Guatemala, Bolivia, and nations in sub-Saharan Africa demonstrate low contraceptive use and high fertility. In the past, family planning programs in some countries were, in effect, population control programs. They were often coercive and did not allow families choice. This is changing, as more people want to limit their family size. In some places, such as China, a strict population control policy is still in place.

In 1994, the global attendees at the International Conference on Population and Development (ICPD) in Cairo, Egypt, placed family planning within a holistic context of reproductive health, and family planning is now considered to be a human right. Family planning helps save women's lives. Over 585,000 women die every year from unsafe abortion, childbirth, and pregnancy, with 90 percent of the deaths occurring in developing countries. These deaths are largely preventable; and contraception could play a role in preventing them.

Despite advances in contraceptive technologies, there is no single method that suits everyone. In some places, choice is limited and access is difficult, resulting in an unmet need for contraception (the condition of wanting to avoid or delay childbearing, but not using a contraceptive method).

One way to categorize contraceptive technologies is by the duration of protection. There are permanent, long-term, and short-term methods. In addition to these technologies, there are also behavioral methods of contraception. What follows is a list of all contraceptive technologies and behaviors, how they prevent pregnancy, their effectiveness, potential problems or side effects, and whether they also prevent reproductive tract infections (RTIs), hepatitis C, or sexual transmission of HIV (human immunodeficiency virus).

PERMANENT METHODS

The two permanent surgical methods of contraception are 99 to 99.5 percent effective. They do not prevent RTIs, or HIV transmission, and they

both involve a risk of infection or bleeding. In male sterilization, or vasectomy, the vas deferens (the tubes that carry the sperm from the testicles to the penis) are blocked or cut. Female sterilization, or tubal ligation, is a surgical procedure in which a woman's fallopian tubes are cut, burnt, or blocked to prevent sperm from reaching and fertilizing the egg.

LONG-ACTING METHODS

None of the long-acting methods protect against RTIs or HIV transmission. IUDs, implants, and injections are 99 percent effective. Oral contraceptive pills are theoretically 99 percent effective, but pregnancies do occur if pills are missed or not taken on time.

IUD. An intrauterine device (IUD) is most often a nonhormonal method of contraception. The IUD is a small plastic or plastic and copper device placed inside a woman's uterus by a trained health care provider, and it protects against pregnancy for up to twelve years. The IUD may increase the risk of RTIs for women who have more than one partner. Side effects include increased cramping and bleeding during monthly periods. Some IUDs contain a hormone (progesterone) to increase their pregnancy protection while decreasing the risk of heavy bleeding. All of the other long-acting contraceptive methods are hormonal methods.

Oral Contraceptive Pill. "The Pill" was introduced in the United States in the 1960s. It contains one or two hormones (either estrogen and progesterone together, or progesterone alone) that prevent ovulation and create a hostile environment for sperm. Although there was originally controversy over the health risks of the pill, it is now considered to be relatively safe for nonsmokers. In fact, it may protect against cancer of the ovaries and uterus. Side effects include nausea, breast tenderness, spotting, weight gain, mood changes, and headaches. Women who smoke should not take the pill as it may cause fatal blood clots. The pill's effectiveness is 99.5 percent if used perfectly, but 95 percent in real use.

Contraceptive Implants. Manufactured under the brand name Norplant®, contraceptive

implants are silicone rods containing the hormone progesterone. Six of these matchstick-sized rods are placed under the skin of a woman's upper arm. The progesterone is released over time, and the implants remain effective for five years. While the effectiveness of implants is 99 percent, side effects include irregular monthly periods, spotting, acne, headaches, weight gain, and hair loss. Newer implants use one or two rods and may contain more than one hormone.

Hormonal Injections. Progesterone injections are given every two to three months, while those containing estrogen and progesterone are administered monthly. Injections work by stopping ovulation and making the cervical mucus hostile to sperm. Side effects include irregular periods, spotting, weight gain, headaches, depression, loss of libido, and hair loss.

SHORT-ACTING METHODS

Somewhat less effective than long-lasting methods, these contraceptives have fewer side effects. They are primarily physical or chemical barriers that also prevent or decrease the chances of transmitting RTIs and HIV.

Male Condom. This type of condom consists of a latex or animal intestine sheath that is placed over the erect penis before intercourse. Effectiveness is about 86 percent, as condoms can tear or slip off. Some people are allergic to latex and cannot use this type of condom. Latex condoms protect against RTIs and HIV infection, while those made from animal intestine do not.

Female Condom. The thin, female condom is plastic, tunnel-shaped device that is closed on one end. The closed end is placed over the cervix. It protects against both RTIs and pregnancy. One advantage of the female condom is that it is controlled by the woman. This feature is particularly important in a relationship where the woman cannot negotiate for safe sex. There are no medical limitations or side effects. At 80 percent effectiveness, the female condom is slightly less effective than the male condom.

Spermicides and Vaginal Barriers. Spermicides are chemicals that kill sperm or immobilize

them. They come in many forms, including foaming tablets or suppositories, melting suppositories, foam, melting film, creams, and jellies. All are placed in the vagina prior to intercourse. Some women have allergic reactions to spermicides. Effectiveness is 80 percent. Spermicides can be used alone or in combination with condoms or vaginal barriers. These devices may also protect against RTIs and HIV, but their effectiveness in this regard is as of yet unknown.

Vaginal barriers (diaphragm, cervical cap, and sponge) are inserted in the vagina before intercourse and must be used with spermicides to be effective. A diaphragm is a soft rubber cup that covers the cervix, a cervical cap is a smaller rubber cup that fits right over the cervix, and a contraceptive sponge is a sponge impregnated with spermicide.

Emergency Contraceptive Pills. Also known as morning-after pills or post-coital pills, these are either estrogen and progesterone or progesterone-only pills that are taken within seventy-two hours of unprotected intercourse or in cases of contraception failure (e.g., forgotten pills, condom breakage, or slippage). Taken as directed they reduce the risk of pregnancy by 75 percent. They provide no RTI or HIV protection.

BEHAVIORAL METHODS

There are a number of ways to prevent pregnancy that rely on human behavior rather than contraceptive technology.

Abstinence. Abstaining from sexual intercourse, whether completely or periodically, is 100 percent effective, but may be difficult to maintain.

Fertility Awareness. There are a variety of methods a woman can use to tell the fertile time of her menstrual cycle. These include calendar calculation, cervical secretions, basal body temperature (BBT), chemical ovulation prediction kits, and cervical changes. All of these methods are used in combination with either barrier methods (during the fertile time) or periodic abstinence (not having intercourse during the fertile time). Effectiveness is approximately 75 to 80 percent. Fertility awareness can also be used to time intercourse in order to facilitate pregnancy.

Lactational Amenorrhea Method (LAM). This is a behavioral method used by women who have recently given birth. It involves simply the use of breastfeeding during the first six months postpartum, and requires that 85 percent of the baby's food be breast milk. During this period and under these conditions, LAM is 100 percent effective. It is also inexpensive, has no hormonal side effects, and benefits the baby.

FUTURE METHODS

Methods of contraception being developed include both variations of existing methods and new concepts. Among the modifications of current methods are biodegradable hormonal implants, subdermal hormonal pellets, injectable hormonal "microspheres" (hybrids of injectables and implants), and intravaginal hormonal rings. New methods include male hormonal contraceptive pills, hormonal patches for men and women, and vaccines against sperm, ovum, or hormones. Microbicides—chemicals that kill bacteria and viruses—are also being tested for use alone, or in combination with spermicides for dual protection.

SUELLEN MILLER

(SEE ALSO: *Abstinence; Condoms; Contraception; Family Health; Family Planning Behavior; Maternal and Child Health; Menstrual Cycle; Planned Parenthood; Pregnancy; Reproduction; Sexually Transmitted Diseases; Women's Health*)

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CORDON SANITAIRE

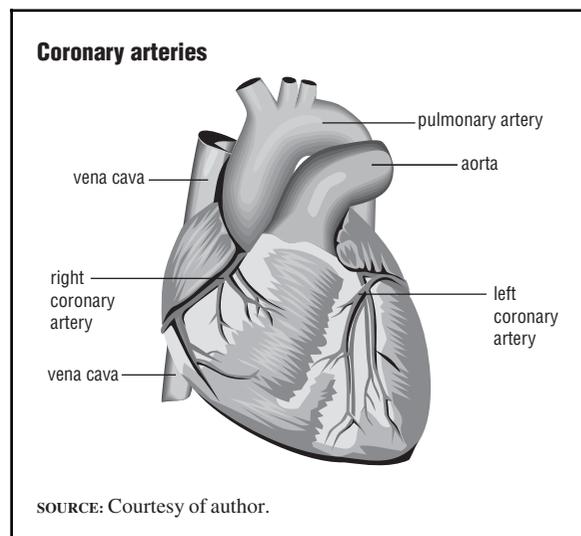
Literally translated from the French, a sanitary cordon is a barrier, administrative as well as actual, between a potential source of infection and a susceptible population. Its administrative aspects involve laws and regulations for protection against contagious diseases by means of isolation of infected cases and quarantine of contacts. The actual barrier is the quarantine station or isolation ward in which contagious cases and contacts are held, and the barrier-nursing procedures, aimed at minimizing the risk that an infection will be transmitted. During the influenza pandemic at the end of World War I, many nations attempted to arrest the progress of influenza pandemic by means of a rigorously enforced cordon sanitaire, but all efforts failed. Since then, and especially since the development of modern antibiotics, the cordon sanitaire approach has been little used. The term, and the procedure it embodies, are now mainly of historical interest.

