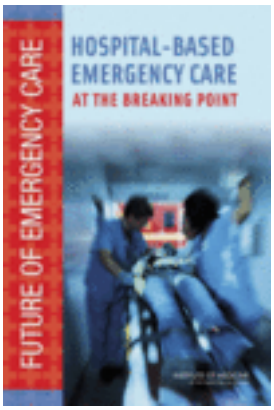

Hospital-Based Emergency Care: At the Breaking Point

Committee on the Future of Emergency Care in the United States Health System

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Future of Emergency Care Series

Hospital-Based Emergency Care

At the Breaking Point

Committee on the Future of Emergency Care in the United States Health System

Board on Health Care Services

INSTITUTE OF MEDICINE
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Willing is not enough; we must do."
—Goethe

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This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

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Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of this report was overseen by **Enriqueta C. Bond**, Burroughs Wellcome Fund, and **Don E. Detmer**, American Medical Informatics Association. Appointed by the National Research Council and the Institute of Medicine, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

FOREWORD

The state of emergency care affects every American. When illness or injury strikes, Americans count on the system to respond with timely and high quality care. Yet today, the emergency and trauma care that Americans receive can fall short of what they expect and deserve.

Emergency care is a window on health care, revealing both what is right and what is wrong with our delivery system. Americans rely on hospital emergency departments in growing numbers because of the skilled specialists and advanced technologies they offer. At the same time, the increasing use of the emergency care system also represents failures of the larger health care system—the growing numbers of uninsured Americans, the limited alternatives available in many communities, and the inadequate preventive care and chronic care management received by many. These demands can degrade the quality of emergency care and hinder its ability to provide urgent and life-saving care to seriously ill and injured patients wherever and whenever they need it.

The Committee on the Future of Emergency Care in the United States Health System, ably chaired by Gail Warden, set out to: examine the emergency care system in the United States; explore its strengths, limitations, and future challenges; describe a desired vision of the emergency care system; and recommend strategies required to achieve that vision. Their efforts build on past contributions, including the landmark National Research Council report, *Accidental Death and Disability: The Neglected Disease of Modern Society* in 1966, *Injury in America* in 1985, and *Emergency Medical Services for Children* in 1993.

The committee's task was to examine the full scope of emergency care, from 9-1-1 and medical dispatch, to hospital-based emergency and trauma care. The three reports in the series—*Hospital-Based Emergency Care: At the Breaking Point*, *Emergency Medical Services At the Crossroads*, and *Emergency Care for Children: Growing Pains*—provide three different perspectives on the emergency care system. The series as a whole unites the often-fragmented prehospital and hospital-based systems under a common vision for the future of emergency care.

As the committee prepared its reports, federal and state policymakers turned their attention to the possibility of an avian flu pandemic. Americans are asking, "Are we, as a nation, prepared?" The emergency care system is on the front lines of surveillance and treatment. The more secure and stable our emergency care system, the better prepared we will be to handle any possible outbreak. In this light, the recommendations presented in these reports take on urgency. The guidance offered here can assist all of the stakeholders in emergency care—consumers, policymakers, providers, and educators—to chart the future of emergency care in the U.S.

Harvey V. Fineberg, M.D., Ph.D.
President, Institute of Medicine
June 2006

PREFACE

Emergency care has made important advances in recent decades: emergency 9-1-1 service now links virtually all ill and injured Americans to immediate medical response; organized trauma systems transport patients to advanced, life-saving care within minutes; and advances in resuscitation and life-saving procedures yield outcomes unheard of just two decades ago. Yet just under the surface, a growing national crisis in emergency care is brewing. Emergency departments (EDs) are frequently overloaded, with patients sometimes lining hallways and waiting hours and even days to be admitted to inpatient beds. Ambulance diversion, in which overcrowded EDs close their doors to incoming ambulances, has become a common, even daily problem in many cities. Patients with severe trauma or illness are often brought to the ED only to find that the specialists needed to treat them are unavailable. The transport of patients to available emergency care facilities is often fragmented and disorganized, and the quality of emergency medical services (EMS) is highly inconsistent from one town, city, or region to the next. In some areas, the system's task of caring for emergencies is compounded by an additional task: providing non-emergent care for many of the 45 million uninsured Americans. Furthermore, the system is ill prepared to handle large-scale emergencies, whether a natural disaster, an influenza pandemic, or an act of terrorism.

This crisis is multifaceted and impacts every aspect of emergency care—from prehospital EMS to hospital-based emergency and trauma care. The American public places its faith in the ability of the emergency care system to respond appropriately whenever and wherever a serious illness or injury occurs. But while the public is largely unaware of the crisis, it is real and growing.

The Institute of Medicine's Committee on the Future of Emergency Care in the United States Health System was convened in September 2003 to examine the emergency care system in the United States, to create a vision for the future of the system, and to make recommendations for helping the nation achieve that vision. The committee's findings and recommendations are presented in the three reports in the *Future of Emergency Care* series:

- ***Hospital-Based Emergency Care: At the Breaking Point*** explores the changing role of the hospital ED and describes the national epidemic of overcrowded EDs and trauma centers. The range of issues addressed includes uncompensated emergency and trauma care, the availability of specialists, medical liability exposure, management of patient flow, hospital disaster preparedness, and support for emergency and trauma research.
- ***Emergency Medical Services At the Crossroads*** describes the development of EMS over the last four decades and the fragmented system that exists today. It explores a range of issues that affect the delivery of prehospital EMS, including communications systems; coordination of the regional flow of patients to hospitals and trauma centers; reimbursement of EMS services; national training and credentialing standards; innovations in triage, treatment, and transport; integration of all components of EMS into disaster preparedness, planning, and response actions; and the lack of clinical evidence to support much of the care that is delivered.
- ***Emergency Care for Children: Growing Pains*** describes the special challenges of emergency care for children and considers the progress that has been made in this area in the 20 years since the establishment of the federal Emergency Medical Services for Children (EMS-C) program. It addresses how issues affecting the emergency care system generally have an even greater impact on the outcomes of critically ill and injured children. The topics addressed include the state of pediatric readiness, pediatric training and standards of care in emergency care, pediatric medication issues, disaster preparedness for children, and pediatric research and data collection.

THE IMPORTANCE AND SCOPE OF EMERGENCY CARE

Each year in the United States approximately 114 million visits to EDs occur, and 16 million of these patients arrive by ambulance. In 2002, 43 percent of all hospital admissions in the United States entered through the ED. The emergency care system deals with an extraordinary range of patients, from febrile infants, to business executives with chest pain, to elderly patients who have fallen.

EDs are an impressive public health success story in terms of access to care. Americans of all walks of life know where the nearest ED is and understand that it is available 24 hours a day, 7 days a week. Trauma systems also represent an impressive achievement. They are a critical component of the emergency care system since approximately 35 percent of ED visits are injury-related, and injuries are the number one killer of people between the ages of 1 and 44. Yet the development of trauma systems has been inconsistent across states and regions.

In addition to its traditional role of providing urgent and life-saving care, the emergency care system has become the "safety net of the safety net," providing primary care services to millions of Americans who are uninsured or otherwise lack access to other community services. Hospital EDs and trauma centers are the only providers required by federal law to accept, evaluate, and stabilize all who present for care, regardless of their ability to pay. An unintended but predictable consequence of this legal duty is a system that is overloaded and underfunded to carry out its mission. This situation can hinder access to emergency care for insured and uninsured alike, and compromise the quality of care provided to all. Further, EDs have become the preferred setting for many patients and an important adjunct to community physicians' practices. Indeed, the recent growth in ED use has been driven by patients with private health insurance. In addition to these responsibilities, emergency care providers have been tasked with the enormous challenge of preparing for a wide range of emergencies, from bioterrorism to natural disasters and pandemic disease. While balancing all of these tasks is difficult for every organization providing emergency care, it is an even greater challenge for small, rural providers with limited resources.

Improved Emergency Medical Services: A Public Health Imperative

Since the Institute of Medicine (IOM) embarked on this study, concern about a possible avian influenza pandemic has led to worldwide assessment of preparedness for such an event. Reflecting this concern, a national summit on pandemic influenza preparedness was convened by Department of Health and Human Services Secretary Michael O. Leavitt on December 5, 2005, in Washington D.C., and has been followed by statewide summits throughout the country. At these meetings, many of the deficiencies noted by the IOM's Committee on the Future of Emergency Care in the United States Health System have been identified as weaknesses in the nation's ability to respond to large-scale emergency situations, whether disease outbreaks, naturally occurring disasters, or acts of terrorism. During any such event, local hospitals and emergency departments will be on the front lines. Yet of the millions of dollars going into preparedness efforts, a tiny fraction has made its way to medical preparedness, and much of that has focused on one of the least likely threats—bioterrorism. The result is that few hospital and EMS professionals have had even minimal disaster preparedness training; even fewer have access to personal protective equipment; hospitals, many already stretched to the limit, lack the ability to absorb any significant surge in casualties; and supplies of critical hospital equipment, such as decontamination showers, negative pressure rooms, ventilators, and intensive care unit beds, are wholly inadequate. A system struggling to meet the day-to-day needs of the public will not have the capacity to deal with a sustained surge of patients.

FRAMEWORK FOR THIS STUDY

This year marks the fortieth anniversary of the publication of the landmark National Academy of Sciences/National Research Council report, *Accidental Death and Disability: The Neglected Disease of Modern Society*. That report described an epidemic of automobile-related and other injuries, and harshly criticized the deplorable state of trauma care nationwide. The report prompted a public outcry, and stimulated a flood of public and private initiatives to enhance highway safety and improve the medical response to injuries. Efforts included the development of trauma and prehospital EMS systems, creation of the specialty in emergency medicine, and establishment of federal programs to enhance the emergency care infrastructure and build a research base. To many, the 1966 report marked the birth of the modern emergency care system.

Since then, the National Academies and the Institute of Medicine (IOM) have produced a variety of reports examining various aspects of the emergency care system. The 1985 report *Injury in America* called for expanded research into the epidemiology and treatment of injury, and led to the development of the National Center for Injury Prevention and Control within the Centers for Disease Control and Prevention. The 1993 report *Emergency Medical Services for Children* exposed the limited capacity of the emergency care system to address the needs of children, and contributed to the expansion of the Emergency Medical Services for Children program within the Department of Health and Human Services. It has been 10 years, however, since the IOM examined any aspect of emergency care in depth. Furthermore, no National Academies report has ever examined the full range of issues surrounding emergency care in the United States.

That is what this committee set out to do. The objectives of the study were to (1) examine the emergency care system in the United States; (2) explore its strengths, limitations, and future challenges; (3) describe a desired vision for the system; and (4) recommend strategies for achieving this vision.

STUDY DESIGN

The IOM Committee on the Future of Emergency Care in the United States Health System was formed in September 2003. In May 2004, the committee was expanded to comprise a main committee of 25 members and three subcommittees. A total of 40 main and subcommittee members, representing a broad range of expertise in health care and public policy, participated in the study. Between 2003 and 2006, the main committee and subcommittees met 19 times; heard public testimony from nearly 60 speakers; commissioned 11 research papers; conducted site visits; and gathered information from hundreds of experts, stakeholder groups, and interested individuals.

The magnitude of the effort reflects the scope and complexity of emergency care itself, which encompasses a broad continuum of services that includes prevention and bystander care; emergency calls to 9-1-1; dispatch of emergency personnel to the scene of injury or illness; triage, treatment, and transport of patients by ambulance and air medical services; hospital-based emergency and trauma care; subspecialty care by on-call specialists; and subsequent inpatient care. Emergency care's complexity can be also be traced to the multiple locations, diverse professionals, and cultural differences that span this continuum of services. EMS, for example, is unlike any other field of medicine—over one-third of its professional workforce consists of volunteers. Further, EMS has one foot in the public safety realm and one foot in medical care, with nearly half of all such services being housed within fire departments. Hospital-based emergency care is also delivered by an extraordinarily diverse staff—emergency physicians, trauma surgeons, critical care specialists, and the many surgical and medical subspecialists who provide services on an on-call basis, as well as specially trained nurses, pharmacists, physician assistants, nurse practitioners, and others.

The division into a main committee and three subcommittees made it possible to break down this enormous effort into several discrete components. At the same time, the committee sought to examine emergency care as a comprehensive system, recognizing the interdependency of its component parts. To this end, the study process was highly integrated. The main committee and three subcommittees were

designed to provide for substantial overlap, interaction, and cross-fertilization of expertise. The committee concluded that nothing will change without cooperative and visionary leadership at many levels and a concerted national effort among the principal stakeholders—federal, state, and local officials; hospital leadership; physicians, nurses, and other clinicians; and the public.

We hope that the reports of the Future of Emergency Care Series stimulate increased attention and reform to the emergency care system in the United States. I wish to express my appreciation to the members of the committee and subcommittees and the many panelists who contributed input to the meetings, and to the IOM staff for their time, effort, and commitment to the development of these important reports.

Gail L. Warden
Chair

ACKNOWLEDGMENTS

The Future of Emergency Care series benefited from the contributions of many individuals and organizations. The Committee and IOM staff take this opportunity to recognize and thank those who helped during the development of the reports.

A large number of individuals assembled materials that helped the committee develop the evidence base for its analyses. The committee appreciates the contributions of experts from a variety of organizations and disciplines who gave presentations during committee meetings or authored papers that provided information incorporated into the series of reports. The full list of presenters is provided in Appendix C. Authors of commissioned papers are listed in Appendix D.

Committee members and IOM staff conducted a number of site visits throughout the course of the study to gain a better understanding of certain aspects of the emergency care system. We appreciate the willingness of staff from the following organizations to meet with us and respond to questions: Beth Israel Deaconess Medical Center, Boston Medical Center, Children's National Medical Center, Grady Memorial Hospital, Johns Hopkins Hospital, Maryland Institute for EMS Services Systems, Maryland State Police Aviation Division, Richmond Ambulance Association, and Washington Hospital Center.

We would also like to express appreciation to the many individuals who shared their expertise and resources on a wide range of issues: Linda Fagnani, Karen Benson-Huck, Carol Haraden, Lenworth Jacobs, Tom Judge, Nadine Levick, Ellen MacKenzie, Dawn Mancuso, Rick Murray, Ed Racht, Dom Ruscio, Carol Spizziri, Caroline Steinberg, Rosemary Stevens, Peter Vicellio, and Mike Williams.

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Important research and writing contributions were made by Molly Hicks of Keene Mill Consulting, LLC. Karen Boyd, a Christine Mirzayan Science and Technology Fellow of the National Academies, and two student interns, Carla Bezold and Neesha Desai developed background papers. Also, our thanks to Rona Briere, who edited the reports and prepared them for publication.