JOHN M. LAST

(SEE ALSO: *Barrier Nursing; Communicable Disease Control; Contact; Contagion; Isolation; Quarantine*)

CORONARY ARTERY DISEASE

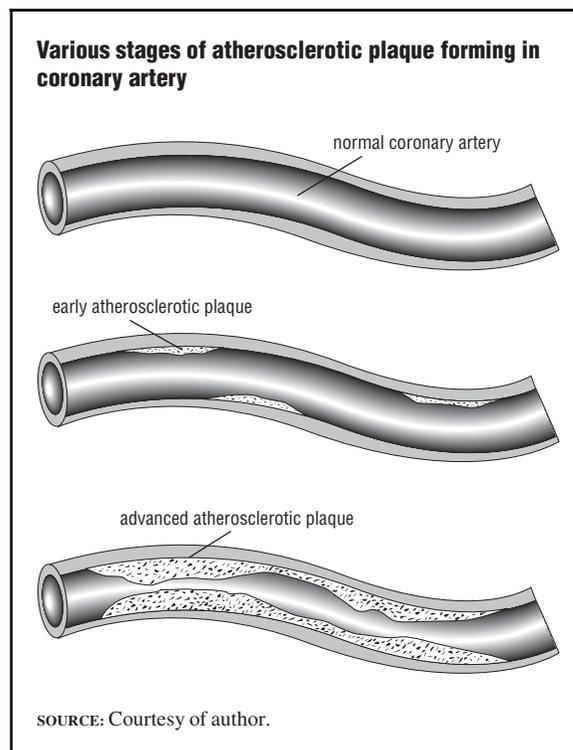
The heart, a powerful muscle that beats over 50,000 times in one day, is fed the blood and energy it needs through small tubes called coronary arteries (see Figure 1). Coronary artery disease (CAD) is the most common cause of death and disability in the United States and other industrialized countries, and it can be manifested if these arteries become narrowed by cholesterol to about half their normal diameter (see Figure 2). Cholesterol, a waxy substance, deposits slowly inside the artery. These deposits, which cause CAD, are called atherosclerotic plaques, having a central soft cholesterol core wrapped in hard fibrous tissue.

Figure 1

Plaque buildup stems from lifestyle and other coronary risk factors, including harmful diets, physical inactivity, smoking, stressful behavior patterns, elevated blood cholesterol, high blood pressure, and diabetes. The wide differences in CAD deaths among countries are largely lifestyle related. Racial differences in susceptibility tend to be minor. Diets overloaded with meat, eggs, butter, whole milk, cheese, and ice cream contain excessive cholesterol and saturated fat, which raise blood cholesterol, thus producing atherosclerosis.

Sedentary lifestyles in America are increasing. From 1991 to 1997, participation by high school students in physical education fell from 42 percent to 27 percent. Obesity increased by 60 percent in the United States in the 1990s because of decreasing physical activity and larger size and frequency of restaurant meals, especially inexpensive high-calorie fast foods. Obesity contributes to atherosclerosis in four ways. It raises blood pressure, cholesterol, and triglycerides (a type of blood fat), and it promotes diabetes, a strong and increasingly common CAD risk factor. A poor diet, and especially one containing excessive amounts of salty foods, can also increase blood pressure.

Smoking cigarettes promotes CAD by damaging the artery's inside lining and by lowering high-density lipoprotein (HDL) cholesterol, a protective fraction of the blood cholesterol. Fortunately, smoking rates have declined in the United States,

Figure 2

and ex-smokers who also exercise benefit by increasing HDL and lowering triglycerides.

In the United States in 1997, CAD caused over 1 million heart attacks and almost 500,000 deaths (one per minute), almost equally affecting men and women. Forty percent of deaths were sudden (within a few hours), usually from ventricular fibrillation, a very rapid beating of the ventricles, the heart's major muscle. A nonfatal heart attack damages the part of the ventricle deprived of blood (a myocardial infarction, or MI; see Figure 3) with a 30 percent chance of recurrence within six years. Angina, less serious than an MI, is diagnosed by noting chest pain or "squeezing" after eating, exercise, emotional stress, or exposure to cold. About 350,000 new angina cases occur in the United States yearly; some of which progress to an MI, either nonfatal or fatal, especially if not treated.

The nearly 1 million new nonfatal MI or angina cases that occur yearly in the United States are treated aggressively, using relatively new surgical and nonsurgical technologies. The most common surgeries are coronary artery bypass graft surgery

(CABGS) or angioplasty. About 1 million of these are performed yearly, at a cost of \$3 billion. CABGS uses short lengths of veins (taken from the patient's legs) to bypass as many as five blocked or severely narrowed arteries. Angioplasty opens narrowed arteries by inflating a strong balloon, fracturing a plaque, and widening that artery segment. A metal tube (a stent) is often inserted to prevent that segment's closure. Nonsurgical approaches seek to change diet, exercise, smoking, body weight, and stress factors. Recently many new anticholesterol drugs, especially the statins, have reduced CAD extensively when used with lifestyle changes.

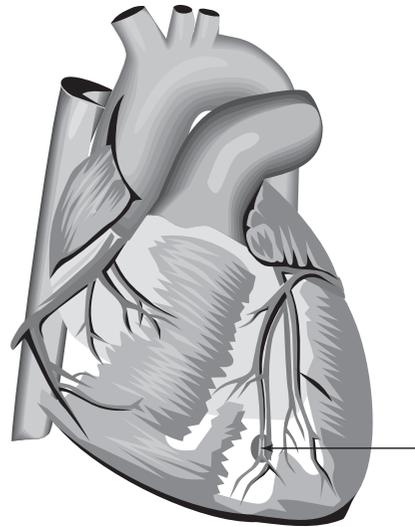
America's lost earnings and medical and disability payments from CAD cost about \$130 billion yearly—an especially tragic burden since scientists now believe that most CAD events are preventable. Optimism regarding CAD's preventability stems from noting a 55 percent fall in CAD rates in the United States between its peak in 1967 and 1995. In turn, the peak represented a 50 percent rise from 1940.

The rise was caused by increases in smoking and rich diets associated with prosperity during and after World War II; the decline resulted from extensive health education that produced major decreases in smoking and dietary intake of saturated fat, and more recently by improved blood-pressure control from medications. CAD rates stopped declining in the United States in 1996, indicating an urgent need for more aggressive prevention. However, without the 55 percent decline since 1967, the human and financial burden would now be even greater.

The international picture has cause for great concern. Although CAD declined in developed countries from 1980 to 2000, the World Health Organization predicts that CAD will become the *major* cause of death in almost all countries by 2020, with over 10 million deaths per year predicted. Developing countries are repeating the earlier lifestyle mistakes of developed countries, ironically aided by aggressive promotion and export of cigarettes and unhealthy fast foods by the United States. Economists predict that rising CAD costs will greatly sap these countries' resources, delay economic growth, and cause unnecessary suffering.

Figure 3

Blocked coronary artery in left ventricle showing damaged heart muscle, a myocardial infarction



SOURCE: Courtesy of author.

Thus, the main lesson that the observed large fluctuations in CAD prevalence teaches is that social and environmental factors, not genetic, predominate in its cause. Therefore, CAD is an excellent example of how public health measures on lifestyle (and human behavior) can either benefit or harm our human potential.

JOHN W. FARQUHAR

(SEE ALSO: *Atherosclerosis; Blood Lipids; Blood Pressure; Cardiovascular Diseases; Chronic Illness; Diabetes Mellitus; HDL Cholesterol; LDL Cholesterol; Lifestyle; Physical Activity; Smoking Behavior; Smoking Cessation; Tobacco Control*)

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CORRELATION COEFFICIENT

Correlation refers to a quantitative relationship between two variables that can be measured either on ordinal or continuous scales. Correlation does not imply causation, rather it implies an association between two variables. The strength of a correlation can be indicated by the correlation coefficient.

The correlation coefficient is a statistic that is calculated from sample data and is used to estimate the corresponding population correlation coefficient. Correlation coefficients generally take values between -1 and $+1$. A positive value implies a positive association between variables (i.e., high values of one variable are associated with high values of the other), while a negative value implies a negative association between variables (i.e., high values of one variable are associated with low values of the other). Thus, a coefficient of -1 means the variables are perfectly negatively related; while $+1$ means a perfect positive relation. A coefficient of 0 means the variables are not related.

For hypothesis testing, the null hypothesis that the population correlation coefficient ρ is 0 is rejected if the sample statistic is unlikely to have been drawn from a population with a true ρ of 0 . In the case where the correlation coefficient has a value of 0 , the null hypothesis will not be rejected. As the coefficient diverges from 0 , the probability of rejecting the null hypothesis will increase as the size of the sample increases.

There are a number of techniques for measuring correlation coefficients. The two most popular are examples of a parametric statistic (Pearson's product-moment correlation) and a nonparametric statistic (Spearman's rank correlation).

The Pearson product-moment correlation coefficient (r) quantifies the linear relationship between variables in terms of their actual raw values.

Use of the Pearson correlation coefficient assumes both linearity and a normal distribution.

The Pearson correlation coefficient for two variables X and Y is defined as the covariance of X and Y divided by the product of the standard deviations of the individual variables:

$$r = \frac{\text{Cov}(X, Y)}{\sigma_X \sigma_Y} = \frac{E[(X - \mu_X)(Y - \mu_Y)]}{\sqrt{E[(X - \mu_X)^2][Y - \mu_Y]^2}}$$

The value of the correlation coefficient can be strongly influenced by one outlying point. For interpretation, r^2 represents the proportion of the variance in one variable that is "explained" by the other variable.

The Spearman rank correlation coefficient (r_s) is used for use ordinal variables (i.e., any data that can be ranked) and requires less stringent assumptions about the distributions of the variables of interest. It measures the strength of the relationship of the ranks of the data; thus it is a measure of correlation for which there may be a nonlinear relationship.

The formula for the Spearman rank correlation is the same as that for the Pearson correlation coefficient. The rank correlation coefficient is affected by the number of ties between data points. If there are no ties in rankings, the Spearman coefficient can be expressed more simply as:

$$r_s = 1 - \frac{6 \sum \frac{d_i^2}{1}}{n(n^2 - 1)}$$

where d_i is the difference in ranks between x_i and y_i . If more than half the ranks are tied, the Spearman coefficient is unreliable.

One example of the use of correlation coefficients is a study of the effects of mercury exposure at a thermometer factory. The study found significant correlation between mercury levels in the air and mercury in urine ($r = 0.92$), blood ($r = 0.79$), and hair ($r = 0.42$).

GEORGE WELLS

(SEE ALSO: *Probability Model; Statistics for Public Health*)

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COST-EFFECTIVENESS

Society confronts many difficult choices in the provision of health care services and public health programs. Many options exist for resolving these choices, though none without compromise. To make informed choices, we need information about the impact of services and programs, their costs, and the consequences of choosing one option over another. One tool for combining these three pieces of information is called cost-effectiveness analysis. The term “cost-effective” describes the dominating option in such an analysis. Thus, for a given cost, program A is cost-effective if its impact is greater than that of program B, all other factors being equal. Or for a given level of impact, program A is cost-effective if its cost is less than program B, all other factors being equal.

“Cost-effective” options may vary among groups in society because they assess costs or value life, improved health outcomes, or other consequences differently. The U.S. Congress, business leaders, managed care organizations, pharmaceutical industry, and the public may all view an analysis differently because they seek different societal objectives. The common meaning, however, is “value for money.” Differences in how various groups view a particular program reflect how different alternatives or aspects of alternatives are valued.