CONTENTS

Summary

Hospital-based emergency and trauma care are critically important to the health and well-being of Americans. In 2003, nearly 114 million visits were made to hospital emergency departments (EDs)—more than 1 for every 3 people in the United States. About one-quarter of those visits were due to unintentional injuries, the leading cause of death for people aged 1 through 44. While most Americans encounter the ED only rarely, they count on it to be there when they need it.

Over the last several decades, the role of hospital-based emergency and trauma care has evolved. EDs continue to focus on their traditional mission of providing urgent and lifesaving care, but have taken on additional responsibilities to meet the needs of communities, providers, and patients. Today, their complex role also encompasses safety net care for uninsured patients, public health surveillance, disaster preparedness, and serving as an adjunct to community physician practices. In some rural communities, the hospital ED may be the main source of health care for a widely dispersed population. While the demands on emergency and trauma care have grown dramatically, however, the capacity of the system has not kept pace. Balancing these roles in the face of increasing patient volume and limited resources has become increasingly challenging. The situation is creating a widening gap between the quality of emergency care Americans expect and the quality they actually receive.

STUDY CHARGE

The Institute of Medicine's (IOM) Committee on the Future of Emergency Care in the United States Health System was formed in September 2003 to examine the emergency care system in the United States; explore its strengths, limitations, and future challenges; describe a desired vision of the system; and recommend strategies for achieving that vision. The committee was also tasked with taking a focused look at the state of pediatric emergency care, prehospital emergency care, and hospital-based emergency and trauma care. This is the third of three reports presenting the committee's findings and recommendations in these three areas. Summarized below are the committee's findings and recommendations for meeting the challenge of high demand for emergency care and achieving the vision of a 21st-century emergency care system.

THE CHALLENGE OF HIGH DEMAND AND INADEQUATE SYSTEM CAPACITY

Between 1993 and 2003, the population of the United States grew by 12 percent, hospital admissions increased by 13 percent, and ED visits rose by more than 2 million per year from 90.3 to 113.9 million—a 26 percent increase (see Figure ES-1). Not only is ED volume increasing, but patients coming to the ED are older and sicker, and require more complex and time-consuming workups and treatments. Moreover, during this same period, the United States experienced a net loss of 703 hospitals, 198,000 hospital beds, and 425 hospital EDs, mainly in response to cost-cutting measures and lower reimbursements by managed care, Medicare, and other payors. By 2001, 60 percent of hospitals were operating at or over capacity.

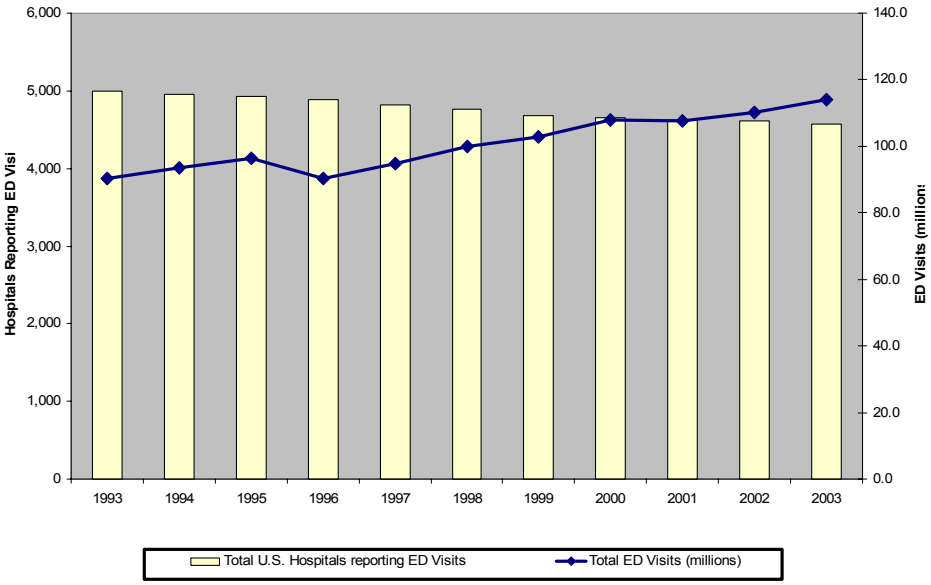

FIGURE ES-1 Hospital emergency departments versus numbers of visits.
SOURCE: AHA Hospital Statistics, 2005; NHAMCS, 1993–2003.

The high demand for hospital-based emergency and trauma care reflects several trends. First, EDs have become one of the nation's principal sources of care for patients with limited access to other providers, including the 45 million uninsured Americans. Indeed, the Emergency Medical Treatment and Active Labor Act of 1986 prevents hospitals from restricting access to uninsured patients by requiring hospitals to provide a medical screening examination to all patients and stabilize or transfer patients as needed. With limited access to community-based primary and specialty care, many turn to the emergency system when in medical need, often for conditions that have worsened because of a lack of regular primary care.

Medicaid beneficiaries also turn to the ED. In fact, Medicaid enrollees visit the ED at a higher rate than any other category of patient (81 visits per 100 enrollees)—double the rate of the uninsured population and nearly four times that of privately insured patients. Although Medicaid enrollees are insured, the low rates of provider reimbursement in many states limit the number of office-based practitioners who are willing to accept them as patients.

In addition, the ED often serves as primary care provider, a role for which it is not optimally designed. Rather, the ED is designed for rapid, high-intensity responses to acute injuries and illnesses. Physicians in the ED face constant interruptions and distractions, and typically lack access to the patient's full medical records. Because nonemergency patients are usually low triage priorities, they often experience extremely long wait times as they are passed over for more urgent cases.

Costs are another concern. When an ED is not busy, the cost of treating an additional nonemergency patient is probably quite low. But while the literature on this issue is mixed, a number of studies suggest that nonemergency care in the ED is more costly than that in alternative settings. Indeed, ED charges for minor problems have been estimated to be two to five times higher than those of a typical office visit. When the ED is at full capacity, treating additional patients who could be cared for in a different environment means fewer resources in

terms of physicians, nurses, ancillary personnel, equipment, and time and space available to respond to the emergency cases.

By law, the front door of the ED is always open. When a hospital's inpatient beds are full, as is frequently the case, ED providers cannot transfer the most severely ill and injured patients to an inpatient unit. As a result, ED patients who require hospitalization begin to back up in the ED. The aggregate result of this imbalance between public demand and hospital capacity is an epidemic of overcrowded EDs, frequent "boarding" of patients waiting for inpatient beds, and ambulance diversion:

- **Overcrowding**—ED overcrowding is a nationwide phenomenon, affecting rural and urban areas alike. In one study, 91 percent of EDs responding to a national survey reported overcrowding as a problem; almost 40 percent reported that overcrowding occurred daily. Overcrowding induces stress in providers and patients, and can lead to errors and impaired overall quality of care.
- **Boarding**—A consequence of crowded EDs is the practice of boarding, or holding patients in the ED until an inpatient bed is unavailable. It is not unusual for patients in a busy hospital ED to be boarded for 48 hours or more. In a nationwide survey of nearly 90 EDs across the country, conducted on a typical Monday evening, 73 percent of hospitals reported boarding two or more patients. Boarding not only compromises the patient's hospital experience, but also adds to an already stressful work environment for physicians and nurses, and enhances the potential for errors, delays in treatment, and diminished quality of care.
- **Ambulance diversion**—Another consequence of crowding is ambulance diversion—when EDs become saturated to the point that patient safety is compromised, ambulances are diverted to alternative hospitals. Once a safety valve to be used in extreme situations, this has now become a commonplace event. A recent study reported that 501,000 ambulances were diverted in 2003, an average of 1 per minute. According to the American Hospital Association, nearly half of all hospitals, and close to 70 percent of urban hospitals, reported time on diversion in 2004. Ambulance diversions can lead to catastrophic delays in treatment for seriously ill or injured patients. It also frequently leads to treatment in facilities with inadequate expertise and resources appropriate to the patient's severity of illness, placing the patient at significant risk.

FINDINGS AND RECOMMENDATIONS

This section presents the committee's key findings and recommendations for meeting the challenge of increased demand and inadequate capacity and improving the quality of hospital-based emergency and trauma care. These findings and recommendations address the need to enhance operational efficiency, the burden of uncompensated care, the use of information technology, inadequate disaster preparedness, the emergency care workforce, and research needs in emergency care.

Enhanced Operational Efficiency

Hospital EDs and trauma centers have little control over external forces that contribute to crowding, such as increasing numbers of uninsured or the growing severity of patients' conditions. There is, however, a great deal they can do manage the impact of these forces. Innovations in industrial engineering that have swept through other sectors of the economy, from banking, to air travel to manufacturing, have failed to take hold in health care delivery—a sector

of the economy that now consumes 16 percent of the nation's gross domestic product and is growing at twice the rate of inflation.

Tools derived from engineering and operations research have been directed successfully at the problem of hospital efficiency in general and ED crowding in particular. A wide range of tools have been developed and tested for addressing patient flow—defined as the movement of patients through the hospital system—generally with good success. Efficient patient flow can increase the volume of patients treated and discharged and minimize delays at each point in the delivery process**,** while improving the quality of care. For example, while controlled studies have yet to be conducted, a growing body of experience suggests that using queuing theory to smooth the peaks and valleys of patient admissions can eliminate bottlenecks, reduce crowding, improve patient care, and reduce costs. The committee recommends that **hospital chief executive officers adopt enterprise-wide operations management and related strategies to improve the quality and efficiency of emergency care.**

A particularly promising technique for managing patient flow is the use of clinical decision units (CDUs), also known as observation units. The technique was developed as a means of monitoring patients with chest pain who had a low to intermediate probability of acute myocardial infarction. By observing patients for up to 23 hours, ED staff were able to rule out many patients at risk of AMI while using fewer resources than would have been consumed if these same patients had been admitted to the ICU or an inpatient telemetry unit. Today, the Centers for Medicare and Medicaid Services (CMS) reimburses CDU stays for only three conditions: chest pain, asthma, and congestive heart failure. Because of the demonstrated success of CDUs, the committee recommends that **the Centers for Medicare and Medicaid Services remove current restrictions on the medical conditions that are eligible for separate CDU payment.**

Incentives to Reduce Crowding and Boarding

While hospitals can use many approaches to reduce crowding and boarding, there are limited financial incentives for hospitals to do so. Hospitals are not reimbursed for difference in costs that is often associated with admissions from the ED. Further, hospitals do not face significant negative financial consequences from operating crowded EDs. In 2004, following a July 2002 alert that tied treatment delays to more than 50 hospital deaths, the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO), instituted new guidelines that would have required accredited hospitals to take serious steps to reduce crowding, boarding, and diversion. Under industry pressure, however, these requirements were withdrawn and replaced with a weaker standard. The committee recommends that **the Joint Commission on the Accreditation of Healthcare Organizations reinstate strong standards that directly address ED crowding, boarding, and diversion.** Furthermore, because the practices of boarding and diversion are so antithetical to quality medical care, the strongest possible measures should be taken to eliminate them. The committee recommends that **hospitals end the practices of boarding patients in the ED and ambulance diversion, except in the most extreme cases, such as a community mass casualty event. The Centers for Medicare and Medicaid Services should convene a working group that includes experts in emergency care, inpatient critical care, hospital operations management, nursing and other relevant disciplines to will develop boarding and diversion standards, as well as guidelines, measures, and incentives for implementation, monitoring, and enforcement of these standards.**

Leadership in Improving Hospital Efficiency

Beyond the use of incentives, the committee looks to hospital executives, including both CEOs and mid-level managers, to provide visionary leadership in promoting the use of patient flow and operations management approaches to improve hospital efficiency. Hospital leaders should be open to learning from the experiences of industries outside of health care, and should be bold and creative in applying these and other new ideas. To foster the development of hospital leadership in improving hospital efficiency, the committee recommends that **training in operations management and related approaches be promoted by professional associations; accrediting organizations, such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the National Committee for Quality Assurance (NCQA); and educational institutions that provide training in clinical, health care management, and public health disciplines.**

Use of Information Technology

Opportunities to improve patient flow, operational efficiency and quality of care can be enhanced by appropriate information technologies. Hospitals, however, lag behind other industries in the use of information technologies (IT), particularly those used to support process management.

Information technologies have broad application to hospitals and health systems, but their use involves unique needs and approaches in emergency care. Information is critically important for rapid decision-making in emergency and trauma care. But emergency physicians are all too often deprived of critical patient information; indeed, it has been said that EDs operate on information "fumes." The following information technologies could significantly enhance emergency care: (1) dashboard systems that track and coordinate patient flow, (2) communications systems that enable ED physicians to link to patients' records or providers, (3) clinical decision-support programs that improve decision making, (4) documentation systems for collecting and storing patient data, (5) computerized training and information retrieval, and (6) systems to facilitate public health surveillance. Given their demonstrated effectiveness in the emergency care setting, the committee recommends that **hospitals adopt robust information and communications systems to improve the safety and quality of emergency care and enhance hospital efficiency**. The committee recognizes that the appropriate prioritization of and investment in these approaches will vary based on each institutions' resources and needs.

The Burden of Uncompensated Care

In most hospitals, if reimbursements fail to cover ED and trauma costs, these costs are subsidized by admissions that originate in the ED. But uncompensated care can be an extreme burden at hospitals that have large numbers of uninsured patients. Many hospital ED and trauma center closures are attributed to financial losses associated with emergency and trauma care. Public hospitals and tertiary medical centers bear a large share of this burden, as surrounding community hospitals often transfer their most complex, high-risk patients to the large safety net hospitals for specialized care. Often, the condition of these patients has deteriorated considerably since their arrival at the referring hospital. Hospitals receive Disproportionate Share Hospital (DSH) payments from both Medicare and Medicaid to compensate for these losses, but these payments are inadequate for hospitals with large safety net populations. As a result, the emergency and trauma care safety net system is at risk in many regions. To ensure the continued

viability of a critical public safety function, the committee recommends that **Congress establish dedicated funding, separate from DSH payments, to reimburse hospitals that provide significant amounts of uncompensated emergency and trauma care for the financial losses incurred by providing those services.**

The committee believes that accurate determination of the optimal amount of funding to allocate for this purpose, which could run into the hundreds of millions of dollars, is beyond its expertise, but that the government must begin to address this issue immediately. The committee therefore recommends that **Congress initially appropriate $50 million for the purpose, to be administered by the Centers for Medicare and Medicaid Services. CMS should establish a working group to determine the allocation of these funds, which should be targeted to providers and localities at greatest risk; the working group should then determine funding needs for subsequent years.**

Inadequate Disaster Preparedness

On September 10, 2001, the cover story of US News and World Report described an emergency care system in critical condition due to demands far in excess of its capacity. While the article focused on the day to day problems of diversion and boarding, the events of the following day brought home the frightening realization to many—if we cannot take care of our emergency patients on a normal day, how will we manage a large scale disaster? More than four years after 9/11, Hurricane Katrina revealed how far there is to go in this regard. While Katrina was unusual in its size and scope, the capacity of the emergency care system to effectively respond to smaller disasters is very much in question.