Cost-effectiveness analysis is an analytical tool whose purpose is to provide information about the relative value of different approaches to eliminating disparities, increasing life expectancy, or any program or initiative. The imprecision associated with the term “cost-effective” comes in part from how cost-effectiveness analysis has evolved. This tool has been crafted by analysts from many different disciplines, including economics, medicine, public health, sociology, operations research, and ethics. Each discipline contributes a particular set of concepts and language, which have been melded together to build cost-effectiveness analysis.

R. BURCIAGA VALDEZ

(SEE ALSO: *Beneficence; Benefit-Cost Analysis; Benefits, Ethics, and Risks; Personal Health Services*)

COUNCIL ON EDUCATION FOR PUBLIC HEALTH

The Council on Education for Public Health (CEPH) is the recognized accrediting body for graduate schools of public health and graduate public health programs in U.S. institutions of higher education. Established in 1974 as an independent not-for-profit corporation, the council assumed the accreditation function from the American Public Health Association (APHA), which initiated public health accreditation in the mid-1940s. Consistent with all specialized accrediting bodies recognized by the U.S. Department of Education, the council’s purpose is to evaluate and attest to the quality of educational programs that help prepare students for entry into a recognized profession. The Council’s mission is to promote quality education in public health through accreditation and related activities.

The Council was formed by APHA and the Association of Schools of Public Health (ASPH). Headquartered in Washington, DC, the council is governed by a ten-member board of directors, appointed either separately or jointly by APHA and ASPH. APHA’s three appointees are practitioners of public health and ASPH’s three delegates are drawn from administrators, faculty, or students in schools of public health. The governing board also includes two members of the general public and two members representing programs outside schools of public health. The latter are nominated by national professional and academic organizations. The board structure is designed as a partnership among those groups that have a vital interest in accreditation and includes educators who train professionals, professionals who deliver public health services, and the public who are consumers of these services.

The governing body adopts procedures and criteria by which schools and programs are evaluated, establishes policy, makes accreditation decisions, and oversees the operations of the agency.

PATRICIA P. EVANS

(SEE ALSO: *Accreditation of Public Health Training Programs; American Public Health Association; Association of Schools of Public Health*)

COUNCIL ON LINKAGES

The Council on Linkages Between Academia and Public Health Practice (COL) was established in 1991 under a Public Health Special Project Grant awarded to the Johns Hopkins University School of Hygiene and Public Health. As of 1999, the COL is staffed by the Public Health Foundation (PHF) and is funded through a cooperative agreement between the U.S. Department of Health and Human Services' Health Resources and Services Administration and the Association of Schools of Public Health (ASPH).

The overall objective of the COL is to improve the relevance of public health education to public health practice. The COL's mission is "to improve public health practice and education by refining and implementing recommendations of the Public Health Faculty/Agency Forum (Forum), establishing links between academia and the agencies of the public health community, and creating a process for continuing public health education throughout one's career."

The COL is comprised of leaders from national organizations representing state and local public health agencies, managed-care organizations, and academic institutions. The COL grew out of the Forum, which recommended the establishment of a national steering committee to "foster, coordinate, and monitor implementation of the Forum recommendations and action steps." The Forum developed recommendations for improving the relevance of public health education to the needs and desires of the public sector. The need for this improvement, for public health professionals to place a higher value on practice-specific training, was documented by the Institute of Medicine report, *The Future of Public Health*.

The COL, which meets quarterly, has made considerable progress since its inception in 1991. Some of the COL's accomplishments include: (1) initiating development of national public health practice guidelines, based on the expertise of the academic and practice communities; (2) promoting revision of accreditation criteria to help guide accredited public health academic programs in their linkages with the practice community; (3) identifying and publicizing model academic-practice linkages through annual Linkages Awards, the COL's quarterly bulletin, *The Link*, and the COL's

web site, www.phf.org/Link.htm; (4) working with ASPH to create and support activities of the ASPH Council of Public Health Practice Coordinators; (5) presenting sessions at meetings of the Association of State and Territorial Health Officials and the National Association of County and City Health Officials to promote academic-practice linkages; (6) participating in national and regional workforce development efforts to enhance the skills and competence of the current public health workforce; (7) developing a demonstration project in Ohio to foster academic-practice linkages; and (8) creating an initiative to develop a national public health practice research agenda designed to help refocus academic research on practice issues.

DIANNA M. CONRAD
RONALD BIALEK

(SEE ALSO: *Association of Schools of Public Health; Future of Public Health; Health Resources and Services Administration; Public Health Foundation; Research in Health Departments; United States Department of Health and Human Services [USDHHS]*)

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COUNSELING

Counseling in the public health setting can be a challenging, frustrating, and rewarding process: challenging because it requires the use of skills such as assessment, treatment planning, counseling methodology, and referral; frustrating due to high caseloads and increased paperwork due to

managed care and low client motivation; and rewarding when a counselor sees individuals regain control of their lives. A knowledge of mental illness and of chemical dependency treatment and recovery issues will enhance a counselor's ability to improve people's lives and their communities. Motivating others to change is a noble task but can only be effective with the proper skills and training.

REDGI E. PRICE

(SEE ALSO: *Access to Health Services; Behavioral Change; Managed Care; Mental Health; Social Work; Substance Abuse, Definition of*)

COUNTER-MARKETING OF TOBACCO

Tobacco counter-marketing campaigns are primarily intended to reduce smoking prevalence. This can be achieved by urging adolescents and adults not to take up smoking (prevention messages), or by convincing current smokers to quit (cessation messages).

In the past, many tobacco counter-marketing campaigns focused on smoking prevention among adolescents. It was thought that reducing smoking uptake among adolescents might be an easier task than trying to convince an addicted smoker to quit. However, many adolescents are exposed daily to role models of parents and older siblings who smoke, and their ability to withstand the lure of smoking under these circumstances may be minimal, even given the support of a tobacco counter-marketing campaign.

An adolescent smoking-prevention campaign should ideally coexist with a smoking cessation campaign. Young adults are an important target group for smoking cessation messages because their behavior can strongly influence the behavior of adolescents. Adolescents strive for maturity, and the smoking behavior of young adults serves as a role model for adolescents. Young adults may also be starting to form families and raise children, giving them a reason to question their smoking habit.

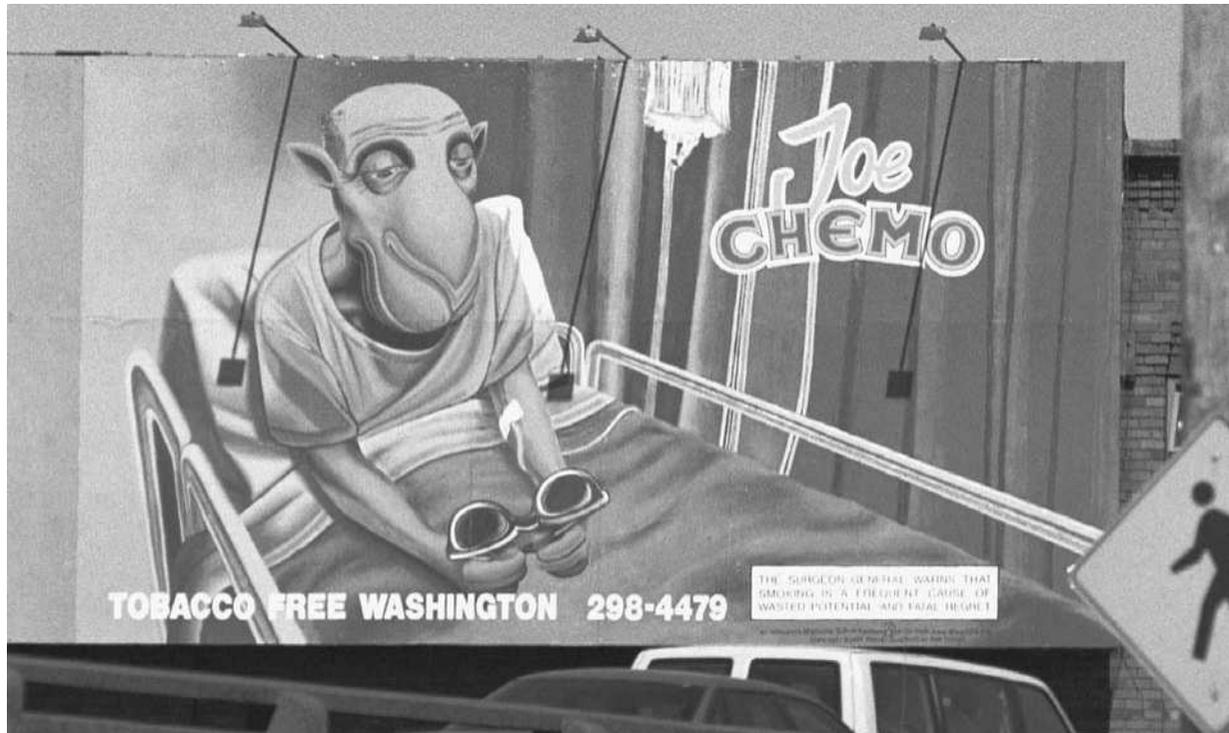
Older adults represent a more difficult target for inducing behavior change because of the average length of time they have been addicted to

nicotine. However, as adults age, they also become more aware of their mortality and may be more open to messages about quitting smoking. Seeing friends or family members succumb to smoking-related diseases may also be a highly motivating reason to quit.

Tobacco counter-marketing campaigns employ various communication approaches, including fear appeals and positive appeals. Fear appeals typically show the negative effects of smoking, such as lung cancer, heart disease, and emphysema. However, adolescents and young adults may not be concerned about long-term health consequences, and they may respond more favorably to messages depicting negative short-term consequences such as bad breath, smelly clothes, or yellow fingers. Positive appeals, on the other hand, emphasize the positive benefits of being part of the smoke-free majority, such as better health, freedom from addiction, and cost savings. Humor, slice-of-life, and lifestyle advertising are used to depict nonsmoking as the norm.

Tobacco companies, through their advertising, sponsorship, and advocacy efforts, have worked hard at making tobacco use seem like a normal, socially acceptable activity. In response to this, many states have begun "denormalization" campaigns, intended to reduce the social acceptability of smoking. Some of these campaigns attack the tobacco industry by showing instances where tobacco companies have lied or attempted to mislead the public (e.g., by withholding information about the addictiveness of tobacco). Some of the advertisements show tobacco executives and tobacco companies in an unsavory light, depicting them as being greedy and heartless.

Another aspect of tobacco counter-marketing is aimed at reducing exposure to environmental tobacco smoke (ETS), also known as secondhand smoke. These protection messages educate smokers and nonsmokers about the health risks from exposure to secondhand smoke. There is significant evidence that ETS is dangerous for smokers and nonsmokers alike (due to its connection to sudden infant death syndrome, miscarriages, childhood asthma, lung cancer, and other conditions). Counter-marketing advertisements can help disseminate little-known information about the dangers of ETS to a broad audience. Increasing public knowledge of ETS helps to provide grassroots



Joe Chemo was used to target adolescents in an anti-smoking campaign. (AP/World Wide Photos)

support for stronger legislation regarding smoking in restaurants and bars and other public places.

Tobacco counter-marketing campaigns typically need a large pool of messages to effectively motivate target groups to quit smoking or to prevent smoking uptake. Individuals are exposed to thousands of advertising messages each day, but because of attitudinal selectivity and perceptual defense they tend to notice commercials most relevant to them personally while screening out messages that are not personally relevant. Consumers do, however, tend to notice advertising messages that are novel and attention getting. Over time, a commercial message will wear out as viewers tire of seeing it, thereby losing its effectiveness. Therefore, a tobacco counter-marketing campaign must continually release new commercial messages in order to break through the clutter.

A key problem with tobacco counter-marketing campaigns is that governments spend far less on promoting these campaigns than tobacco companies spend in promoting their products. Governments typically reap large sums in tax revenues

from tobacco products, but are often unwilling to spend this revenue on reducing the prevalence of smoking. Governments need to be convinced that spending money on tobacco counter-marketing campaigns is an investment that will save lives, as well as large sums in future health care costs.

ANNE M. LAVACK

(SEE ALSO: *Adolescent Smoking; Advertising of Unhealthy Products; Communication for Health; Health Promotion and Education; Mass Media; Mass Media and Tobacco Control; Smoking Behavior; Smoking Cessation; Workplace Smoking Policies and Programs*)

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Women are warned of the dangers of secondhand smoke in this anti-smoking campaign. (AP/World Wide Photos)

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CRIME

Crime is often defined as "conduct in violation of the criminal laws of a state, of the federal government, or of a local jurisdiction, for which there is no legally acceptable justification or excuse" (Schmallegger 2001, p. 700). Not only is a crime the commission of an act, it can also be an omission of an act, such as the failure to assure that a child has clothing, food, or shelter. In 1999, law enforcement agencies in the United States made approximately fourteen million arrests, excluding traffic violations. The offenses most frequently committed were driving under the influence of drugs or alcohol and drug abuse (approximately 1.5 million arrests for each). The second most frequently committed was simple assault (approximately 1.3 million arrests).

Fifty-five percent of all crimes in the United States are committed by people under the age of twenty-five. Individuals in this age group commit approximately 44 percent of all violent crimes and 58 percent of all property crimes. Seventy-eight percent of all people arrested are men.

Crime has many detrimental effects on society. Victims of crime can suffer fear, stress, suicidal thoughts or behaviors, personal financial costs, medical costs, and health problems. The Bureau of Justice Statistics estimates that the cost of crime to victims is approximately \$17.6 billion a year. This estimate does not include the direct cost to the criminal justice system to process and punish/rehabilitate offenders.

According to the National Crime Victimization Survey (NCVS), approximately twenty-three million households in the United States are "touched" by crime annually. This represents approximately one-fourth of all homes, resulting in over thirty-one million victims of crime each year. Individuals who live in urban areas are two times more likely to be the victim of crime than are those who live in rural settings. Men are more likely to be the victims of a crime, and younger Americans are more likely than elderly Americans to be victimized.

Of those arrested for violent crimes and street crimes, including predatory crime, the number of African Americans arrested is roughly the same as, or higher than, the number of Caucasians. This is a major concern because African Americans make

up only 12 percent of the U.S. population. Approximately 30 percent of African American males aged twenty to twenty-nine are under the control or supervision of the criminal justice system—four times as many as Caucasian men in the same age group.

Not only are African Americans overrepresented among criminal offenders, they are also overrepresented among victims of crime. While Caucasian Americans account for over 80 percent of the people living in the United States, they are the victims in less than 50 percent of the murders committed. According to the NCVS, African Americans are more likely than any other racial group to be victims of violent crimes. One out of every twenty-one African-American males is murdered.

In April 1990, President George Bush signed into law the Hate Crime Statistics Act, which requires that hate-crime data be collected and reported. Congress defines hate crimes as offenses “in which the defendant’s conduct was motivated by hatred, bias, or prejudice, based on the actual or perceived race, color, religion, national origin, ethnicity, gender, or sexual orientation of another individual or group of individuals.” In 1998 there were approximately 8,000 hate-crime incidents; and racial hatred was the motive in 58 percent of these acts. Most hate crimes are acts of intimidation, vandalism, simple assault, or aggravated assault.

The majority of crimes in the United States occur in poor urban areas, and the majority of crime victims are poor. The NCVS reported in 1998 that violent-crime rates were greater for individuals living in lower-income families than individuals from more affluent homes. This puts a large burden on the health and medical systems in high-crime areas and strains community resources.

The types of crimes that law-enforcement agencies deal with are changing. Crimes such as cybercrimes (computer crimes) and crimes against the elderly are growing. Domestic violence, although always a criminal act, is being reported more frequently, and there are strict laws dealing with such offenses. It has been estimated that in

2001 the United States will spend over eighty billion dollars to finance its criminal justice system.

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(SEE ALSO: *Domestic Violence: Fraud and Misrepresentation; Gun Control; Homicide; Prostitution; Violence*)

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CRISIS COUNSELING

At different points in life most people experience some kind of crisis. A crisis is defined as a situation or event in which a person feels overwhelmed or has difficulty coping. A crisis might be caused by an event such as the death of a family member, the loss of a job, or the ending of a relationship. During such times people experience a wide range of feelings, and each person’s response to a crisis is different. It is normal to feel frightened, anxious, or depressed at such a time.

Crisis counseling involves providing support and guidance to an individual or a group of people such as a family or community during a crisis. The purpose of crisis counseling is to decrease emotional pain, provide emotional support, make sure that the person in crisis is safe, and help develop a plan for coping with the situation. Sometimes it also involves connecting a person to other community or health services that can provide long-term support.

Crisis counseling can be linked to health education if it is used to increase knowledge of how to

avoid or cope with a crisis in the future. It can also be used to change people's attitudes and beliefs about people in crisis, and to provide people with information about help available in their community. Public health professionals, for example, might educate a community on how to cope with a natural disaster such as a hurricane or an earthquake.

Crisis counseling is also related to health promotion. People can be taught useful skills that will help them to anticipate and cope with a crisis. Skills, information, and support services gained through crisis counseling can also help a person or a group of people to improve their health and quality of life. Crisis counseling can also be tied to health promotion through the development of health-related public policy and supportive environments. For example, public health professionals might create a policy to build crisis counseling centers or to develop a peer counseling program in high schools or colleges.

A valuable tool for public health, crisis counseling has several advantages over other types of counseling or health services. It is relatively low-cost and simple to provide, and it is flexible and easy to learn. A wide variety of health professionals, including doctors, nurses, psychologists, and social workers, can be taught to help people through the application of crisis counseling techniques. Crisis counseling services can also be provided in a wide variety of places or settings, including hospitals, community clinics, military bases, and police stations, as well as through telephone-based services. New technologies have also created the possibility of Internet-based crisis counseling.

Such services provide an important link between a community and the health care system. By using these resources people can sometimes get the help they need without using more expensive health care services, and they can often take advantage of twenty-four-hour crisis services. People with chronic health problems such as schizophrenia or depression can also get help from twenty-four-hour services when their physician or psychiatrist is not available. Many communities have developed peer counseling programs for specific groups such as adolescents and senior centers.

Public health professionals who offer crisis counseling have been faced with a growing variety of issues and clients. Many communities are home

to an increasing number of people from a wide variety of cultural and ethnic backgrounds. There are also more older people in society than ever before. These trends have increased the number of incidents of elder abuse, hate crimes, and cultural clashes. These types of events, along with issues such as AIDS (acquired immunodeficiency syndrome), have increased the workload of crisis counselors. The field has also grown with the development of "first response" programs. Police officers, firemen, paramedics, and others are being trained to deliver on-the-spot crisis counseling. People working in public places such as stores and airline terminals are also learning how to do crisis counseling in order to deal with unhappy or violent customers. These types of programs only add to the importance of crisis counseling for individuals, families, and communities.

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(SEE ALSO: *Communication for Health; Counseling; Health Promotion and Education; Hotlines, Helplines, Telephone Counseling*)

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CROSS INFECTION

Cross infection refers to the transmission of a pathogenic organism from one person to another. It is a common and important mode of infection with many varieties of organisms, including streptococcal and other bacterial diseases, viral hepatitis A and some other fecal-oral infections, such as scabies, fungus infections, pinworms, and roundworms. Cross infection can occur in kindergartens, day-care centers, schools, prisons, military barracks, places of employment, and other

settings where individuals and groups interact with one other. When it happens in a medical setting, such as a hospital or nursing home, it is sometimes called nosocomial infection. But this is a misnomer; nosocomial infections may be acquired in other ways, including hospital staff or inadequately sterilized surgical instruments.

Cross infection is a potential problem in all institutional settings. It is an ever-present problem in kindergartens and day-care centers, which should always observe procedures that can minimize this type of infection and limit the effects of such infections. These procedures include constant surveillance, maintenance of sanitary conditions, and prompt intervention whenever an infection is detected. The best way to prevent cross infections is by rigorous observance of personal hygiene at all times, and through the use of barrier nursing, sanitary practices, and other pertinent procedures.

JOHN M. LAST

(SEE ALSO: *Contact; Contagion; Communicable Disease Control*)

CROSS-CULTURAL COMMUNICATION, COMPETENCE

Almost all American public health professionals work with people from a variety of cultural backgrounds and communication styles. Developing and refining one's skills for communicating effectively with people different from one's self is a process that requires trust, awareness, sensitivity, respect, and honesty. The public health professional may be very proficient when working with one culture (i.e., "cross cultural"), yet inadvertently insult another. Competence is not a state but a constantly evolving process of adaptation and refinement.

The lack of cultural and geographic relevance in public health materials and programs may result in communities erroneously feeling that they are not susceptible to the health problem discussed. Various cultural communities are likely to have worldviews completely different from one's own—including the causes, spread, and treatment of diseases.