Surge Capacity

Hospitals in many large cities are operating at or near full capacity. A multiple car highway crash can create havoc in an ED. Few hospitals have the capacity to handle a major mass casualty event. One reason for this lack of capacity is the small amount of funding for bioterrorism and other threats that has gone directly to hospitals. For example, hospital grants from the Health Resources and Services Administration's Bioterrorism Hospital Preparedness Program in 2002 were typically between $5,000 and $10,000—insufficient to equip even one critical care room.

Training

Training for ED workers in disaster preparedness is also deficient. In 2003, hospital training varied widely among staff: 92 percent of hospitals trained their nursing staff in responding to at least one type of threat, but residents and interns received any such training at only 49 percent of hospitals (although this represented an improvement over the situation prior to the terrorist attacks of 2001).

Protection of Hospitals and Staff

Protecting hospitals and their staff from biological or chemical events poses extraordinary challenges. The outbreak of severe acute respiratory syndrome (SARS) in Toronto revealed the difficulties associated with containing even a small outbreak—particularly when health professionals themselves become both victims and spreaders of disease. One of the most important tools in such an event is negative pressure rooms that prevent the spread of airborne

pathogens. Unfortunately, the number of such rooms is limited, and is generally restricted to a handful of tertiary hospitals in each major population center. The committee believes that this lack of adequate negative pressure suites is a critical vulnerability of the current system, and that the existing capacity could be quickly overwhelmed by either a terrorist event or a major outbreak of avian influenza or some other airborne disease, posing an extreme danger to hospital workers and patients.

Staff must also be protected through appropriate personal protective equipment. Current training and equipment in this regard are inadequate. In 2005, the Occupational Safety and Health Administration developed guidelines for use of personal protective equipment, but more needs to be done.

Approaches to Improve Disaster Preparedness

To address the above concerns about surge capacity, training, and protection of hospitals and staff, the committee recommends that **Congress significantly increase total disaster preparedness funding in FY 2007 for hospital emergency preparedness in the following areas: strengthening and sustaining trauma care systems; enhancing ED, trauma center, and inpatient surge capacity; improving EMS response to explosives; designing evidence-based training programs; enhancing the availability of decontamination showers, standby ICU capacity; negative pressure rooms, and appropriate personal protective equipment; conducting international collaborative research on the civilian consequences of conventional weapons (CW) terrorism.**

In addition, to further address the need for competency in disaster medicine across disciplines, the committee recommends that **all institutions responsible for the training, continuing education, and credentialing and certification of professionals involved in emergency care (including medicine, nursing, EMS, allied health, public health, and hospital administration) incorporate disaster preparedness training into their curricula and competency criteria.**

The Emergency Care Workforce

Emergency care is delivered in an inherently challenging environment, often requiring providers to make life-and-death decisions, with little time and information. Emergency care providers wage battles on many fronts, including: scheduling diagnostic tests; obtaining timely laboratory results and drugs; getting patients admitted to the hospital; finding specialists willing to come in during the middle of the night; and finding psychiatric centers, skilled nursing facilities, or specialists who are willing to accept referrals. ED staff often confront violence and deal with an array of social problems that confound their attempts to heal their patients. As a result, providers on the front lines of emergency care are increasingly exhausted, stressed out, and frustrated by the deteriorating state of emergency care and the safety net it supports.

On-Call Specialists

One of the most troubling trends is the increasing difficulty of finding specialists to take emergency call. Providing emergency call has become unattractive to many specialists in critical fields such as neurosurgery and orthopedics. Specialists have difficulty collecting payment for on-call services, in part because many emergency and trauma patients are uninsured; nearly 80 percent of specialists in one survey had difficulty obtaining payment for their services.

Liability concerns also discourage many specialists from taking emergency call. Procedures performed on emergency patients are inherently risky and expose specialists to an increased likelihood of litigation. Patients are often sicker and emergency procedures are frequently performed in the middle of the night or on weekends, when the hospital's staffing and capabilities are not at their peak. A national survey of neurosurgeons found that 36 percent had been sued by patients seen through the ED. These factors drive premiums for those for physicians taking emergency call well above those for physicians who do not. The problem has been exacerbated by recently revised guidelines under the Emergency Medical Treatment and Active Labor Act that make it easier for on-call physicians to limit their emergency practices.

Hospitals are using a number of different strategies to stabilize the services of on-call physicians. One promising approach is to regionalize the services of certain on-call specialties, so that every hospital need not need maintain on-call services for every specialty. Such regionalization would rationalize the limited supply of specialists by ensuring coverage at key tertiary and secondary locations based on actual need, replacing the current haphazard approach that is based on many factors other than need. For example, one county is developing a community-wide cooperative that will contract collectively for the services of certain specialists. The committee recommends that **hospitals, physician organizations, and public health agencies collaborate to regionalize critical specialty care on-call services**.

Exposure of Emergency Providers to Medical Malpractice Claims

As noted above, physicians providing emergency and trauma care face extraordinary exposure to medical malpractice claims—far higher than those not providing such care. Safety net providers are especially affected by the liability problem: as on-call panels diminish at community hospitals, these hospitals increasingly export their sickest patients to the large safety net hospitals, which have no choice but to accept them. The result is even higher concentrations of uninsured, high-risk patients. Protections must be instituted so that emergency providers and EDs do not become the dumping ground for the liability crisis. Although the public is largely unaware of the situation, this crisis has already seriously eroded the capacity of emergency and trauma care across many cities. Therefore, the committee recommends that **Congress appoint a commission to examine the impact of medical malpractice lawsuits on the declining availability of providers in high-risk emergency and trauma care specialties, and to recommend appropriate state and federal actions to mitigate the adverse impact of these lawsuits and ensure quality of care.**

The Rural Workforce

Rural EDs face persistent shortages of emergency and trauma physicians, as well as on-call specialists. With such shortages likely to continue, it is important to find alternative ways of enhancing emergency services in rural areas. One approach is to increase collaboration between rural hospitals and regional academic health centers to foster training, resource sharing, and coordination of care. **The committee recommends that states link rural hospitals with academic health centers to enhance opportunities for professional consultation, telemedicine, patient referral and transport, and continuing professional education.**

Need for Emergency Care Research

Although emergency medicine and trauma surgery are relatively young specialties, researchers have made important contributions to both basic science and clinical practice that have dramatically improved emergency care, and have resulted in significant advances in general medicine. Examples are assessment and management of cardiac arrest, including the development and refinement of guidelines for cardiopulmonary resuscitation (CPR), the pharmacology of resuscitation, understanding and treatment of hemorrhagic shock, and electrocardiogram (EKG) analysis of ventricular fibrillation. Because emergency and trauma care are young fields, however, they are not strongly represented in the political infrastructure of the National Institutes of Health (NIH), its various institutes, and its study sections. As a result, scant resources are allocated to advance the science of emergency care, and few training grants are offered to develop researchers who want to focus on emergency care. For example, only .05 percent of NIH training grants awarded to medical schools go to departments of emergency medicine—an average of only $51.66 per graduating resident. In contrast, internal medicine receives approximately $5,000.00 per graduating resident.

The current uncoordinated approach to organizing and funding emergency and trauma care has been inadequate. There are well-defined emergency and trauma care research questions that would benefit from a coordinated and well-funded research strategy. Therefore the committee recommends that **the Secretary of the Department of Health and Human Services (DHHS) conduct a study to examine the gaps and opportunities in emergency and trauma care research, and recommend a strategy for the optimal organization and funding of the research effort**. **This study should include consideration of training of new investigators, development of multi-center research networks, funding of General Clinical Research Centers (GCRCs) that specifically include an emergency and trauma care component, involvement of emergency and trauma care researchers in the grant review and research advisory processes, and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency and trauma care research (including the Department of Transportation, the Department of Health and Human Services, the Department of Homeland Security, and Department of Defense) should implement the study's recommendations.**

ACHIEVING THE VISION OF A 21ST-CENTURY EMERGENCY CARE SYSTEM

Hospital-based emergency and trauma care are part of an interdependent system of emergency services; thus optimizing emergency care requires improvements in both hospital-based care and the larger system. To that end, the committee developed a vision for the future of emergency care that centers around three goals: coordination, regionalization, and accountability. Many elements of this vision have been advocated previously; however, progress toward achieving these elements has been derailed by deeply entrenched parochial interests and cultural attitudes, as well as funding cutbacks and practical impediments to change. Concerted, cooperative efforts at all levels of government—federal, state, regional, local—and the private sector are necessary to finally break through and achieve this vision.

Coordination

One of the most long-standing problems with the emergency care system is that services are fragmented. EMS, hospitals, trauma centers, and public health have traditionally worked in silos. For example, public safety and EMS agencies often lack common radio frequencies and protocols for communicating with each other during emergencies. Similarly, emergency care providers lack access to patient medical histories that could be useful in decision-making.

Ensuring that each patient is directed to the most appropriate setting, including a level I trauma center, when necessary, requires that many elements within the regional system—community hospital, trauma centers, and particularly prehospital EMS—coordinate the regional flow of patients effectively. In addition to improving patient care, coordinating the regional flow of patients is a critical tool in reducing overcrowding in EDs.

Unfortunately, only a handful of systems around the country coordinate transport effectively at the regional level. Short of formally instituting diversion, there is typically little information sharing between hospitals and EMS regarding overloaded EDs and trauma centers and the availability of ED beds, operating suites, equipment, trauma surgeons, and critical specialists—information that could be used to balance the load among EDs and trauma centers regionwide. Too often a hospital's location places it in a logistical situation in which it is overloaded with emergencies and trauma cases while an ED several blocks away may be working at a comfortable 50 percent capacity. There is little incentive for ambulances to drive by a hospital to take patients to a facility that is less crowded.

The benefits to patients of better regional coordination have been demonstrated. The technologies needed to facilitate such coordination exist, and police and fire departments are ahead in this regard. The main impediment appears to be entrenched interests and a lack of vision to motivate change in the current system.

The committee envisions a system in which all patients receive well-planned and coordinated emergency care services. Dispatch, EMS, ED providers, public safety, and public health should be fully interconnected and united in an effort to ensure that each patient receives the most appropriate care, at the optimal location, with the minimum delay. From the standpoint of patients, delivery of emergency care services should be seamless.

Regionalization

Because not all hospitals within a community have the personnel and resources to support the delivery of high-level emergency care, critically ill and injured patients should be directed specifically to those facilities with such capabilities. That is the goal of regionalization. There is substantial evidence that the use of regionalization of services to direct such patients to designated hospitals with greater experience and resources improves outcomes and reduces costs across a range of high-risk conditions and procedures. Thus the committee supports further regionalization of emergency care services. However, use of this approach requires that prehospital providers, as well as patients and caregivers, be clear on which facilities have the necessary resources. Just as trauma centers are categorized according to their capabilities (i.e., level I–level IV/V), a standard national approach to the categorization of EDs that reflects their capabilities is needed so that the categories will be clearly understood by providers and the public across all states and regions of the country. To that end, **the committee recommends that the Department of Health and Human Services and the National Highway Traffic Safety Administration, in partnership with professional organizations, convene a panel of**

individuals with multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.

This information, in turn, could be used to develop protocols that would guide EMS providers in the transport of patients and improve the regional coordination of patient flow. These protocols should be based on current and emerging evidence about the appropriate models for transport given the patient's condition and location, and should include protocols that, given appropriate information about the status of facilities, direct patients to less crowded local EDs rather than to the highest-level center. **Therefore, the committee also recommends that the National Highway Traffic Safety Administration, in partnership with professional organizations, convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients**.

Accountability

Without accountability, participants in the emergency care system need not accept responsibility for failures and can avoid making changes to improve the delivery of care. Accountability has failed to take hold in emergency care to date because responsibility is dispersed across many different components of the system, so it is difficult even for policymakers to determine where system breakdowns occur and how they can subsequently be addressed.

To build accountability into the system, **the committee recommends that the Department of Health and Human Services convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance.** Because of the need for an independent, national process with the broad participation of every component of emergency care, the federal government should play a lead role in promoting and funding the development of these performance indicators. The indicators developed should include structure and process measures, but evolve toward outcome measures over time. These performance measures should be nationally standardized so that statewide and national comparisons can be made. Measures should evaluate the performance of individual providers within the system, as well as that of the system as a whole. Measures should also be sensitive to the interdependence among the components of the system; for example, EMS response times may be related to EDs going on diversion.

Using the measures developed through such a national, evidence-based, multi-disciplinary effort, performance data should be collected at regular intervals from all hospitals and EMS agencies in a community. Public dissemination of performance data is crucial to driving the needed changes in the delivery of emergency care services. Dissemination can take various forms, including public report cards, annual reports, and state public health reports. Because of the potential sensitivity of performance data, they it should initially be reported in the aggregate rather than at the level of the individual provider. Individual providers should have full access to their own data so they can understand and improve their individual performance, as well as contribute to the overall system. Over time, individual provider information should become an important part of the public information on the system. These performance measures should ultimately become the basis for pay-for-performance initiatives as those reimbursement techniques mature.

Achieving the Vision

States and regions face a variety of different situations, including the level of development of trauma systems; the effectiveness of state EMS offices and regional EMS councils; and the degree of coordination among fire departments, EMS, hospitals, trauma centers, and emergency management. Thus no single approach to enhancing emergency care systems will achieve the goals outlined above. A number of different avenues should be explored and evaluated to determine what types of systems are best able to achieve the three goals. The committee therefore recommends that **Congress establish a demonstration program, administered by the Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate $88 million over 5 years to this program.** Grants should be targeted at states, which could develop projects at the state, regional, or local level; cross-state collaborative proposals would also be encouraged. Over time, and over a number of controlled initiatives, such a process should lead to important insights about what strategies work under different conditions. These insights would provide best-practice models that could be widely adopted to advance the nation toward the committee's vision for efficient, high-quality emergency and trauma care.

Supporting System Integration

Reducing fragmentation at the state and local level will require federal leadership and support. But today, the federal agencies that support and regulate emergency services mirror the fragmentation of emergency services at the state and local levels. Prehospital EMS, hospital-based emergency care, trauma care, injury prevention and control, and medical disaster preparedness are scattered across numerous agencies within DHHS, DOT, and DHS.