Many cultural communication styles incorporate stories and analogies rather than using the linear style of scientists. When responding to a survey or intake, the client may respond by telling a story about his aunt. The public health professional can actively listen to the story, then fill in the appropriate items on the instrument and collect additional information as needed.

In contemporary speech patterns, one person may be talking and another could begin responding prior to the first speaker's completion of the last sentence. Several cultural groups include a lengthy pause between speakers to allow a polite and respectful period of time for the person to finish speaking prior to the listener responding. The public health professional needs to adopt a similar pause when speaking with members of those cultures.

The public health professional is usually taught to look the client directly in the eye to develop trust. However, such direct eye contact is interpreted by some to be intrusive and offensive. Standing or sitting close to the client without realizing that he or she has entered the client's personal space can also result in making the client feel uncomfortable and uneasy.

Selected health information or screening may violate one's personal feelings of modesty. Many health tests require partial nudity and violate one's personal modesty, resulting in a refusal to participate in screening programs. One adaptation is to allow the patient to wear some clothing during the test to respect personal modesty.

Public health professionals need to develop and retain a sense of trust with the client and the community. To instill trust requires that the professional be honest, provide quality programs or services, and remain in the community for years. Trust includes respecting the client's privacy and confidentiality in all matters and requires consistency and time to develop.

Some words used in the public health fields have totally different connotations in communities. For example, when informing an individual about biopsy results, the test is said to be "positive" (for cancer cells). But the patient being told that the test results are "positive" may interpret this as meaning that there was no cancer.

Public health messages need to be prepared and delivered in an understandable manner to the intended population. *Literacy* refers to the ability to use reading and writing to get information. It does not imply “limited intelligence.” *Reading level* refers to the average reading skill expected at each year of school in the U.S. public school system. Limited literacy is an inhibiting factor in accessing health information such as patient education materials, informed consent, materials describing insurance or health care plan options, discharge documents, and directions for self-care or medication.

Many professional prepared materials are written at grade fourteen reading level. The word choice and sentence structure need to be modified in informational materials, the informed consent process, directions, and so on. Health information prepared for the general public needs to be at the seventh grade reading level or lower, using a large (e.g., 14-point), plain (e.g., arial) font, with a lot of white (empty) space on the page.

English as a second language (ESL) describes people for whom other language(s) were learned prior to English. It does not imply that the individual has low literacy skills or is of limited intelligence. When public health messages are translated, it is imperative that the messages be “back-translated” into English. By doing this, slight variations of word choice are frequently identified. For example, there are multiple versions of Spanish, and the translation must be made by someone in the community so that the appropriate dialect is used. Health care facilities should employ trained translators instead of relying on personal acquaintances or staff on hand.

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(SEE ALSO: *Acculturation; American Indians and Alaska Natives; Anthropology in Public Health; Assimilation; Biculturalism; Communication for Health; Community Health; Cultural Anthropology; Cultural Appropriateness; Customs; Ethnicity and Health; Social Assessment in Health Promotion Planning; Values in Health Education*)

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CROSS-SECTIONAL STUDY

A cross-sectional study is the simplest variety of descriptive or observational epidemiology that can be conducted on representative samples of a population. Simply put, it is a study that aims to describe the relationship between diseases (or other health-related states) and other factors of interest as they exist in a specified population at a particular time, without regard for what may have preceded or precipitated the health status found at the time of the study. For instance, a single cross-sectional study may include questions about smoking behavior, occupational exposure to dusts and fumes, respiratory symptoms (cough, breathlessness), and physical examinations of physical fitness—including simple tests of lung function. Such a study would throw some light on the relationship of both occupational exposures and smoking behavior to respiratory symptoms and respiratory function. However, it is impossible either to establish causal relationships or to get reliable perspectives on the natural history of respiratory disease from such a study.

Cross-sectional studies must be done on representative samples of the population if generalizations from the findings are to have any validity. These studies gather information about the prevalence of health-related states and conditions, but they cannot distinguish between newly occurring and long-established conditions. All they can do is measure the frequency (prevalence) of conditions and demonstrate associations. They cannot identify cause-and-effect relationships, though they do identify the existence of health problems.

Cross-sectional studies, also known as surveys, are a useful way to gather information on important health-related aspects of people’s knowledge, attitudes, and practices (such studies are known as “KAP” surveys). In the area of reproductive health, such a survey might include questions such as:

How much do girls and women in their reproductive years know about pregnancy and control over their own fertility? What are their beliefs, values, and attitudes towards making decisions about getting pregnant and about desired family size? How do they control their own fertility? KAP surveys are a good example of a tried and tested form of cross-sectional study. Many have been conducted serially to measure the efficacy of family-planning programs, anti-smoking measures, and other public health and health-promotion interventions. The distinction between a cohort study and a repeated cross-sectional study is that a cohort study is conducted with the same individuals who participate over a long period; repeated or serial cross-sectional studies, on the other hand, do not necessarily (or even usually) study the same individuals repeatedly.

The U.S. National Health Surveys are a form of cross-sectional study. Like many other cross-sectional studies, they can identify health problems and provide data from which many useful inferences can be made and hypotheses generated.

Cross-sectional studies are often used as a basis for health-policy decisions, and it is important to ensure that only current, rather than obsolete, information is used for this purpose. When health department resources are limited, information gathered in a cross-sectional study in the past can usually be refreshed with up-to-date facts from a small sub-sample; it would be necessary to repeat a large cross-sectional study only if the findings from a current sub-sample are seriously discrepant from earlier results.

JOHN M. LAST

(SEE ALSO: *Case-Control Study*; *Cohort Study*; *Epidemiology*; *Survey Research Methods*; *Surveys*)

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CRUDE RATES

See Rates

CRYPTOSPORIDIOSIS

Cryptosporidium is a genus of protozoan parasites that are infectious to humans and animals. The first reports of human infection with *Cryptosporidium* were made in 1976; the infection occurs worldwide. Cryptosporidiosis, the enteric disease caused by *Cryptosporidium* is considered one of the most common parasitic infections in the United States. The largest water-borne outbreak occurred in Milwaukee, Wisconsin, in 1993, when more than 400,000 people were affected. People at highest risk are children less than two years of age, animal handlers, international travelers, homosexual individuals, health care and day-care workers, and the elderly. Cryptosporidiosis infections have been associated with drinking water, recreational water, contaminated food (mainly fruits and vegetables), and direct fecal local contamination.

There are many species of *Cryptosporidium*, and they infect a wide range of animals. *Cryptosporidium parvum* is the most common species infecting humans; however, rare cases of *C. felis*, *C. canis*, and *C. meleagridis* infections have been reported in persons with compromised immune systems. There are two main strains of *C. parvum*, one apparently restricted to humans (anthroponotic), the other infecting animals and humans (zoonotic). *C. parvum* can also infect humans, cattle, and other domestic animals.

Identification of *Cryptosporidium* is of both medical and veterinary importance. *Cryptosporidium* oocysts, the infectious stage of the parasite passed in the feces, predominantly colonize the epithelial cells of the small intestine—yet infections have also been found in epithelial cells of both the gastrointestinal and respiratory tract, including the bile ducts, gall bladder, pancreas, stomach, trachea, lungs, and possibly conjunctiva. Asymptomatic infections are common, though the most frequent symptom in humans is diarrhea. Symptoms often wax and wane, but generally remit in fewer than thirty days (with an average of one to two weeks) in most healthy, immunocompetent persons. Symptoms include profuse or watery diarrhea, dehydration, fever, anorexia, nausea, vomiting, stomach cramping, and flatulence. Immunocompromised persons often cannot clear the infection, which significantly contributes to such persons' illness and death.

Transmission routes are fecal-oral, person-to-person, animal-to-person, waterborne, and foodborne. Oocysts of *C. parvum* are round and 4 to 6 microns in diameter. They are so small that over 10,000 of them would fit on the period at the end of this sentence. The oocysts are highly resistant to chlorine, and to environmental conditions such as frost and heat.

In the laboratory, the most commonly used technique to detect *Cryptosporidium* oocysts in feces are staining procedures and commercial testing kits. Molecular methods of detection are mainly used as a research tool. Commercial blood tests are not yet available.

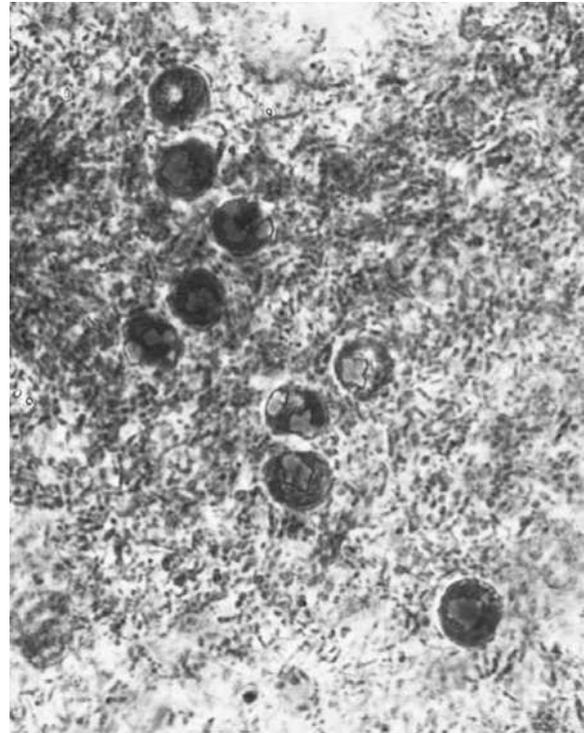
Various ways of preventing *Cryptosporidium* infection include educating the public in personal hygiene, using care in handling animal or human excreta, washing all vegetables and fruits, and avoiding drinking untreated water from lakes, rivers, springs, ponds, or streams. Ways of eliminating oocysts from drinking water are by boiling for one minute or by filter sterilization with either absolute 1.0 micron filters, reverse osmosis filters, or filters that meet NSF (National Sanitation Foundation) standards. Infected food handlers should be removed from work areas, and infected children should be excluded from day-care and recreational water facilities until the infection clears.

There is no established therapy for human cryptosporidiosis. Supportive measures to alleviate symptoms include antidiarrheal medication and management of fluid and electrolyte balance.

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Laboratories use staining procedures to detect *Cryptosporidium* oocysts. (Photo Researchers Inc.)