Strong federal leadership for emergency and trauma care is at the heart of the committee's vision for the future, and continued fragmentation of responsibility at the federal level is unacceptable. A lead federal agency could better move the emergency and trauma care system toward improved integration, unify decision-making and funding decisions, and represent all emergency and trauma care patients, providers, and settings, including prehospital EMS, (both ground and air), hospital-based emergency and trauma care, pediatric emergency and trauma care, rural emergency and trauma care, and medical disaster preparedness. The committee therefore recommends that **Congress establish a lead agency for emergency and trauma care within two years of this report. The lead agency will be housed in the Department of Health and Human Services, and will have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress will establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency care.**

1
Introduction

Memorial Hospital Emergency Department
Tuesday, 3:00 PM

Memorial Hospital, a large, urban medical center and level I trauma center has an emergency department (ED) designed to hold 40 acute patients. It is operating well over capacity with more than 80 patients actively undergoing care, 30 of whom lie on wheeled stretchers in hallways. Of these 80 patients, 24 are waiting to be admitted to inpatient beds; 4 have been waiting between 7–10 hours, 1 for 20 hours, and 1 for over 24 hours. The hospital has been on EMS diversion for 5 hours, but with other nearby hospitals also on diversion, it is still receiving a steady stream of patients. Doctors and nurses used to the high stress of emergency care are maintaining relative order, although they have been operating at full tilt for most of the shift. The risk of errors from fatigue, stress, and hurry grows steadily higher. An EMS crew that has been waiting to offload a patient into the busy ED for more than 35 minutes stands by impatiently. The waiting room is crowded with more than 50 people—34 patients, family, and friends—including children, adults, and elderly. Some are in pain, at least one is bleeding, while others appear to have cold or flu symptoms.

A call from the dispatch center notifies the ED that five patients will soon arrive from a car crash on the nearby interstate—with injuries of varying severity. One is coming by helicopter, and the trauma team is mobilized. The ED director does her best to clear additional space in the ED. Additional nursing staff are requested, but none are available—the evening supervisor has been trying to call in personnel for the past 4 hours. The level of activity in the ED is growing visibly, and the amount of attention being provided to each patient is minimal. Several patients in the waiting room give up and leave the before being seen by a physician, and two patients who are undergoing treatment in the ED sign out against the medical advice of staff.

To make matters worse, a nearby hospital requests to transfer a complex neurological and orthopedic case to Memorial. The patient is stable but his condition may deteriorate without immediate intervention. Memorial is normally well equipped to handle such patients, but the neurological and orthopedic specialists on-call to Memorial are already busy with other cases in the operating room.

As the night wears on, the volume of patients gradually declines. Although the ED has been pushed to the limit at times, a meltdown has been averted by the efforts of the staff. Nonetheless, despite the best efforts of the emergency care professionals—from emergency medical technicians to emergency doctors and nurses and on-call specialists—the quality of heath care delivered by the emergency care system on this night was less than it could and should have been.

Hospital-based emergency and trauma care are critically important to the health and well-being of Americans. In 2003, nearly 114 million visits were made to hospital emergency departments (EDs), more than 1 for every 3 people in the United States. About one-quarter of those visits were due to unintentional injuries, the leading cause of death for people aged 1 through 34; indeed, traumatic injury has surpassed heart disease as the most expensive category of medical treatment, resulting in $71.6 billion dollars in expenditures per year (AHRQ, 2006). While most Americans encounter the ED only rarely, they count on it to be there when they need it.

Over the last several decades, the role of hospital-based emergency and trauma care has evolved substantially. EDs continue to focus on their traditional mission of providing urgent and lifesaving care, but have taken on additional responsibilities to meet the needs of communities, providers, and patients. EDs have become a key component of the health care safety net, providing a considerable volume of care to uninsured patients and Medicaid beneficiaries who often cannot access health services elsewhere. EDs are also an important public health partner, responsible for alerting public health agencies to possible threats in the community and sometimes counseling patients on prevention or self-care. Moreover, EDs play a central role in preparing their communities for disasters, and have become an important adjunct to community physicians' practices. While the demands on emergency and trauma care have grown dramatically, however, the capacity of the system has not kept pace. Balancing these roles in the face of increasing patient volume and limited resources has become increasingly challenging.

A GROWING NATIONAL CRISIS

Hospital EDs have become frequently crowded environments, with patients sometimes lining hallways and waiting hours and even days to be admitted to inpatient beds (Asplin et al., 2003). Ambulance diversion, once rare, is now a common if not daily event in many major cities, and can lead to catastrophic consequences for patients (GAO, 2001; Schafermeyer and Asplin, 2003). Specialists needed to treat emergency and trauma patients are increasingly difficult to find; the result is longer waits and at times, distant transport of critically ill or injured patients for specialty care. The emergency system itself appears to be crumbling in major cities. In Los Angeles, for example, 8 hospital EDs have closed since 2003, bringing the total closed countywide to over 60 in the last decade (see Box 1-1) (Robes, 2005).

BOX 1-1 Meltdown of Emergency Care: Emergency Department Closures in Los Angeles County

Los Angeles (LA) County, the largest county in the nation, is home to more than 10 million people (L.A. County Online, 2005). It also leads the nation in shuttered EDs. Between 1980 and 2000, 20 percent of the county's EDs closed (Sussman, 2000); since 2003, 8 more hospital EDs and 1 trauma center have closed. At the same time, the number of patients seeking care at EDs has soared, so the facilities that remain are being forced to absorb an overwhelmingly large patient load. These hospitals are in an increasingly tenuous financial position (Robes, 2005).

While some ED closures may be justified by the changing needs of communities, the ED closures in LA County have led to serious consequences for patient care. The demand for ED care at the EDs that remain is so high that waiting times can reach 8 to 12 hours (South Bay's ERs are in a State of Emergency, 2005). Additionally, LA County hospitals went on diversion an average of 23 percent of the time in 2004, meaning they closed their doors to patients arriving by ambulance almost one-quarter of the time. Paramedics in LA County report that the closure of EDs, coupled with frequent ED diversion, is forcing them to drive farther and farther to find a hospital that is able to care for a sick or injured patient. Longer transport times translate into delays in patients' receiving definitive care. But even once paramedics arrive at an open ED with a patient, one in eight trips involves an additional delay (Hymon, 2003). Because EDs are so crowded with patients, paramedics often must wait hours for the transported patient to be admitted to the ED. While the paramedics wait with the transported patient, they are unable to respond to other emergency calls.

Even the most severely injured patients are affected by problems within the system. The LA Fire Department, which oversees EMS, has a departmentwide mandate that requires a maximum transport time of 30 minutes for trauma patients. However, it is difficult for paramedics to find an open trauma center within a 30-minute radius, so at times they deliver patients to non–trauma centers (regular EDs that are less well equipped to handle serious injuries). These types of situations occur almost every weekend in LA (California Healthline, 2004).

The closure of LA County EDs and trauma centers can be attributed to financial pressures on hospitals, due particularly to the large volume of care they provide to uninsured patients. In fact, one in three ED patients in LA County is uninsured (Felch, 2004). Historically, about two-thirds of uninsured patients were served by the four county-run hospitals, while private hospitals cared for the remaining third. In 2003, however, because of cost concerns, the county changed its policies to limit the ability of private hospitals to transfer patients to the county hospitals. In the 14 months following the policy change, the number of uninsured doubled at some private hospitals and tripled at others (Felch, 2004).

In 2002, LA County voters overwhelmingly approved (73 to 27 percent) a modest tax on building improvements to fund emergency services, trauma care, and bioterrorism preparedness efforts countywide. This was the first voter-approved increase in the property tax since the 1970s. The measure passed after a $1.5 million media campaign that warned voters of a system collapse unless the tax was approved. Advertisements for the measure showing feverish paramedics driving around the city looking for a hospital with available beds struck a cord with voters (L.A. County Online, 2005). The measure, although a step in the right direction, has been described as "a $170-million answer to a $700 million problem" (Trauma Tax Falls Short, 2004). More ED closures are expected in the county.

These trends are symptomatic of a growing national crisis in emergency care. This crisis is multifaceted and impacts every aspect of emergency care—from prehospital EMS to hospital-based emergency and trauma care. Of the many challenges confronting hospital-based emergency and trauma care today, the following stand out for their complexity, gravity, and urgency:

- **Demand outpacing capacity**—Between 1993 and 2003, ED visits increased from 90.3 to 113.9 million, a 26 percent increase. During this same period, the United States experienced a net loss of 425 hospital EDs. The problem of excess demand is exacerbated by the above-noted

role of the ED as one of the nation's principal sources of care for patients with limited access to other providers, including the 45 million uninsured Americans. The result of this growing imbalance between demand and capacity is a nationwide epidemic of ED overcrowding, boarding, and ambulance diversion.

- **ED crowding** is the most obvious manifestation of the imbalance between demand and capacity. It occurs when patient volume backs up in the ED: many patients come in the front door, but not enough can be admitted to the hospital in a timely manner to make room for more incoming patients. As admitted patients back up in the ED, crowding becomes severe. ED overcrowding blocks access to emergency care, induces stress in providers and patients alike, and can lead to errors and impaired quality of care.
- **Boarding**—Boarding is the practice of holding patients in the ED who need to be admitted to the hospital because an inpatient bed is unavailable. In a nationwide survey of nearly 90 EDs across the country, conducted on a typical Monday evening, 73 percent of hospitals reported boarding two or more admitted patients. Boarding is not only frustrating and at times hazardous for the patient, but also adds to an already stressful work environment for physicians and nurses, and enhances the potential for errors, delays in treatment, and diminished quality of care.
- **Ambulance diversion**—When EDs become saturated to the point that patient safety is compromised, inbound ambulances may be diverted to alternative hospitals. Once a safety valve to be used in extreme situations, ambulance diversion has now become a commonplace event. A recent federal study reported that 501,000 ambulances were diverted in 2003, an average of 1 per minute. According to the American Hospital Association, nearly half of all hospitals, and close to 70 percent of urban hospitals, reported time on diversion in 2004. Ambulance diversions can lead to catastrophic delays in treatment for seriously ill or injured patients.
- **Uncompensated care**—Hospital EDs are required by federal law to provide emergency care to all in need without regard for the patient's ability to pay. No federal funding is allocated to offset the costs of this care. Uncompensated emergency and trauma care services can impose an extreme financial burden on hospitals that see large numbers of uninsured patients. Substantial financial losses and ED and trauma center closures have been attributed to uncompensated emergency and trauma care.
- **Inefficient use of resources**—Innovations in industrial engineering that have swept through other sectors of the economy, from banking, to airlines, to manufacturing, have failed to take hold in health care delivery. Tools and information technologies adapted from other industries could be used effectively to address the bottlenecks that occur in the flow of patients throughout the hospital and result in ED crowding. But hospitals have been slow to adopt these measures.
- **Inadequate surge capacity**—Many hospitals are already operating at or over capacity. Because major hospital EDs are already crowded with patients and may even be boarding large numbers of inpatients, there is little or no surge capacity to absorb a large influx of patients from a significant mass casualty event. Furthermore, supplies of specialized equipment, such as personal protective equipment, negative pressure rooms, and ventilators, are inadequate to meet the demands of a major disaster or an epidemic.
- **Inadequate protection for staff**—Hospital workers confront a host of daily hazards, from bloodborne and airborne pathogens to violent patients. Inadequate steps have been taken to protect hospital assets and staff in routine situations, let alone in the event of an infectious disease outbreak or a chemical or biological attack.

- **Inadequate supply of on-call specialists**—One of the most troubling aspects of the current emergency and trauma care system is the lack of available specialists to provide on-call services to hospital EDs and trauma centers. This is particularly true for highly skilled specialties such as neurosurgery, interventional cardiology, and orthopedic surgery.
- **Medical liability**—Emergency and trauma care providers, including hospitals, emergency and trauma physicians, and on-call specialists, face extraordinary liability exposure, leading many to limit the scope of their practice or stop taking on ED call.
- **Fragmented systems**—Emergency care systems are highly fragmented. Emergency medical services (EMS) agencies, hospitals, trauma centers, public safety services (e.g., police and fire), and public health agencies often lack effective communications and fail to coordinate effectively across the continuum of emergency care. Coordinating the regional flow of patients is critical to ensuring that each patient is directed to the most appropriate setting for care, yet few systems nationwide have effective coordination between EMS and hospital EDs and trauma centers.
- **Lack of performance measurement and accountability**—There is no standardized measurement or reporting of the performance of emergency and trauma care providers and systems. As a result, few people have any real understanding of the quality of care that they can expect to receive from their local emergency providers.
- **Inadequate research funding and infrastructure**—Because emergency care is a relatively young field, it lacks a strong and stable research base within the National Institutes of Health and other agencies. Despite the importance of emergency and trauma care, research funding in the field lags well behind that in other fields.

IMPACT ON QUALITY AND PATIENT SAFETY

Quality and safety have been driving concerns of emergency care leaders for decades, and notable achievements in quality have been made. Improved care of patients with acute myocardial infarction, stroke, pneumonia, and sepsis are notable examples (Barron et al., 1999; Adams et al., 2002; Dellinger, 2004). Nonetheless, the numerous problems identified in this chapter have an impact on the quality and safety of the care provided by the system. The depth of this impact is difficult to determine. One way to assess the overall quality of the emergency care system is to consider the six quality aims defined by the Institute of Medicine (IOM) in *Crossing the Quality Chasm: A New Health System for the 21st Century* (IOM, 2001): care should be safe, effective, patient-centered, timely, efficient, and equitable (see Box 1-2). While the evidence base is limited, there are strong indications that the current emergency care system fails the American public in significant ways.

BOX 1-2 The Six Quality Aims of the Institute of Medicine's *Quality Chasm* Report

Health care should be:

- **Safe**—avoiding injuries to patients from the care that is intended to help them.
- **Effective**—providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit.
- **Patient-centered**—providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions.
- **Timely**—reducing waits and sometimes harmful delays for both those who receive and those who give care.
- **Efficient**—avoiding waste, including waste of equipment, supplies, ideas, and energy.
- **Equitable**—providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.

SOURCE: IOM, 2001, pp. 5–6.

Safe

EDs are often high-risk, high-stress environments fraught with opportunities for error (Leape et al., 1991; Chisholm et al., 2000; Goldberg et al., 2002; Cosby, 2003; Weiss et al., 2004; Chamberlain et al., 2004; Selbst et al., 2004). A landmark study of hospitalized patients found that although the ED was the site of only 3 percent of adverse events, it was the site of 70 percent of those events attributed to negligence (Leape et al., 1991). Additional studies looking at hospital admissions and malpractice claims have also found the ED to be a site of a significant number errors resulting in adverse events (Thomas et al., 2000). Two of the most common types of errors in the ED are failure to diagnose a patient properly (Leape et al., 1991; Weingart et al., 2000; Cosby, 2003; Thomas et al., 2004; White et al., 2004) and medication errors (Leape et al., 1991).

Errors in the ED are caused by multiple factors. ED staff are frequently interrupted in the course of their duties to attend to other patients or issues (Chisholm et al., 2001); are required to see a broad case mix of patients; and must often make rapid clinical decisions, frequently without the benefit of medical histories or diagnostic tests (Selbst et al., 2004). Failures of communication or teamwork are significant problems in the ED, and in some cases have been shown to be direct contributors to adverse medical outcomes (Risser et al., 1999; White et al., 2004). The routine distractions of an ED are dramatically compounded when conditions are crowded. Problems include patients boarded in hallways for long periods; long waiting times; patients who decide to leave without being seen; others who demand to sign out against medical advice; and delays in diagnostic imaging, laboratory results, drug administration, and consultative support by on-call specialists.

Effective

In contrast to the surprisingly limited evidence base for a number of clinical practices that are widely used in the prehospital arena, hospital-based emergency care is substantially evidence-based. In major tertiary hospitals, emergency and trauma care brings together the best of American medicine—highly trained, interdisciplinary teams of dedicated specialists armed with advanced medical technology. Beyond these large tertiary centers, however, the effectiveness of the system is less certain. Many community hospitals, especially in rural areas, do not have board-certified emergency physicians on staff. Many lack key specialists to back up their ED physicians. Furthermore, as discussed earlier, hospital EDs are often required to provide an enormous amount of primary care that would likely be provided better in other settings. Because ED physicians may not have access to the patient's medical record, they cannot easily address primary care issues that go beyond the patient's chief complaint. They have little or no opportunity for follow-up contact with patients, chronic care management, assurance of patient compliance, and coordination of care across providers and patient care settings.

Patient-Centered

EDs are designed to maximize visibility rather than to preserve patient privacy. At best they can hardly be considered patient-centered. A crowded ED, with its packed waiting rooms, long waiting times, and patients boarding in hallways is even less so. Physicians and nurses find it nearly impossible to have a private conversation with a patient in such conditions. Injured or highly contagious patients may be placed in close proximity to children and individuals with only minor health problems who are using the ED for primary care.

Hospitals have begun to address these issues in a variety of ways. Some have established fast-track areas to deal with patients who are not truly emergency cases. Hospitals have also set up specialized areas, such as psychiatric and pediatric EDs within or adjacent to the main ED. Other approaches to making ED care more patient-centered include using bedside registration rather than making patients register first; sending physicians to the waiting room to see patients with simple problems, thus averting the need for long waits for an ED exam room; expediting inpatient admissions to clear crowded ED hallways; and treating pain more aggressively.

Timely

EDs are designed to provide timely care for unscheduled emergencies; nevertheless, timeliness of care in the ED is a growing concern. As noted, many patients experience long wait times before being seen, especially if they have a problem that is not immediately life-threatening, and the boarding of admitted patients who are waiting for an available inpatient bed has become commonplace. Long ED wait times can result in protracted pain and suffering and delays in diagnosis and treatment (Derlet et al., 2001; Derlet, 2002; James et al., 2005), and can lead some patients to leave without being seen (Quinn et al., 2003) or to sign out against medical advice. Cognizant of these problems, ED staff and hospital administrators are attempting a variety of strategies to address the problem. Nevertheless, the problems persist.

Efficient

The health sector in general, and emergency and trauma care services in particular, lag behind other industries in adopting engineering principles and information technologies that can improve process management, lower costs, and enhance quality. Although EDs are quite

efficient in some respects (they have diagnostic testing readily available and can complete in hours an in-depth evaluation that might otherwise require several days), they are highly dependent on hospital operations for efficient operation. When a hospital is full or its ancillary services are slow, ED crowding, inpatient boarding, and ambulance diversion are almost inevitable. These are system failures that could be addressed through better overall management of hospital operations. There are other dimensions of inefficiency in emergency care as well. For example, the increasing amount of primary care delivered in EDs has important cost and quality implications, and may detract from the ED's primary mission of providing emergency and lifesaving care. Further, the high degree of liability exposure in emergency and trauma care can lead to defensive medicine—the use of diagnostic tests and treatment measures primarily for the purpose of averting malpractice lawsuits (Lawthers et al., 1992; Berenson et al., 2003; Katz et al., 2005; Studdert et al., 2005).

Equitable

Disparities in the health care received by Americans on the basis of race and ethnicity were thoroughly documented in the IOM report *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care* (IOM, 2003). Results of a small number of studies suggest that disparities may exist in access to emergency care access and the treatment received. For example, there is evidence of variability in treatment, wait times, and insurance authorizations based on patients' race and ethnicity (Lowe and Bindman, 1994; Todd et al., 2000; Bazarian et al., 2003; Richardson et al., 2003; James et al., 2005), although other researchers have reported that for a given level of patient severity of illness, the decision to admit an ED patient to the hospital does not appear to be influenced by the patient's race, ethnicity, or payor status (Kellermann and Haley, 2003; Oster and Bindman, 2003). ED crowding, patient boarding, and ambulance diversion tend to be associated with large, urban medical centers, and thus have a disproportionate effect on racial and ethnic minorities that tend to dwell in the inner cities. Nonetheless, emergency care is arguably one of the more equitable settings in medicine, largely because of the Emergency Medical Treatment and Active Labor Act, which has created a broad mandate to serve all, regardless of ability to pay.

PURPOSE OF THIS STUDY

While the problems discussed in this report are not new, they have largely been overlooked until now. Within the last several years, the complex problems facing the emergency care system have erupted into public view. Negative stories have increasingly appeared in the media regarding slow EMS response, ambulance diversions, trauma center closures, the medical malpractice crisis, ground and air crashes occurring during patient transport, and the frequent lack of on-call specialist coverage. The events of September 11, 2001, and more recent disasters, such as the train bombings in Madrid and Hurricane Katrina, have sharpened the public's awareness of these issues.

The sponsors of this study—the Health Services and Resources Administration (HRSA), Emergency Medical Services for Children (EMSC) Division; the National Highway Traffic Safety Administration; the Agency for Healthcare Research and Quality; the Centers for Disease Control and Prevention; Center for Injury Prevention and Control; and the Josiah Macy Foundation—requested that the IOM undertake a study aimed at assessing the current emergency care system, identifying its strengths and weaknesses, developing a comprehensive vision for the

future of emergency care and to providing a blueprint for achieving that vision. The study was designed to encompass all of the key components of emergency care—prehospital EMS, hospital-based emergency care, trauma care, and injury prevention and control—in an integrated effort. The complete statement of task for the study committee is shown in Box 1-3.

BOX 1-3 Statement of Task for this Study

The objectives of this study are to: (1) examine the emergency care system in the U.S.; (2) explore its strengths, limitations, and future challenges; (3) describe a desired vision of the emergency care system; and (4) recommend strategies required to achieve that vision. In this context, the Subcommittee on Hospital-Based Emergency Care will identify and address a wide range of issues, including:

- the role and impact of the emergency department within the larger hospital and health care system;
- the interaction between the emergency department and inpatient and ancillary services, such as lab, pharmacy, and imaging;
- patient flow and information technology;
- workforce issues across multiple disciplines, including emergency physicians, nurses, and other members of the care team;
- the impact of technological innovations on emergency care;
- patient safety and the quality and efficiency of emergency care services;
- the legal and regulatory framework for emergency care, including the Emergency Medical Treatment and Active Labor Act (EMTALA), liability issues, and reimbursement; disaster preparedness, surge capacity, and surveillance;
- basic, clinical, and health services research relevant to emergency care; and
- special challenges of emergency care in rural settings.

This study builds on a large body of previous work, some conducted by the National Academies and some by other organizations. The landmark report *Accidental Death and Disability: The Neglected Disease of Modern Society* (NAS and NRC, 1966) first focused attention on the inadequacy of emergency and trauma care in the United States. This was followed by *Injury in America: A Continuing Public Health Problem* (NRC and IOM, 1985), which called for expanded research into the epidemiology and treatment of injury, and *Reducing the Burden of Injury* (IOM, 1999), which called for the development of a broad program for injury research, prevention, and control. The report *Emergency Medical Services for Children* (IOM, 1993) described the limited capacity of the developing emergency care system to address the special needs of children, and called for strong state and federal support for enhancements to emergency care education and training, infrastructure, research, and funding targeting the needs of children.

Other reports have touched on important specific aspects emergency care. A report of the Josiah Macy, Jr. Foundation, *The Role of Emergency Medicine in the Future of American Medical Care* (Josiah Macy, Jr. Foundation, 1995) examined the young specialty of emergency medicine and explored a vision for the future development of emergency medical practice, research, and delivery. The IOM report *A Shared Destiny: Community Effects of Uninsurance* described the importance of the emergency care system to the national public health safety net, and the enormous burden placed on hospitals by the growing uninsured population (IOM, 2004). *To Err Is Human: Building a Safer Health System* (IOM, 2000) and *Crossing the Quality Chasm: A New Health System for the 21st Century* (IOM, 2001) drew attention to the critical quality

problems in health care, to which emergency care contributes significantly, and provided an important framework for assessing the performance of the emergency care system—the six quality aims reviewed above. *Building a Better Delivery System: A New Engineering/Health Care Partnership* identified engineering and operations management tools from other industries that could be adapted to health care settings, assessed barriers to adoption, and highlighted research opportunities for engineering applications to improve the health care delivery system (IOM, 2005).

In addition, a series of *EMS Agenda for the Future* reports sponsored by major federal agencies have addressed key issues. The original *EMS Agenda for the Future* (NHTSA, 1996), published in 1996, described a vision for an integrated emergency care system of the future, while a companion report, *EMS Agenda for the Future: Implementation Guide* (NHTSA, 1998) outlined detailed steps for achieving that vision. Detailed assessments were then provided in *EMS Education Agenda for the Future: A Systems Approach* (NHTSA, 2000), *National EMS Research Agenda* (NHTSA, 2001a), *Rural and Frontier EMS Agenda for the Future* (NHTSA, 2003), *Trauma System Agenda for the Future* (NHTSA, 2001b), and *CDC Acute Injury Care Research Agenda: Guiding Research for the Future* (CDC National Center for Injury Control and Prevention, 2005).

As important as these preceding works have been, progress in implementing needed reforms has been slow, and much work remains to be done. Deeply entrenched parochial interests have impeded progress, and today the field is as fragmented as ever. Accountability remains dispersed, and there is little public understanding of either the importance or the profound limitations of emergency and trauma care.

Study Scope

The scope of this study is broad, like the field of emergency care itself. It encompasses the full range of activities associated with emergency care, including first aid and cardiopulmonary resuscitation (CPR) rendered by bystanders; 9-1-1 and dispatch; emergency medical response and treatment at the scene; transport of patients via ambulance or air medical service; emergency assessment and treatment at the hospital ED or trauma center; critical care services in the operating room, the intensive care unit, or other inpatient departments; interfacility transport of patients; treatment in specialized facilities such as burn, stroke, and cardiac centers, as well as children's hospitals; and access to follow-up in community-based referral sites, such as primary care practices, skilled nursing facilities, psychiatric hospitals, and substance abuse clinics.

Emergency care is unique in the health field because it operates at the intersection of medical care, public health, and public safety. Consequently, the study views emergency care from all three perspectives. In addition to exploring the traditional role of the emergency care system as provider of urgent and life-saving care, the study considers the system's roles in public health—including surveillance to detect injury trends and disease outbreaks—and as a critical component of the public safety net. Also addressed are the multiple interactions between emergency care and community providers: urgent care that can substitute for ED services, use of the emergency care as an adjunct to physician practices, and the role of preventive services and chronic care management that can reduce the need for emergency services. The study further considers emergency care's public safety role and its intersection with police, fire, and emergency management services. Finally, emergency care is examined within a systems framework: how the many components of the system, such as EDs, EMS, community providers, and on-call

specialists, work together—or frequently fail to work together—to achieve a level of performance for the system as a whole.

STUDY APPROACH

The committee was structured to balance the desire for an integrated, systems approach to the study with an interest in placing focused attention on pediatric, EMS, and hospital-based emergency care issues. The result was a main committee and three subcommittees representing the latter three focus areas (see Figure 1-1).

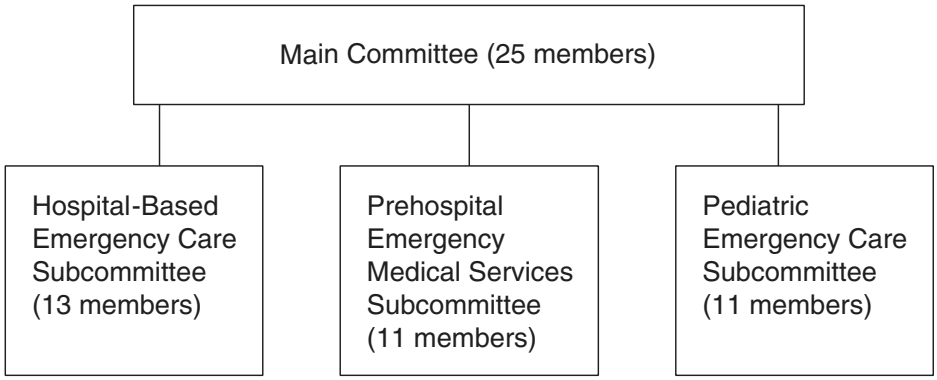

FIGURE 1-1 Committee structure.

The main committee guided the overall study process and separately addressed a set of overarching system-wide issues. The three subcommittees examined the unique challenges associated with the provision of emergency services to children; issues related to prehospital EMS; and issues associated with hospital-based emergency and trauma care. The membership of the main committee and subcommittees overlapped—the 11-member pediatric subcommittee, for example, included 5 members from the main committee. Subcommittees met both separately—reporting to the main committee their discussions and findings—and in combined session with the main committee. A total of 40 individuals[1] served across all four committees (see Appendix A). Biographical information on each committee member is contained in Appendix B.

The committee held 17 main and subcommittee meetings from February 2004 through October 2005, heard testimony from a wide range of experts (see Appendix C), and commissioned 11 technical papers (see Appendix D). Staff and committee members met with a variety of stakeholders and interested individuals, conducted study visits, and participated in public meetings sponsored by stakeholder groups and the study sponsors.

A NOTE ABOUT TERMINOLOGY

There is substantial confusion about terminology in emergency care. In order to ensure clarity and consistency, this study uses the following terminology throughout. *Emergency medical services*, or *EMS*, denotes prehospital emergency medical services, such as 9-1-1 and dispatch, emergency medical response, field triage and stabilization, transport by ambulance or

[1] One committee member resigned from the original 41-member body during the course of the study.

helicopter to a hospital, and between facilities. *EMS system* refers to the organized delivery system for EMS within a specified geographic area—local, regional, state, or national—as indicated by the context.