CULTURAL ANTHROPOLOGY

Cultural anthropology emerged as an area of study following the era of European exploration, when the full diversity of human experience became globally apparent. Sir Edward Burnett Tylor (1832-1917) one of the founders of anthropology, defined culture as "that *complex whole* which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society" (Tylor 1871, p. 1, emphasis added). It is the holistic emphasis of cultural anthropology that distinguishes it most clearly from other related disciplines. For example, an anthropologist may focus his or her research on a particular dimension of culture, such as religion or political organization, but that dimension will also be described in terms of its relationship to the "complex whole" of the local culture.

Anthropologists generally describe culture in terms of a set of interacting systems that perpetuate cultural practices through generations. For

example, kinship systems are one of the basic building blocks of culture, encompassing mate choice, marriage customs, family relationships and obligations, and household composition. Social systems encompass stable non-kin relationships such as voluntary associations. Religions or belief systems provide guidance for relationships between people and the natural world, as well as the unseen or unknown forces that affect people's lives; they exist in all cultures and show an astounding diversity in terms of content and practices. Economic systems and political systems extend relationships beyond the family and household. Though some of these systems and relationships may ultimately encompass global dimensions, cultural anthropologists are primarily concerned with the impact of each of these systems at the local level, in the day-to-day experiences of communities.

The emphasis on understanding local experience has led to the development of an array of field observation methods collectively called "ethnographic" methods. Cultural anthropology is a field-based science that emphasizes direct observation of and participation in a culture as the primary source of knowledge about that culture. Controlled experimentation is rarely an option, for obvious ethical reasons. Instead, emphasis is placed on the collection of detailed, repetitive observations using diverse methods, under diverse conditions, and with diverse community members. Methods include both qualitative and quantitative data collection and analysis techniques. A single study may include a quantitative household census or survey, structured and unstructured open-ended interviews, time-series observations of specific types of behaviors, and detailed observational notes on events such as marriages and funerals. Anthropologists use a process called *triangulation* to compare the results from the various data collection strategies. This is often done during the field research process, such that hypotheses generated from one strategy are investigated using another. This iterative process serves to reduce overall bias and increase the robustness of conclusions.

Within cultural anthropology, a number of subfields overlap. Ethnography is the broadest and encompasses the systematic study of cultures. Medical anthropology focuses specifically on the study of disease and health in the context of cultural systems. Applied anthropology centers on the systematic use of anthropological knowledge

to address contemporary problems. Urban, national, and global anthropology are three closely related subfields that focus on interrelationships at these different levels and how they affect and are affected by the everyday social and cultural lives of people living, acting, and struggling in particular places. Psychological anthropology encompasses the study of cultural, psychological, and social interrelations at all levels. Linguistic anthropology explores language in its social and cultural context.

Cultural anthropologists also work within a variety of theoretical perspectives that range from the strongly scientific and objective to the strongly literary and subjective. Hahn (1999) described anthropological theory as encompassing three major areas:

1. Ecological/evolutionary theory, which claims that the physical environment and human adaptations to it are the principal determinants of sickness and healing
2. Cultural theory, which posits that cultural systems of beliefs, values, and customs are the basic determinants
3. Political/economic theory, which proposes that economic organization and contending relationships of power are the principal forces controlling human sickness and health

The choice of theoretical perspective is driven by the overall goal of the research, with some problems requiring an integration of theories from different perspectives. For example, the intersecting epidemics of substance abuse, violence, and AIDS in impoverished urban settings in the United States led Merrill Singer (1996) to develop the theoretical construct of *syndemics*, comprising synergistic, mutually enhancing health and social problems. The syndemic concept integrates aspects of both ecological and political/economic theories in medical anthropology. It also typifies the anthropological approach by striving to model the relationships among multiple subsystems at the community level.

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(SEE ALSO: *Acculturation; Anthropology in Public Health; Assimilation; Biculturalism; Community*)

Health; Cross-cultural Communication; Cultural Norms; Customs; Ethnicity and Health; Folk Medicine; Lifestyle; Theories of Health and Illness)

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CULTURAL APPROPRIATENESS

Sensitivity to other cultures refers to the awareness of how other ethnic, racial, and/or linguistic groups differ from one's own. Sensitivity can be manifested through knowledge of different languages or manners of speech, norms, and mores, religious beliefs and practices, family structures and dynamics, community decision-making patterns, and class consciousness and socioeconomic realities. Cultural appropriateness puts this sensitivity in action through the tailoring of public health interventions to specific cultures or subcultures. Thus, public- and clinical-health services, health behavior change interventions and social marketing, community organization and empowerment, and even environmental and occupational health approaches are adapted according to the target population to which they will be applied.

HISTORY OF IMPLEMENTATION IN PUBLIC HEALTH

Many countries, including the United States, Canada, Australia, New Zealand, and Argentina, are almost entirely populated by immigrants and their descendants, which juxtaposed with the surviving indigenous populations make them highly diverse. Since World War II, European nations have become far more heterogeneous as well. Yet dominant groups are highly ambivalent about diversity.

This ambivalence may contribute to negative health and social impacts on minority populations.

Concerns about diversity in the United States date from colonial time. As the new nation evolved, the founding fathers saw a need to populate the region with more Europeans (and their African slaves). Hence, the number of immigrants gradually accelerated until the beginning of the Civil War, when over 150,000 newcomers arrived each year. Nevertheless, public health efforts continued to emphasize the needs of the dominant population. Efforts directed toward disadvantaged and diverse groups were based more in controlling the spread of diseases that they might have had rather than in promoting their health itself. In the twenty-first century, immigrants continue to arrive in the United States and other industrialized countries at a record pace. Moreover they are now far more likely to come from Latin America, Asia, or Africa. Together these phenomena make the issues of cultural sensitivity and appropriateness more relevant than ever.

RELATIONSHIP TO HEALTH

Cultural sensitivity (or the inability to achieve it) may impact the health of individuals and populations in many ways. Social isolation—low or poor interaction with the surrounding society—may result in underutilization of health care. Social isolation may stem from a variety of factors such as a lack of transportation or financial resources, fear of being deported due to documentation status, or physical distance from the community. As a whole, social isolation, poverty, and lack of health care coverage may encourage individuals to postpone professional treatment in the hopes that the illness will resolve itself.

Even when care to the disadvantaged population is provided, it may be inadequate. Cultural and linguistic barriers may contribute to inadequate health care by limiting the ability of the provider to understand the patient and his or her symptoms, and result in an inappropriate course of treatment.

When considering various models of health behavior among immigrants, the ethnic context of their origin must be addressed. In most cases, theories of behavior change are normalized on

stable, English-speaking middle-class populations. But these models of individuals as relatively autonomous beings who weigh potential personal outcomes, their own “self” efficacy, and their personal readiness to change, while at the same time choosing whether to listen to or ignore pressure from peers, may have little relevance to diverse communities, who often have a strong sense of identification with and attachment to their families, both nuclear and extended. The design of health messages must acknowledge this attachment. Dramatic differences among ethnic and racial minorities in terms of language and literacy, religion and family orientation, acculturation and experience with the dominant culture, and socioeconomic and legal status must also be considered.

Health officials and providers may be ignored as message sources, perceived to be unaware of the patient’s culture, or even perceived as siding with hostile law enforcement. Formal health promotion programs typically rely on broadcast and print channels intended for non-English-speaking or immigrant communities. Many of these barriers can be surmounted by the use of community health advisors (CHAs) who come from the communities they serve and yet are sufficiently comfortable with the host culture to be able to understand and redirect health messages to their communities.

Cultural appropriateness is often manifested through attention to the literacy needs of a population. Current health instructional approaches and materials are typically designed for relatively educated individuals highly literate in English. Materials in non-English languages are largely direct translations from English and are often not culturally or even linguistically appropriate. Health communication messages aimed at immigrant or minority communities will often specify the audience’s ethnicity in an attempt to render the communication more interesting, attractive, and acceptable to the audience.

Attention to religious beliefs in health communication efforts may be especially important given the central role that these beliefs and related practices may play in the concepts of illness, recovery, and wellness (received characteristics) as well as the potential for using the place of worship as a source for the message itself. Providers must also determine the specific roles of the family members

and incorporate this knowledge into any treatment regimen. Adherence to the regimen is unlikely to occur unless the family trusts the provider and thinks that his or her recommendations are valuable and important.

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(SEE ALSO: *Anthropology in Public Health; Cross-Cultural Communication, Competence; Cultural Factors; Lay Concepts of Health and Illness*)

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CULTURAL FACTORS

Culture encompasses the set of beliefs, moral values, traditions, language, and laws (or rules of behavior) held in common by a nation, a community, or other defined group of people. Culturally determined characteristics include: the language spoken at home; religious observances; customs (including marriage customs that often accompany religious and other beliefs); acceptable gender roles and occupations; dietary practices; intellectual, artistic, and leisure-time pursuits; and other aspects of behavior. In the United States, and in other nations with large immigrant populations, there is a wide range of cultural diversity, religious

beliefs, customs, and values, reflecting the scattered origins of the people. The “melting-pot” concept of nationality reduces this diversity with successive generations, but considerable variation remains—distinguishing rural from urban, African American from European, East Asian from South Asian, religious believers from secularists.

Anthropologists and epidemiologists have identified many associations between culture, customs, and risks to health. Those who, for religious reasons, abstain from tea, coffee, alcohol, and tobacco have smaller risks of getting cancer of the gastrointestinal or respiratory tract than others of similar social, economic, and residential background. Seventh-day Adventists, who are strict vegetarians and are very health conscious have low death rates from coronary heart disease when compared to neighbors of similar socioeconomic backgrounds. Though often called “lifestyle factors,” in such cases these differences are culturally determined because the related behaviors are associated with religious beliefs and practices. Jews who practice circumcision have lower incidence and death rates than gentiles from cancer of the male genital tract, perhaps related to sexual hygiene and reduced risk of infection with carcinogenic viruses.

Many cultural characteristics, and the health states related to them, are associated with education, occupation, income, and social status. These factors influence one’s awareness of the world, and whether one will seek improvement or accept things as they are. Well-educated white-collar workers may be more aware of the benefits of exercise than those lacking education—they are more likely to play than watch sports, and are more likely to have better-paying jobs that enable them to afford sporting equipment. Values related to these perceptions also shape the relative priority accorded to intellectual versus athletic pursuits, motivating some working-class parents to encourage their children to study and remain in school in hopes of a better life for the children than the parents have had. The clash of competing values between environmental sustainability and economic development also has a cultural component. Appreciation of the fact that health is ultimately dependent on the integrity of the earth’s life-supporting ecosystems is part of a value system. Such values may sometimes be over-ridden by short-term priorities such as job security or financial gain.