Emergency care is defined more broadly than *EMS* and encompasses the full continuum of services involved in emergency medical care, including EMS, hospital-based emergency department and trauma care, on-call specialty care, bystander care, and injury prevention and control. *Emergency care system* refers to the organized delivery system for emergency care within a specified geographic area. It is important to note that the committee's definitions of emergency care and emergency care systems may be more narrow than other definitions, such as the ones used by the federal Emergency Medical Services for Children Program, which also encompasses injury prevention and rehabilitation services.

Trauma care is the care received by a victim of trauma in any setting, while a *trauma center* is a hospital that is specifically designated to provide trauma care. Some trauma care is provided in settings other than a trauma center. *Trauma system* refers to the organized delivery system for trauma care at the local, regional, state, or national level. Trauma care is an essential component of emergency care. *Primary care* and *ambulatory care* are often mentioned in the context of the expanding role of the emergency department. It is usually described as the first point of care for patient except in emergencies. It is typically office- or clinic-based medical care that includes diagnosis, treatment, prevention, and on-going care management, and can include the establishment of patient-physician relationships, and continuity of care over time. Ambulatory care is all care that is provided outside the hospital. *Primary care* is a subset of *ambulatory care*, but we use them somewhat interchangeably throughout to the report to indicate the type of care that is typically given outside of the hospital, but is increasing being delivered in emergency departments.

For the purposes of this report, the terms *children* and *pediatric* denote infants, children, and adolescents through age 18. To avoid confusion, we use *Emergency Medical Services for Children* and *EMSC* only to denote the HRSA program itself.

ORGANIZATION OF THE REPORT

This report—one of a series of three—summarizes the committee's findings and recommendations regarding hospital-based emergency care:

- Chapter 2 describes the evolution of emergency and trauma care and the multiple roles currently served by the emergency care system—from care for those in urgent need to primary care for the uninsured, public health surveillance, and preparation for disasters.
- Chapter 3 defines the committee's broad vision for an emergency care system that is regionalized, coordinated, and accountable.
- Chapter 4 considers the efficiency of emergency and trauma care in the context of other industries, and explores applications of engineering techniques that can be used to improve the efficiency and quality of emergency services.
- Chapter 5 takes a focused look at the array of new information and clinical technologies that have the potential to transform medicine and emergency care over the next two decades, and offers guidance on how to prioritize these technologies to enhance emergency care most cost-effectively.
- Chapter 6 addresses workforce issues and focuses on one of the most serious problems confronting emergency and trauma care today—the shortage of specialists available to take

emergency call. It also addresses the neglected problem of provider safety and the need for better protections from the day-to-day hazards encounters in emergency care, a theme echoed in the next chapter in the context of threats of biological and chemical threats.

- Chapter 7 deals with disaster preparedness and the current lack of hospital surge capacity to address normal surges in ED visits, much less a major mass casualty event.
- Chapter 8 describes the significant achievements of emergency and trauma care research, and the vast range of opportunities for expanding the evidence base in basic, clinical, and health systems–oriented research. It also considers the meager funding that supports this critically important enterprise.
- Appendix A contains a chart of all committee and subcommittee members.
- Appendix B contains biographical information for members of the Main Committee and Subcommittee on Hospital-Based Emergency Care.
- Appendix C lists the presentations that were made to the committee during public sessions of the committee meetings.
- Appendix D lists the research papers commissioned by the committee.
- Appendix E provides additional statistical information about emergency department utilization, supplementing that in Chapter 2.
- Appendix F also supplements Chapter 2 by providing a description of the historical development of the emergency and trauma care fields.
- Appendix G summarizes the recommendations from all 3 reports in the *Future of Emergency Care* series in a table that indicates the entity with primary responsibility for implementation of each recommendation.

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2
The Evolving Role of Hospital-Based Emergency Care

The emergence of the modern emergency department is a surprisingly recent development. Prior to the 1960s, emergency rooms were often poorly equipped, understaffed, unsupervised, and largely ignored. In many hospitals, the emergency room was a single room staffed by nurses and physicians with little or no training in the treatment of injuries. It was also common to use foreign medical school graduates in this capacity (Rosen, 1995). In teaching hospitals, the emergency areas were staffed by junior house officers and faculty supervision was limited (Rosen, 1995). One young medical student in the 1950s described emergency rooms as "dismal places, staffed by doctors who could not keep a job—alcoholics and drifters" (University of Michigan, 2003).

Over four decades, the hospital emergency department has been transformed into a highly effective setting for urgent and lifesaving care, as well as a core provider of ambulatory care in many communities. An extraordinary range of capabilities converge in the ED—highly trained emergency providers, the latest imaging and therapeutic technologies, and highly trained on-call specialists in almost any field—all available 24 hours a day, 7 days a week.

The appeal of the modern ED is undeniable—it is in some ways all things to all people. To the uninsured, it is a refuge. To the community physician, it is a valuable practice asset. To the patient, it is convenient, one-stop shopping. To the hospital itself it is an escape valve for its strained inpatient capacity. The demands being placed on emergency care, however, are overwhelming it, and the result is a growing, national crisis. The decrement in emergency care capacity and quality, however, is almost invisible to those outside the system. Few people have regular contact with the emergency system. But when serious illness or injury strikes, the emergency system that they expect to be there may fail them, with catastrophic results. In this chapter, we explain the increasing demands on hospital-based emergency care, describe the nature of the crisis, and explore how it impacts the individuals day to day.

AN IMBALANCE BETWEEN DEMAND AND CAPACITY

In the decade between 1993 and 2003, the United States experienced a net loss of 703 hospitals, an 11 percent decline. The number of inpatient beds declined by 198,000, or 17 percent, and the number of hospitals with emergency departments declined by 425, a 9 percent decrease (AHA, 2005b). This sharp decline in capacity was largely in response to cost cutting measures and lower reimbursements by managed care, Medicare, and other payors, as well as shorter lengths of stay and reduced admissions due to evolving clinical models of care.

During this same period, the population of the United States grew by 12 percent and hospital admissions increased by 13 percent. Between 1993 and 2003, ED visits increased from 90.3 million to 113.9 million, a 26 percent increase, representing an average increase of more than 2 million visits per year (Figure 2-1) (McCaig and Burt, 2005). The outcome of the intersecting trends of falling capacity and rising use was inevitable. By 2001, 60 percent of U.S. hospitals reported that they were operating "at" or "over" capacity (Lewin Group, 2002).

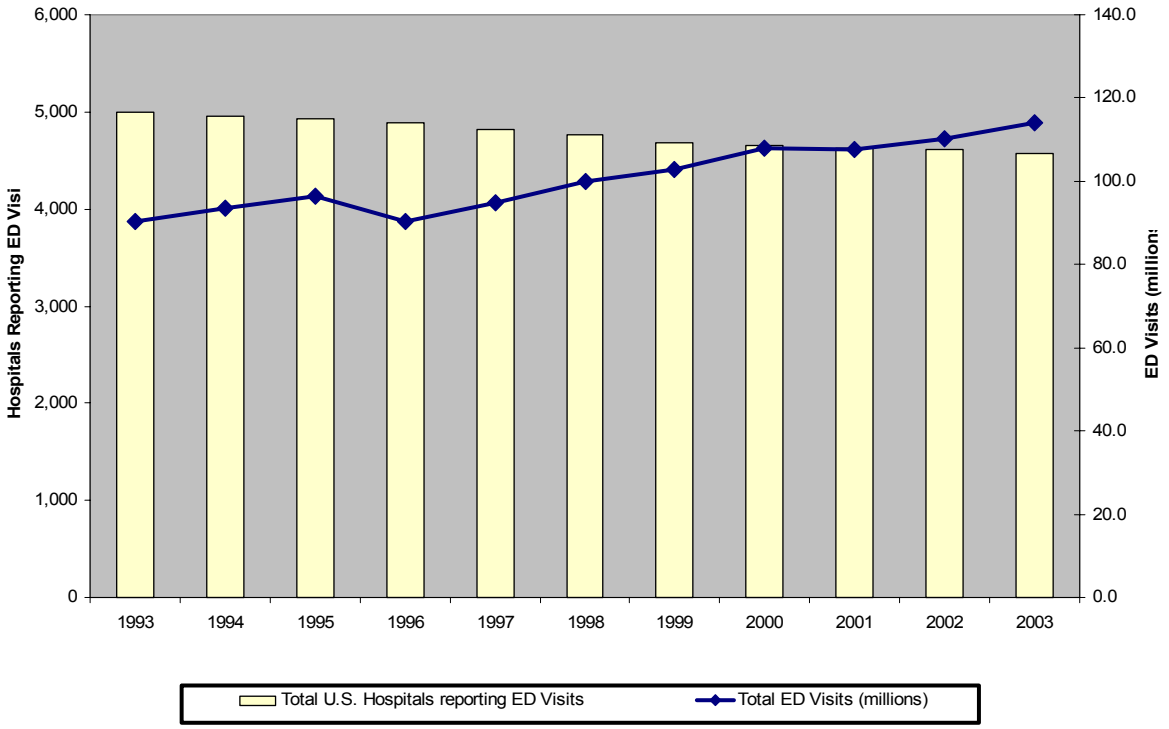

FIGURE 2-1 Hospital EDs versus ED visits.
SOURCE: AHA, 2005b; McCaig and Burt, 2005.

Not only is ED volume increasing, but patients are presenting with more serious or complex illnesses. The U.S. population is aging, and thanks to advances in the treatment of HIV, cancer, kidney and heart disease many have significant comorbidities and chronic diseases (Derlet and Richards, 2000; Bazzoli et al., 2003). These patients require more complex and time-consuming workups and treatments.

Consequences of the Imbalance between Patient Volume and Inpatient Capacity

When patient volume exceeds inpatient capacity, the excess volume tends to back up in the ED. This occurs for several reasons. First, of the normal flow of patients into the ED, some require hospitalization, some are treated and released, some are transferred, and a few die in the ED itself. Nationwide, about 13.9 percent of ED patients were admitted to the hospital in 2003 (McCaig and Burt, 2005); this represented about 43 percent of all hospital patients in 2002 (Merrill and Elixhauser, 2005).

When a hospital is full or beds are in very short supply, patients who require hospitalization are frequently held in the ED until an inpatient bed becomes available. When delays to accessing inpatient beds become excessive, these patients are commonly referred to as “boarders” because they are technically inpatients but cannot leave the ED. But “boarder” is a misnomer, because it implies that these patients require little care. In fact, ED boarders are often the sickest, most complex patients in the emergency department—which is why they require hospitalization. And

since these patients cannot be moved upstairs, the ED staff must provide ongoing care while simultaneously evaluating and stabilizing incoming emergency department patients.

The problem is depicted in Figure 2-2. By law, the front door of the emergency department is always open, and faces a growing public demand for its services. But when a hospital's inpatient beds are full, this creates a bottleneck to admitting the most severely ill and injured from the emergency department. As a result, patients who require hospitalization begin to back up in the ED (Andrulis et al., 1991; Asplin et al., 2003). The most common cause of this bottleneck is the inability to admit critically ill patients because all of the hospital's intensive care unit (ICU) beds are filled (GAO, 2003). High levels of hospital occupancy not only create ED "boarders"—the process can dramatically worsen ED crowding if community physicians who are unable to secure a bed for their scheduled admissions start sending patients through the ED instead. In either case, the normal congestion in the ED is increased.

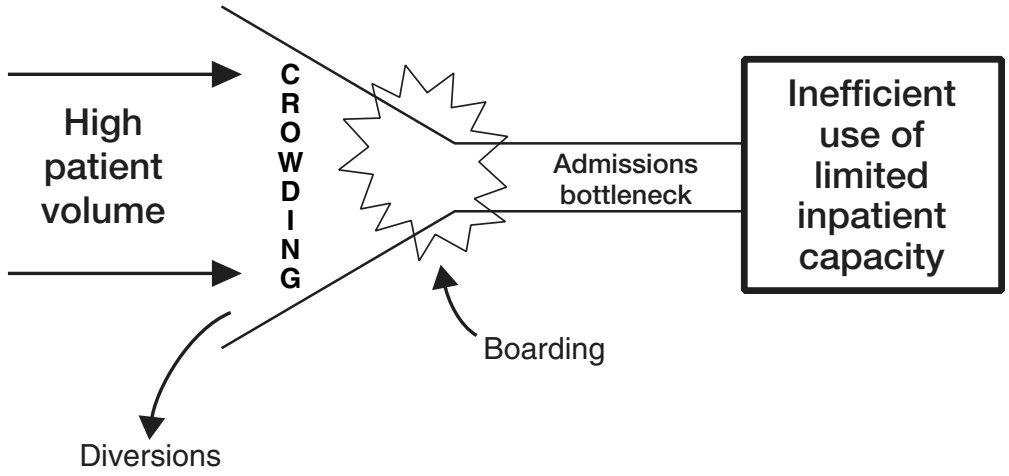

FIGURE 2-2 Consequences of the imbalance between patient volume and inpatient capacity.

The result of this imbalance is an epidemic of overcrowded emergency departments, frequent boarding of patients waiting for inpatient beds, diversion of ambulances, and patients who leave without being seen or leave against medical advice (Kellermann, 1991).

Overcrowding

Emergency department overcrowding is a nationwide phenomenon, affecting rural and urban areas alike (Richardson et al., 2002). In one study, 91 percent of EDs responding to a national survey reported overcrowding as a problem; almost 40 percent reported that overcrowding occurred daily (Derlet et al., 2001). Another study, using data from the National Emergency Department Overcrowding Study (NEDOCS), found that academic medical center EDs were crowded on average 35 percent of the time. This study developed a common set of criteria to identify crowding across hospitals that was based on a handful of common elements: all ED beds full, people in hallways, diversion at some time, waiting room full, doctors rushed, and waits to be treated greater than 1 hour (Weiss et al., 2004; Bradley, 2005).

Overcrowding can adversely impact the quality of care in the ED and trauma centers. It can

also lead to dangerous delays in treatment in the ED and can cause delays in EMS transport (Schull et al., 2003, 2004).

Boarding

The most common cause of ED crowding is the boarding of admitted patients in the ED. A GAO study found that 90 percent of hospitals in 2001 boarded patients at least 2 hours, and about 20 percent of hospitals reported an average boarding time of 8 hours (GAO, 2003). It is not unusual for patients in a busy hospital to board up to 24 or even 48 hours. In a point-in-time survey of nearly 90 hospital emergency departments across the country, on a typical Monday evening, 73 percent of hospitals reported boarding two or more patients (ACEP, 2003a). The potential for errors, life-threatening delays in treatment, and diminished overall quality is enormous (Andrulis et al., 1991; Conn, 1993; Litvak et al., 2001; Needleman et al., 2002; Schull et al., 2004).

Ambulance Diversions

Another indication of the degree of crowding is the frequency of ambulances being diverted to alternative hospitals—a now common, if not daily, event in many major cities. According to the American Hospital Association (AHA), nearly half of all hospitals (46 percent) reported time on diversion in 2004. Sixty-eight percent of teaching hospitals and 69 percent of urban hospitals reported time on diversion (AHA, 2005b). A GAO study found that 69 percent of hospitals went on diversion at least once in 2001 (GAO, 2003). A Massachusetts Department of Public Health survey indicated that 67 of 76 hospitals responding to the survey "either diverted or employed special procedures" during one week in February of 2001 to meet the demands on the ED (Massachusetts Department of Public Health, 2001). A report using NHAMCS data from 2003 indicated that 501,000 ambulances were diverted in 2003 (Burt et al., 2006).

There are so far limited data on the health outcomes associated with diversion. A 2002 study by the Joint Commission for the Accreditation of Healthcare Organizations (JCAHO) revealed that over half of all emergency department events described as sentinel were caused by delayed treatment (Delays in Treatment, 2002). According to an American Hospital Association (AHA) Survey, hospitals reporting 20 percent or greater time spent on diversion had longer wait times for treatment by a physician, longer average length of stay in ED treatment, longer wait times for transfer from the ED to an acute or critical care bed, and longer wait times for transfer from the ED to a psychiatric bed (Lewin Group, 2002). A study of trauma patients in Houston found that deaths among trauma patients were consistently higher than average on days with high levels of diversion, but differences were not statistically significant (Begley et al., 2004). In Canada, reports of a patient's death while en route to an open hospital since his local ED was on diversion have raised questions about the legality of ambulance diversion (Walker, 2002).

Ambulance diversions indicate a lack of ability to handle surges in the need for emergency care. If operating at a normal level forces ambulances on diversion on a regular basis, then in the event of a terrorist attack, natural disaster, or other severe and widespread medical emergency, the emergency system would be unprepared for the volume and severity of ED visits (Moroney, 2002).

Patients Who Leave Without Being Seen (LWBS)

About 1.9 million ED patients in 2003 left without being seen by a physician or other emergency care provider—1.7 percent of all ED patients, versus 1.1 percent in 1993 (McCaig and Burt, 2005). While the majority of these patients has low acuity levels, that is not always the case. Studies have shown that in some cases these patients were in need of immediate medical attention (Baker et al., 1991; Fernandes et al., 1997). One study revealed that those who left without being seen were twice as likely to report pain or a worsening of their problem. In another study, 27 percent returned to an emergency department and 4 percent required subsequent hospitalization (Bindman et al., 1991).

Crowding and wait times are important predictors of patients leaving (Fernandes et al., 1994; Hobbs et al., 2000). One study found that as emergency department utilization rises above capacity, more patients leave without being seen (Quinn et al., 2003). In addition to patients who leave without being seen, about 1.2 million patients, or 1 percent of all patients, left "against medical advice," in other words, once assessment or treatment had begun, but before its completion (McCaig and Burt, 2005).

THE EMERGENCY DEPARTMENT AS A CORE COMPONENT OF COMMUNITY AMBULATORY CARE

The "Safety Net of the Safety Net"

Hospital emergency departments are the provider of last resort for millions of patients who are uninsured or lack adequate access to care from community providers. The number of uninsured in the United States is now estimated to exceed 45 million Americans and continues to climb (DeNavas-Walt et al., 2005). That number is expected to reach between 51.2 million and 53.7 million by 2006 (Simmons and Goldberg, 2003). Some suggest that an additional 29 million Americans are underinsured, lacking sufficient coverage for essential medical care (O'Brien et al., 1999).

The IOM report, *America's Health Care Safety Net: Intact but Endangered*, called attention to the growing threats to the health care safety net—increasing number of uninsured; erosion of direct and indirect subsidies to providers, including Medicaid DSH and cost-based reimbursement to Federally Qualified Health Centers (FQHCs); and the continuing growth of Medicaid managed care, which lowers payments and diverts patients from core safety net providers (IOM, 2000). The IOM's five part *Insuring Health* series comprehensively examined the consequences of uninsurance in the United States. *A Shared Destiny: Community Effect of Uninsurance,* one of the reports from that series, demonstrated the impact of uninsurance on the demand for safety net services, and in particular, the burden that this places on an overextended emergency system (IOM, 2003). Many of these uninsured patients have no regular source of care, and fail to realize the benefits associated with having a primary care provider. An earlier IOM Report, *Primary Care: America's Health in a New Era*, examined the features of primary care—including integration of medical services; coordination of physical, mental, emotional and social concerns; sustained clinician-patient relationships--and documented the decrements in quality of care and health that result from inadequate public access to primary care (IOM, 1996). With limited access to community-based alternatives to the emergency system—public clinics, specialists, psychiatric facilities, and other services—many of these people turn to the emergency

system when in medical need, often for conditions that have worsened due to lack of primary care.

Because the emergency care system is the only component of the nation's safety net that must provide care to everyone, regardless of insurance coverage or ability to pay, hospitals have no option but to try to absorb these patients as best as they can. Community-based services, when faced with high demand, can restrict access to their services. Community health centers typically operate only during business hours, maintain long waiting lists, and may lack significant specialty and diagnostic services that are required to fully address their patients' needs. Emergency departments, however, have no such options—they are mandated to serve all who come. Without the ED to fall back on, other community safety net services would be equally overwhelmed. Thus, the emergency care system truly has become the "safety net of the safety net."

Nonurgent Utilization

Just over half of ED visits in 2003 were categorized as emergent or urgent, translating into needed care within 15 minutes to one hour of ED arrival, while about 33 percent of visits were categorized as semi-urgent or nonurgent, requiring attention within 1 hour or 24 hours, respectively (McCaig and Burt, 2004) (see Figure 2-3). Defining ED care as nonurgent or medically unnecessary is controversial because the terms are difficult to define and may vary depending on who is defining them. Is necessity determined by the patient's signs and symptoms at the time of arrival, or by the diagnosis at the time of hospital admission or discharge from the ED? A patient with chest pain would certainly consider this a proper reason to seek ED care, but a patient discharged with a diagnosis of "heartburn" might be judged by his insurer to have made an inappropriate ED visit. How likely is it that a physician, patient, and insurer will agree on the level of urgency of any given case? Around these gray areas, however, most would agree that there are patients who could be treated as well or better in a different setting, if this care was available.

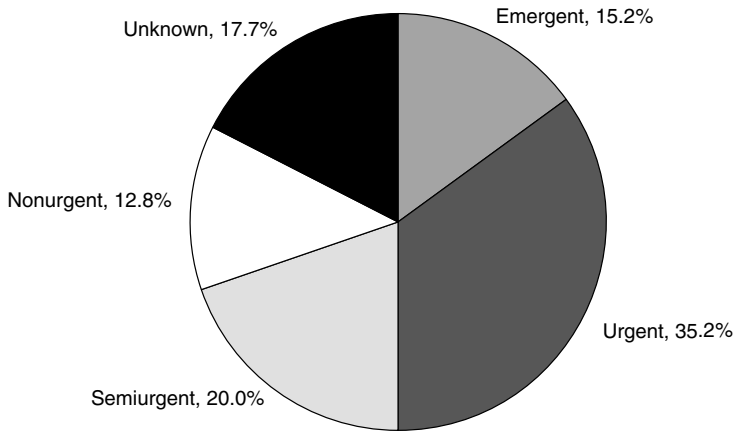

FIGURE 2-3 Percent distribution of emergency department visits by immediacy with which patient should be seen, 2003.
SOURCE: McCaig and Burt, 2005.

Other components of the health care system that serve large safety net populations have received substantial government support. For example, Community Health Centers (CHCs) are funded by a federal grant program under Section 330 of the Public Health Service Act and are administered by the Health Resources and Services Administration (HRSA). They received more than $1.7 billion in federal funding in 2005 and served an estimated 14 million patients. In fiscal year 2002, President Bush proposed a five year $780 million initiative to increase the number of CHC sites throughout the nation in order to reach an additional 6.1 million patients by the end of 2006. By the end of 2005, 428 new sites had been established, and many more had increased their medical capacity (HRSA Bureau of Primary Health Care, 2006).

A recent CDC report indicates that EDs represent an important component of the ambulatory care system (12.7 percent of all visits) (Schappert and Burt, 2006). The proportion is much higher in many rural and urban communities where the local ED is the principal provider. Despite their importance in providing ambulatory care and the legal requirement to accept all patients regardless of their insurance coverage or ability to pay, hospital emergency care receives little direct federal support.

Why Nonurgent Patients Use the ED

Research has identified several important determinants of nonurgent utilization of the ED. These include: financial barriers to alternatives to the ED; limited availability of alternative sources of care; referrals to the ED by community physicians; and patient preference for the ED over other alternatives.

Financial Barriers

Studies have shown that a significant number of patients utilize the ED for nonurgent concerns due to financial barriers. While often unable to access private physician practices, uninsured patients do have access to public health clinics operated by local and county health departments, including FQHCs. But these clinics are limited in number and geographic distribution. In addition, they may have limited hours, long waits, and queues for new patients. Unlike EDs, they are neither typically open 24/7, nor required by law to accept all who come. They may also have limited services. For example, many provide primary care services, but lack the resources to provide specialty care and diagnostic services. A recent study suggests that expanding primary care capacity may actually increase demand for emergency department care (Cunningham and May, 2003). The authors suggest that patients with access to primary care are more likely to seek specialty care and diagnostic services. If this is the case, an expansion of access to primary care services in the community may further increase ED visits.

Although Medicaid beneficiaries have a source of payment for medical care, the rates of reimbursement are so low that the number of office-based practitioners who are willing to accept Medicaid patients is low (The Medicaid Access Study Group, 1994). Oster and Bindman (2003) found that uninsured and Medicaid patients have higher rates of ED utilization and are less likely to have a follow-up visit scheduled with a regular physician. In a study by the Medicaid Access Study Group, research assistants posing as Medicaid patients attempted to secure appointments with clinics and physician practices. Fifty-six percent of these providers declined to give an appointment and the most prevalent reason given was “not accepting Medicaid.” When asked for an alternative, most either offered none, or advised the caller to “go to an emergency room” (The Medicaid Access Study Group, 1994). Asplin and colleagues found that similar barriers to

follow-up care exist, even following an ED visit for a serious health problem (Asplin et al., 2005). Research assistants posing as ED patients telephoned doctors offices and clinics to schedule an urgent follow-up visit for a serious problem diagnosed in the ED (pneumonia, severe hypertension, or suspected ectopic pregnancy). When callers stated that they had private insurance coverage, they were almost twice as likely to get an appointment as the same callers when they stated that they were covered by Medicaid. They were about 2.5 times more likely to get an appointment than the same caller posing as an uninsured patient stating a willingness to pay $20 up front and arrange for complete payment later. Of note, nearly 98 percent of clinics specifically inquired about the caller's ability to pay, but only 28 percent inquired about the caller's health.

One consequence of Medicaid patients' lack of primary care access is greater reliance on the emergency department. Medicaid recipients use the ED more than any other group, and their rate of utilization is increasing—81 visits per 100 persons in 2003, versus 65.4 per 100 the year before. This is double the rate of the uninsured population (41.4 percent) and nearly four times that of privately insured patients (21.5 percent) (McCaig and Burt, 2005). All but privately insured individuals also increased their utilization rates from the year before (McCaig and Burt, 2004, 2005). From numerous studies, we also know that Medicaid patients disproportionately utilize the ED for nonurgent conditions, often relying on the ED as their primary source of care (Cunningham et al., 1995; Liu et al., 1999; Sarver et al., 2002; Irvin et al., 2003b). This appears to be largely due to lack of access to care in other settings.

Limited Alternative Sources of Care

Even in the absence of financial barriers, patients may utilize the ED because of limited access to alternative sources of care. For example, nonurgent use of the ED is greater in rural areas—visit rates were about 15 percent higher in non-metropolitan areas that in metropolitan areas (McCaig and Burt, 2005)—where the limited number of primary care providers limits alternatives to the ED. Having a usual source of care deters utilization of the ED for nonurgent scenarios (Petersen et al., 1998). Even patients with a usual source of care, however, frequently utilize the ED after hours when clinics and physicians' offices are closed. Recent trends in utilization indicate that insured patients, who are less likely to face financial barriers, are utilizing the ED in larger numbers (Cunningham and May, 2003). But the most common reason "walk in" patients seek care in the ED is because they are experiencing painful or worrisome symptoms that they believe require immediate evaluation and treatment (Young et al., 1996).

The ED as an Adjunct to Physician Practices

There is evidence that physicians and clinics are increasingly utilizing the ED as an adjunct to their practices, referring patients to the ED for a variety of reasons, including their own convenience after regular hours, reluctance to take on complicated cases, the need for diagnostic tests that they cannot perform in the office, and liability concerns (Berenson et al., 2003; Studdert et al., 2005). In a three-site study in Phoenix, AZ, researchers found that while two-thirds of patients did not contact a health professional prior to their ED visit, of those who did contact a provider, 80 percent were referred to the ED (St. Luke's Health Initiative, 2004). The Medicaid Access Study Group found that a plurality of clinics that declined to see Medicaid patients with minor problems offered any advice about alternatives. The second most common option was to tell the caller to seek care in an emergency department. Young's national study of

ambulatory use of hospital emergency departments revealed that 19 percent of "walk in" patients were instructed to seek care in the ED by a health care provider (Young et al., 1996). This phenomenon, sometimes called "physician deflection", is likely to accelerate in the future because primary care offices will be unable to keep up with the technological advances needed to address complex patient needs. Office physicians may consider potentially acute patients to be safer in the ED. Private offices therefore often refer patients directly to the ED even if appointments are available. In addition, it has also become almost the only way to get referrals to certain specialties, since specialists refuse Medicaid in many cases. Chronic disease management, medication management, counseling, and case management resources, on the other hand, are areas that primary and specialty care ambulatory practices should be able to provide as an alternative to the ED.

Patient Preference

Patients are increasingly utilizing the ED for convenience in seeking timely resolution of health care problems (Young et al., 1996; Guttman et al., 2003). Some patients use the ED if they feel they need immediate attention but cannot see their primary care provider within 24 hours (Stratmann and Ullman, 1975; Andren and Rosenqvist, 1985). Patients who try to reach their physicians by phone in the evening or on weekends might have difficulty getting through, or may be instructed to use the ED. Patients with primary care providers with extended evening office hours or weekend office hours have been associated with lower rates of ED utilization (Lowe et al., 2003).