Much can be learned about the linkages between culture and health by studying migrant populations, whose culture of origin is often very different from the culture into which they migrate. Japanese migrants to California and Hawaii were found to have higher rates of coronary artery disease than their counterparts in Japan. Part of this difference could be attributed to changes in risk factors such as diet, weight, and cholesterol levels. However, loss of a stable, cohesive social environment also appears to have contributed to the rise in prevalence of coronary artery disease in the migrant groups. In another study, blood pressure values among African Americans from the southern United States who migrated to an urban environment were compared with that of urban-born African Americans. The longer the period of city life, the higher was their blood pressure. Many studies have shown that immigrants have higher rates of mental illness, probably due to the tremendous stresses of living in a new cultural environment. Cultural groups that have a strong group identity and cohesion seem to be somewhat protected against this type of stress.

Culturally shaped illnesses are disorders that reflect the social, political, and moral worlds of the patient. They also often represent ways in which deep cultural messages are transmitted through the medium of the human body. For example, among Latino populations in Central America and the United States, anthropologists describe “ataques de nervios,” an illness characterized by symptoms such as shaking, a feeling of heat in the chest, difficulty in moving the limbs, and parasthesias. Among Latino immigrants in the United States, anthropologists have linked the illness to the sense of social and political disempowerment that these people experience. Other culturally shaped illnesses include: “heart distress” in Iran; “semen loss” in South Asia; and “susto” in Latin America. Anthropologists study the symbolic meaning of symptoms within specific cultural contexts in order to understand the cultural messages these illnesses express.

Cultural context can profoundly affect the transmission of disease. A tragic example is the spread of HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome), particularly in Africa, where economic necessity shapes choices that are often hazardous to health. The

combination of limited education, migratory labor that separates men from their wives and families, and the breakdown of traditional family networks creates a context in which men may seek multiple sexual partners. Women often lack the social power to negotiate condom use, and their need for economic and social survival outweighs the risk that they know they are taking by having unprotected intercourse. In Thailand, where culturally condoned intravenous drug use is widespread among the large population of sex workers, HIV/AIDS and other blood-borne viral diseases became epidemic in the 1990s, creating a national public health emergency.

The health of girls and women is particularly sensitive to cultural influences. In societies where women are able to make decisions for themselves, especially about their education and their reproductive choices, have longer life expectancy, lower fertility rates, and better overall health. When political totalitarianism and religious zealotry flourish, women usually suffer oppression disproportionately compared to men, and this can adversely affect their health and longevity.

Patriarchal values can also be harmful to the health of girls and women. Such values have a pervasive influence in many settings, mainly in traditional agricultural societies, but also in some urbanized economies. In some strict Islamic societies where girls and women are segregated and allowed to appear in public only if totally covered from head to toe, deprivation of sunlight can impair the cutaneous synthesis of vitamin D, causing a deficiency of this vitamin and putting the women at risk for rickets or osteomalacia.

Another cultural practice with severe health consequences is female genital mutilation, which is performed on young girls in many African and Middle Eastern nations. In its most extreme form, the procedure can be life threatening. It deprives women of sexual fulfillment and makes childbirth a hazardous process for both mother and infant. While performed in many predominantly Islamic countries, this procedure is not a religious ritual, and is not condoned by any Islamic scripture. Anthropologists have described the complex cultural meanings of ritual purity associated with female genital mutilation that serve to perpetuate this practice despite its serious adverse effects on

health. The majority of women and men in cultures that perform genital mutilation support the continuation of the practice which makes change all the more difficult. Both international and national efforts are underway to stop or change this practice, with some of the most promising initiatives coming from within the cultures themselves. Female genital mutilation was banned in the United States in 1995, and is also outlawed in Britain, France, Canada, Sweden, Switzerland, and some African countries.

In Western societies the female body is often altered for cultural reasons. Women in the nineteenth century constricted their waists and compressed their breasts with rigid corsets. Many women today wear high heels and tight shoes that deform their feet, with painful consequences in old age. Some undergo painful cosmetic surgery in the quest for an idealized physical form, with reshaped ears, eyes, and nose; facelifts; liposuction; and breast implants. Some girls and women strive to achieve a very low body weight, a modern, culturally shaped notion of beauty that has supplanted the former "ideal"—the plump female form depicted in the paintings of Rubens and Renoir. The pursuit of very low body weight may be associated with the development of anorexia nervosa, an illness that can be fatal. Men in Western society in the late twentieth century also began seeking an "improved" body image by taking muscle-enhancing steroids or having muscle grafts to enlarge pectoral and calf muscles.

In modern industrial societies an adolescent culture has developed. This culture often fosters rebelliousness and defiance of adult authority figures, leading some young people to smoke, take drugs, and expose themselves to dangerous and unhealthy practices. Such actions have, unfortunately, often been encouraged by the tobacco industry and advertisers of beer and other alcoholic drinks. The pervasive influence of the media, especially television, in almost all contemporary societies projects cultural values and behavior that emanate from the American entertainment industry. Many of these messages, such as encouraging the use of mood-altering substances and sexual promiscuity, are potentially harmful to health.

Public health specialists must be aware of these and other cultural trends, and they must endeavor to mobilize beneficial cultural influences

while discouraging unhealthy ones. The task of public health professionals is particularly challenging when influential and economically motivated interests glorify aspects of culture that are harmful to health.

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(SEE ALSO: *African Americans; Anthropology in Public Health; Asian Americans; Assimilation; Cultural Anthropology; Ethnicity and Health; Folk Medicine; Hispanic Cultures; Race and Ethnicity; Theories of Health and Illness; Traditional Health Beliefs, Practices; Women's Health*)

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CULTURAL IDENTITY

The classic definition of culture, written in 1871 by Edward Burnett Tylor, states that "culture . . . is that complex whole which includes knowledge, belief, art, morals, law, customs, and any other capabilities and habits acquired by man as a member of society" (*Primitive Culture*). In 1952, Kroeber and Kluckhohn cited 164 definitions of culture, ranging from "learned behavior" to "ideas in the mind." Culture depends upon an ability, possessed by humans alone, called symboling, which consists of "assigning to things and events certain meanings that cannot be grasped with the senses alone." (*Encyclopaedia Britannica* 1997, p. 847). Language is an example of symboling.

CULTURAL DIVERSITY IN THE UNITED STATES

For more than two hundred years, the United States has been the most culturally diverse country in the world. At the beginning of the twenty-first

century, this diversity grew with the influx of more and more cultures from around the globe. Racial and ethnic minorities have been the fastest-growing segments of the U.S. population, making up almost 23 percent of the total population in 1990 and 25 percent of the population in 2000. Non-white children accounted for one-third of all children under nineteen in the United States in the year 2000.

Culture can affect how chronic and disabling conditions are defined and treated. For example, white Americans typically emphasize physical survival and functional capacity, and they therefore tend to battle against chronic conditions and disabilities that they see as being inflicted on them. In contrast, many Asian cultures emphasize living in harmony with nature; a chronic condition is therefore seen as part of the normal cycle of life. A person's culturally based health beliefs and practices determine what problems are recognized as needing traditional Western medical care, and whether someone will follow through with prescribed treatment, change lifestyle behaviors, or reduce exposure to environmental factors associated with an illness. Because of historic inequalities and racism in the health care system, many African Americans delay seeking health care. Beliefs about health and illness also influence community responses to health communication messages designed to promote health and prevent disease. Language and cultural differences often hinder communication between public health professionals and members of minority populations.

To understand cultural identity in the context of public health it is important to focus on the worldviews of the communities and people in need of health services. The meaning of words used to describe disease and adaptive behaviors needed to maintain good health must be examined in the light of a diverse cultural environment. People live their lives as simultaneous members and participants in a multiplicity of social contexts. An individual's cultural identity can be shaped not only by race and ethnicity, but also by age, gender, family configuration, religion, socioeconomic status, education, occupation, sexual orientation, political ideology stage of acculturation, and place of upbringing (rural, urban, or suburban).

Epidemiology enables public health professionals to systematically assess the health status of

various populations. However, when morbidity and mortality data is used without an appreciation for the social context, unintended consequences can result. For example, it is not uncommon to use surveillance data to describe populations as “intravenous drug users,” “homeless,” “high risk,” and “hard to reach.” While such categorization enables public health professionals to focus scarce resources where the need is greatest, it also stigmatizes the very people in greatest need of assistance. Ethnic and racial minority populations have historically suffered from the way in which public health data is presented to the policy makers and the general public. A prominent example of this is the figures regarding “crack mothers” and “crack babies” made prevalent by the media in the 1990s.

DISPARITIES IN HEALTH STATUS

The disparity in health status between black and white Americans was not new when it was documented in the *Report of the Secretary's Task Force on Black and Minority Health* (U.S. Department of Health and Human Services, 1985). This task force identified the six leading causes of preventable excess death for minority populations as cancer, cardiovascular disease, diabetes, infant mortality, chemical dependency, and homicide/unintentional injury. The report developed the descriptive term *excess death*, which was defined as the difference between number of deaths in minority populations and what would be expected in the majority population; by this standard, blacks experienced 42 percent excess mortality compared to whites. In 1985 these findings led to the creation of the Office of Minority Health within the U.S. Department of Health and Human Services.

In 1998, President Bill Clinton announced a new initiative that set a national goal of eliminating longstanding racial and ethnic disparities in health status by the year 2010. The president announced that the federal government would, for the first time, set high national health goals for all Americans, ending a practice of separate, lower goals for the racial and ethnic minorities. To help reach these ambitious targets, a five-step plan was put in place to mobilize the resources and expertise of the federal government, the private sector, and local communities to eliminate disparities that had long been treated as intractable.

Since culture influences how communities view and take action on disease conditions, public health professionals will increasingly need to understand the cultural context in which disease prevention and health promotion strategies are delivered. The fear and mistrust that shape the behavior and attitudes of many people of color must be addressed if disparities in health care delivery are to be eliminated.

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(SEE ALSO: *Access to Health Services; African Americans; Asian Americans; Cultural Appropriateness; Cultural Factors; Ethnicity and Health; Ethnocentrism, Minority Rights; Prejudice*)

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CULTURAL NORMS

Passed from one generation to the next, cultural norms are the shared, sanctioned, and integrated systems of beliefs and practices that characterize a cultural group. These norms foster reliable guides for daily living and contribute to the health and well-being of the group. As prescriptions for correct and moral behavior, cultural norms lend meaning and coherence to life, as well as the means to achieve a sense of integrity, safety and belonging.

Thus, normative beliefs, together with related values and rituals, confer a sense of order and control upon aspects of life that might otherwise appear chaotic or unpredictable.

Cultural norms are woven into interpretations and expressions of health and illness through dynamic, interactive relationships at all levels of influence—from the gene to the society. Cultural norms often mediate the relationship between ethnicity and health, even effecting gene expression through such practices as marriage rules, lifestyle choices, and environmental exposures. At the individual and group levels, cultural norms have a substantial role in health-related behaviors such as dietary practices, tobacco use, and exercise. Conversely, health can influence cultural norms, as illustrated by Jewish dietary laws governing *kashrut* (keeping kosher) that were an adaptive response to parasitic diseases centuries ago, yet are still widely practiced today.

Cultural systems, as adaptive tools, change in response to external cues, as evident in the transmutations that occur in norms as diverse groups interact and influence one another. Practices are also adapted to new environments as a response to immigration or technology, such as the genetic engineering of foods that may increase crop resistance to disease or drought and thus alter moral messages of crop failures. Such natural occurrences may have been interpreted as due to retribution for transgressions against the social religious order of a society. Another instance may be greater size and weight of a group after one or two generations due to an abundance of food sources (e.g., meat, vegetables, and fruit) leading to cardiovascular disease or diabetes.

An individual or group's relationship to the contemporary Western health care system is steeped in cultural norms. Utilization patterns or adherence to treatment protocols may be mediated by a traditional orientation to health and disease, by particular conceptions regarding the authority of clinicians, or by what is considered acceptable communication between patients and practitioners. Cultural differences also affect the responsiveness of the health care system to diverse patient populations. Inequities in access to adequate/optimal health care are a major cause of health disparities among racial and ethnic minorities in the United States. While the extent is not

known, many inequities in health outcomes are due to incompatibilities between the beliefs, values, and cultural norms of the growing minority population segments and the culture of Western biomedicine.

Public health research has yet to fully recognize the importance of such cultural norms for health outcomes or the need to question these relationships on a broad integrated scale. Consequently, the field of public health has little to guide practice in this regard. In fact, recognition of the considerable disparities in health status associated with racial, ethnic, and cultural diversity is relatively recent. One of the first comprehensive accounts of racial and ethnic disparities in health was published in 1986, in the *Report of the Secretary's Task Force on Black and Minority Health* (U.S. Department of Health, Education, and Welfare 1986).

Documentation of the extent and nature of health-status differences have improved, and research and interventions targeting ethnic minorities have increased since 1985. Still, public health policies and programs often fail to address cultural and ethnic differences—as distinct from racial differences—that are critical to the delivery of health care and to the promotion of health for many at-risk communities. These persistent disparities, coupled with extraordinary demographic growth in some of the most underserved populations, led to the 1999 President's Initiative on Race which notes the critical role of “culturally-sensitive implementation strategies” (U.S. Department of Health and Human Services 1999).

One barrier to improved understanding of the role of cultural norms in health is the common failure to distinguish between race, ethnicity, and culture. These concepts are often used interchangeably, implying that racial categories have scientific validity, and that one's membership in these homogeneous racial groupings has an overriding significance to health outcomes. Neither is true. The evidence indicates that variations within cultural, socioeconomic, and political groups have far more relevance to health behavior, risk, and status than differences between groups. Progress has clearly been made, however, since the “first generation” of health promotion studies conducted from the 1960s through the early 1980s. During this time, research focused on reducing health

risks through interventions aimed at broad population segments—predominately at the white middle class. Little or no differentiation was made in terms of targeting different cultural populations.

In the late 1980s and 1990s, the “second generation” of health promotion studies were immersed in racial and ethnic group differences. These studies mainly focused on descriptive and intervention studies of African-American and Hispanic populations, but they showed little ability to distinguish universal from culturally specific factors, both because of the heterogeneity of these populations and the imprecise use of the concepts of race, ethnicity, and culture.

Current theories used to explain behavior and inform health-promoting interventions, however, continue to be founded on an assumption of universality (commonalities in human behavior across groups). This monocultural view of health behavior is based on Eurocentric cultural values of autonomy and individuality, as noted, for example, in the Patient’s Bill of Rights (Annas 1998) and the Belmont Report (USDHEW 1979). This focus on individuality also frames how professionals are educated to provide care and how patients are expected to respond within the system. Yet these values are based upon a particular cultural construction of reality that is antithetical to many other cultures in which the needs of the group supersede the importance of the individual. This focus on individual autonomy is increasingly recognized as too restrictive to be valid or functional to predict behavior or to design effective interventions in cultural groups other than those for whom these theories and models were developed.

The need for a “third generation” of health-promotion studies has been suggested to elucidate similarities and differences through cross-cultural research that distinguishes among more meaningful subgroups based on cultural norms and other relevant shared characteristics. In this way, interventions to improve access to care and promote health could not only be targeted more precisely to those in need, but could be tailored to appropriate cultural norms, thus providing a greater likelihood of acceptability, relevance, and success. With increasing clarity in the role and nature of cultural norms as they relate to health, advances will be evident in public health interventions that recognize, respect, and respond to the similarities and

differences throughout all segments of American society.

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(SEE ALSO: *Acculturation; Attitudes; Behavior, Health-Related; Biculturalism; Community Health; Cross-Cultural Communication, Competence; Cultural Appropriateness; Cultural Factors; Cultural Identity; Customs; Health Promotion and Education; Lifestyle; Predisposing Factors; Race and Ethnicity; Theories of Health and Illness*)

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CUSTOMS

Public health workers consider the customs of people and communities, especially when they try to encourage the acceptance of health promotion and disease prevention programs or policies. Customs are more than aggregates of individual habits. They are regular, patterned, learned, and traditional ways of appearing or behaving in response to a given situation or occasion. Customs may be reflected in language, greetings, communications, religion, and certainly in health practices that distinguish one social group from another. The complexity of the study of customs was emphasized by the anthropologist Ruth Benedict, who noted in the 1930s that traditional customs the world over consist of a mass of detailed behaviors more varied than that which any one person could ever evolve individually.

Customs are derived from social norms, which are those rules or standards that guide, control, or regulate proper and acceptable behavior of a group. These norms define the shared expectations of a group and enable people to anticipate how others will interpret and respond to their words and actions if there is deviation from a custom. For example, if one has an infectious disease, typically the custom within the general community is to act in a manner to prevent infecting others. Failing that, the customary responses from others may range from ignoring the individual's behavior, verbally reprimanding, or even ostracizing him or her for threatening the health of other members.

A custom may exist at the level of a folkway or a more. Each of these concepts help demarcate the strength and importance of a custom held by a

particular group relevant to a particular situation. The concept of folkways was developed by the American sociologist William Graham Sumner and his followers in the early 1900s. "The ways of the folk" arose and persisted over time as repetitive and accumulative patterns of expected behavior for responding to similar social situations or individual needs. They ultimately became incorporated into tradition and received some degree of formal recognition but were not considered of moral significance. Folkways may be reflected in the everyday habits and conventions people obey without giving much thought to the matter, for example, eating three meals a day, drinking alcohol but not to a state of drunkenness, or using the group's "right way" to cure disease. People who violate folkways may be labeled eccentrics and as a rule they are tolerated by the group.

When certain folkways become well established and are regarded by general agreement as highly important and obligatory, as evidenced by strong sentiments against deviation and by severe punishment for violation, they become mores. Mores are customs that represent the absolute truth to the particular group and are the norms people consider vital to their well being and to their most cherished values. They typically take the form of laws, for example, prohibitions against incest, drunk driving, and child abuse. In contrast to folkways, violations of mores by people or groups can provoke intense reactions ranging from being ostracized, beaten, jailed, exiled, or executed.

From the moment of birth, the customs into which the people are born shape their experiences and behavior. In many groups, health-related behavior may be custom bound and very normative—tradition sets the precedent and solves problems, whether by authority or by consensus. Individuals are required to learn about the specific customs that shape their health behavior and to perform what they have learned. In reality, however, by the time children can think independently, the health-related customs of the family group have become an intimate part of their personalities. They do not question these customs, which become deeply held and extremely difficult to change over time. For example, the manner of tobacco, alcohol, and drug use in some groups and communities have become customs or norms, even though such use carries major health risks. Any attempts to eliminate or modify or reverse behaviors so integrally

tied to social customs often provokes hostile resistance to a new health program that intends to reduce health-related risks. Also, in many groups the custom is not to talk about certain sensitive topics, such as cancer or the sexual activities of adults or teenagers relevant to preventing pregnancy. For instance, in a particular ethnic group, the custom of its members may be to shun any discussion of cancer. The effect of this custom discourages individuals from initiating early screening behaviors that could save their lives.

Sometimes it is necessary to try to change or circumvent established customs in a community, particularly when this can bring modern health procedures for reducing particular health-related risks. Changing folkways and mores can be a very slow process, and it is not until their functional utility has disappeared that they may gradually change. New practices may then become embedded in the community as new values to be transmitted from one generation to the next. This requires public health workers to gradually adapt the customs and values of a community rather than trying to abruptly and totally change them.

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(SEE ALSO: *Acculturation; Assimilation; Benefits, Ethics, and Risks; Cultural Norms; Ethics of Public Health; Ethnicity and Health; Immigrants, Immigration*)

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CYTOMEGALOVIRUS DISEASE

As the name indicates, cytomegalovirus (CMV) disease is a virus infection. It is caused by herpes virus type 5, and it takes two forms. Intrauterine infection of the fetus is a very serious, often lethal, condition that affects a small proportion (about 5–10%) of infants whose mothers contract the infection during pregnancy. In the United States this is about 0.5 to 1.0 percent of all pregnancies. When it is not fatal, the infant may suffer from permanent neurological damage, as well as damage to the eyes, liver, lungs, and other organs. CMV infection is also a serious risk following organ and bone-marrow transplants. The risk is greatest when the donor is seropositive (i.e. a carrier) and the recipient is seronegative. A third category of CMV infection can occur as a complication of AIDS (acquired immunodeficiency syndrome).

CMV is transmitted mainly by intimate personal contact of an infected and an uninfected mucosal surface during sexual intercourse, by body secretions, and in feces. The incubation period is several weeks, and infected individuals remain capable of transmitting the virus for many months, perhaps for life. Antiviral agents may arrest the progress of the disease, but by far the most important actions are preventive, including careful attention to hygiene at all times. Universal precautions are highly desirable in handling all suspected or potentially contaminated body secretions.

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(SEE ALSO: *Communicable Disease Control; HIV/AIDS; Maternal and Child Health; Pregnancy*)

ISBN 0-02-865350-5



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