Patients may also have a preference for the ED if they believe that this is the best place to get access to specialized equipment (Roth, 1971; Smith and McNamara, 1988; Brown and Goel, 1994). Increasingly, admitting physicians are insisting that EDs complete very detailed workups before they will admit a patient to the hospital. This may partly explain the increasing utilization of diagnostics such as MRIs and CAT scans in the ED, up 103 percent according to the CDC from 1992–1999. It is possible that some patients view the ED as a convenient site for one-stop shopping. Even with a wait of 2 or more hours, they are able to satisfy all of their needs in a single visit to the ED, and avoid possibly much longer total time spent seeking care and diagnostic testing from multiple providers.

Concerns about Nonurgent Utilization

The delivery of nonurgent care in the ED is of concern for three reasons: First, the primary care delivered in the ED may be of lower quality than in other settings. The emergency department is designed for rapid, high intensity responses to acute injuries and illnesses. It is fast-paced and requires intensive concentration of resources for short durations. Such an environment is ill suited to the provision of primary care and preventive care (Derlet and Richards, 2000). Physicians in the ED typically don't have a patient relationship, often lack complete patient medical records, face constant interruption and distraction, and have no means for patient follow-up. Further, because they have low triage priority, these patients have extremely long wait times—sometimes 6 hours or more.

Second, nonurgent utilization may be less cost-effective than in other settings. Emergency departments and trauma centers are expected to provide a full array of services on a 24/7 basis, and the fixed costs associated with maintaining this readiness can be substantial. On the other hand, this standby capacity is likely to result in low marginal costs, making it efficient to provide

non-urgent care in the ED, at least during slack periods.

The literature is mixed on this issue. Some studies support the notion that nonurgent care costs in the emergency setting may be substantially higher than in a primary care setting (Fleming and Jones, 1983; White-Means and Thornton, 1995). High costs may result from the frequent lack of patient records and inability to construct a patient history, which result in a high frequency of full workups (Murphy et al., 1996). ED charges for services for minor problems have been estimated to be 2 to 5 times higher than a typical office visit (Kusserow, 1992; Baker and Baker, 1994), resulting in $5–$7 billion in excess charges in 1993 (Baker and Baker, 1994). While studies of charges probably overestimate the excess cost, they are nevertheless substantial. Bamezai and colleagues used data on all California hospitals with EDs from 1990 to 1998 to calculate average outpatient ED costs ranging from $116 to $130 for non-trauma EDs and $171 to $215 for Trauma EDs, depending on volume (Bamezai et al., 2005).

In contrast, Williams studied a sample of 6 hospitals in Michigan, and found that average and marginal costs of ED visits were quite low, especially for those classified as nonurgent, perhaps below the cost of a typical physician visit (Williams, 1996). However, if as a result of the increased use of nonurgent care, hospitals build additional high cost emergency department capacity, then the true cost of treating nonurgent care in the ED will be much higher than just the marginal or average cost of treating such patients.

Third, nonurgent utilization may detract from the ED's primary mission of providing emergency and life-saving care. Regardless of their efficiency on average, ED resources are not unlimited. When the ED becomes saturated with patients who could be cared for in a different environment, there are fewer resources in terms of physicians, nurses, ancillary personnel, equipment, time, and space available to respond to the population of emergent patients.

Identifying Nonurgent Visits

Identifying nonurgent visits is not a simple matter. The inability of patients to accurately distinguish between emergent and urgent and nonurgent conditions has been documented (Lowe and Bindman, 1997). Patients may overestimate the urgency of their condition—in one study, 82 percent of nonurgent patients considered their condition to be urgent (Gill and Riley, 1996). On the other hand, many nonurgent patients understand that their condition is not emergent—they utilize the emergency department for a variety reasons, knowing that they can receive nonurgent care. In a case study of over 400 individuals using the ED, researchers found that more than one-third of patients described their condition as other than an emergency (Guttman et al., 2003).

An even more important question is how many urgent patients underestimate the urgency of their condition—such a miscalculation could delay care and have catastrophic consequences. A survey of patients across 56 hospital EDs nationwide found that 5 percent of patients who viewed their condition as nonurgent were subsequently admitted to the hospital (Young et al., 1996). In another study, using NHAMCS data from 1992–1996, 4 percent of nonurgent patients were subsequently hospitalized (Liu et al., 1999). These studies probably underestimate the magnitude of the problem because they do not account for patients who never show up at the emergency department because they underestimate the urgency of their condition. Further, indirect evidence for patients underestimating the urgency of their condition is suggested by the failure to call 9-1-1 in cases of heart attacks and other life-threatening emergencies (National Heart Attack Alert Program (NHAAP) Coordinating Committee, 2004), although other factors such as feelings of embarrassment and loss of control also play a role in the failure to call EMS.

The bottom line is that attempts to eliminate nonurgent visits should not discourage patients

from seeking help at the ED, in particular when the condition lies in the gray area where the distinction between life-threatening emergencies and nonurgent acute episodes is blurred. It is important that patients can choose the ED if they are uncertain about where on this spectrum their particular condition falls.

Scheduled Versus Unscheduled Visits

A useful way to conceptualize the utilization of ED services is to consider them within the broad context of all health care services within a community. Services can be categorized according to whether they are scheduled or unscheduled. Scheduled services are those that are predictable and planned—they include regular doctor visits and scheduled surgeries, for example. Unscheduled services are those that are unpredictable and irregular due to unexpected injuries or illnesses, such as a heart attack, trauma from a car crash, or sports injuries (Asplin et al., 2003).

Scheduled and unscheduled visits are illustrated in Figures 2-4a and 2-4b. In each figure, the area of the entire box represents all health care visits. The blocks on the right side represent services that are related to preexisting chronic conditions, for example, asthma or congestive heart failure, while those on the left side are not related to a chronic condition. The top two blocks represent visits for primary care services such as preventive care and management of chronic conditions, which are largely scheduled in nature. The middle 2 blocks represent visits that are typically unscheduled, including acute exacerbations of chronic disease, such as a severe episode of asthma, and acute episodic illness and injury, which may include a case of the flu or a sports injury. (Note that a small proportion of preventive services are included in unscheduled visits.) The bottom block represents life-threatening emergencies, such as heart attacks and serious traumatic injuries.

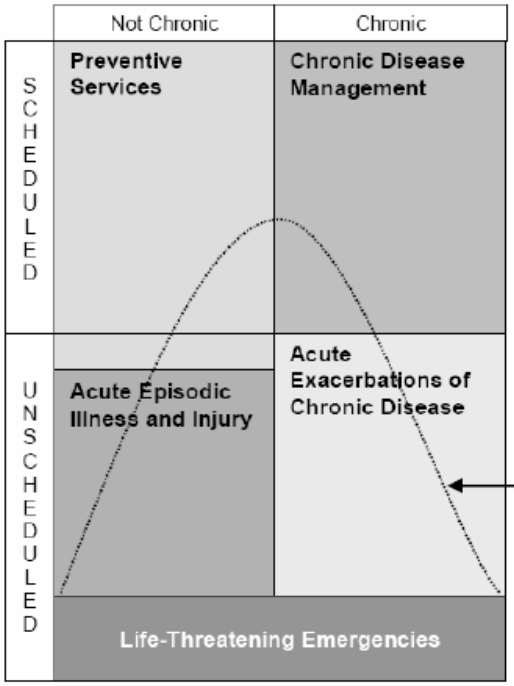

FIGURE 2-4a Current distribution of all health care visits.

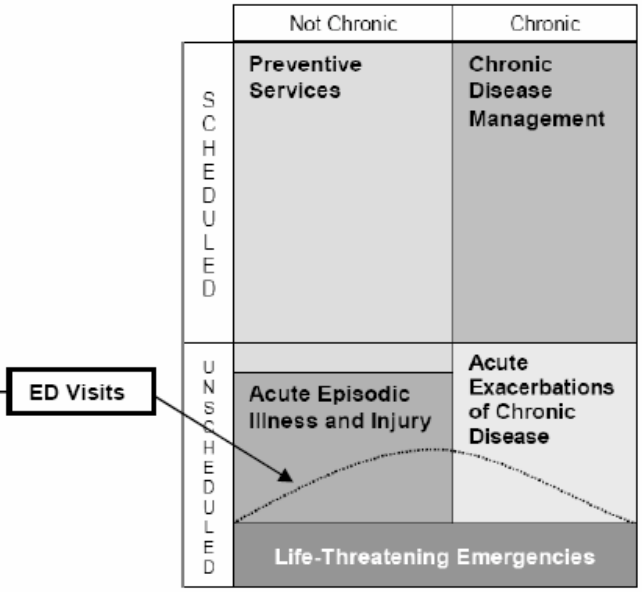

FIGURE 2-4b Ideal distribution of all health care visits.

The ED is one of many sites in the health care delivery system that might provide the types of services in the top four boxes, while the bottom box is, ideally, the exclusive domain of emergency departments and trauma centers. The area underneath the dashed line indicates care that is provided within the ED. The vast majority of scheduled care will occur outside of the ED at provider locations throughout the community—e.g., doctors offices, diagnostic facilities, hospital inpatient facilities. Likewise, sites outside of the ED will deliver a large proportion of unscheduled care for both acute episodic illness and injury and acute exacerbations of chronic disease. The relative size of each section within the figure, along with the location of the line depicting the ED's role, will vary depending on various factors. Aday and Anderson (1974) proposed a model of community access to medical care that describes these factors as predisposing factors—such as the health status of the community and the amount of preventive care that is provided—and enabling factors, that increase or reduce barriers to access—such as insurance coverage and the supply of physicians and other services.

Figure 2-4a represents a hypothetical distribution of medical services between emergency departments and other providers that is typical of many communities today. Preventive services and chronic disease management are provided mainly outside the ED, while acute illnesses and exacerbations of chronic disease are often treated in the ED.

One can envision variations of Figure 2-4a based on differences between communities or groups of patients. For example, suburban and rural community hospitals are likely to look quite different than urban safety net hospitals—urban hospitals have been shown to have 25 percent more nonurgent cases and 10 percent more patients presenting with emergent conditions that are primary care treatable than other hospitals (Burt and Arispe, 2004).

The relative dimensions of the blocks are also likely to vary over the 24 hour cycle. There is evidence that a significant portion of the nonurgent care that is provided in the ED is provided during evenings and weekends, when alternative providers are not available. Visits associated with chronic care management and acute exacerbations of chronic disease are likely to increase during the evening and night hours due to the lack of alternative community providers, reducing the boxes associated with these visits.

Communities with strong access to preventive care and chronic disease management services outside the ED may have less demand for such care in the ED. More importantly, by improving health and reducing the frequency of acute episodes, the proportion of unscheduled care in the community may be reduced. Improved preventive care may also reduce the need for chronic care management itself. These effects are shown in Figure 2-4b as a smaller row representing unscheduled care, a smaller column representing chronic care visits, and a dashed line indicating a smaller amount of care delivered in the ED. Better access to chronic care management and preventive care may also reduce the amount of care for life-threatening emergencies, also shown in Figure 2-4b by the reduced size of the bottom box. For example, communities that do a better job of managing asthma care will have fewer and less severe acute asthma attacks among the population.

This story is complicated somewhat by Cunningham and Hadley's observation that increased access to community clinics resulted in increased use of the ED, presumably because enhanced primary care heightened the demand for a limited supply of specialized and diagnostic care (Cunningham and Hadley, 2004). It also ignores a potentially important long term effect of prevention and chronic disease management—that increasing lifespans may result in an increase in the amount of medical care demanded overall.

Other versions of Figures 2-4a and 2-4b might include a 'nightmare scenario', which

combines the coming burden of chronic disease that we face with the aging of the baby boomers with a system that continues to manage chronic disease in a disorganized and uncoordinated fashion. In this scenario, the entire area of the box would be larger, and the amount of care provided in the ED, especially acute exacerbations of chronic disease, would be extremely high.

REIMBURSEMENT FOR EMERGENCY AND TRAUMA CARE

There is substantial evidence that reimbursement to safety net hospitals is inadequate to cover the costs of emergency and trauma care. Of the 114 million ED visits in 2003, 36 percent had private insurance, 21 percent were enrolled in Medicaid or SCHIP, and 16 percent were covered by Medicare (see Figure 2-5). The payor mix varies widely across hospitals, however, and differences in payor mix can have a substantial impact on a hospital's financial condition. Some hospitals treat a large number of uninsured patients, many of whom are unable to pay for their care. To address this gap, the Centers for Medicare and Medicaid Services (CMS) provides Disproportionate Share Hospital (DSH) payments to these hospitals, as well as payments for treating undocumented aliens. A number of states also provide additional support to emergency and trauma systems through general revenues or special taxes.

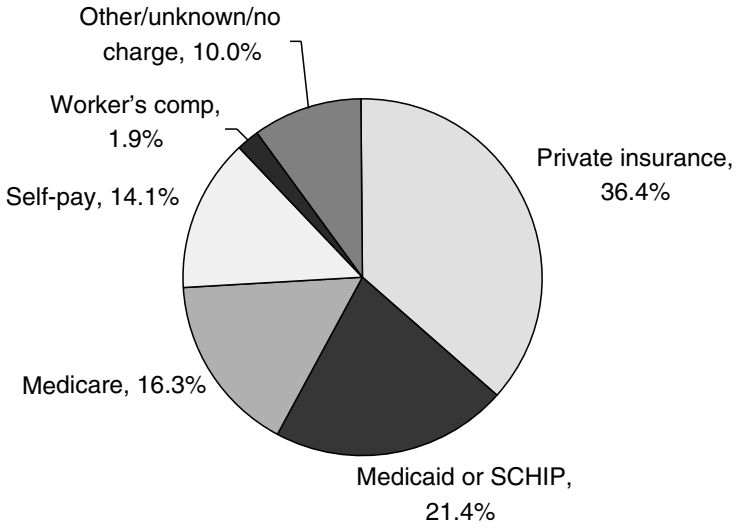

FIGURE 2-5 Payment sources for ED visits, 2003.
SOURCE: McCaig and Burt, 2005.

The Uninsured, or Self-Pay

The uninsured utilize the ED at a significant rate—about 41.4 visits per 100 individuals in 2003, and they represented 14.1 percent of all ED utilization in 2003 (McCaig and Burt, 2005). A recent study documented that ED use by uninsured patients is increasing (Cunningham and Hadley, 2004). The rate of reimbursement for services provided to these patients is difficult to quantify, but is known to be quite low—and they account for a large proportion of the losses associated with hospital ED and trauma care.

Medicaid

Medicaid payment methods vary by state. The most common method is fee-for-service, which is used in 23 states. This is followed by a cost-based reimbursement system. A prospective payment system similar to that of Medicare (Kaiser Commission on Medicaid and the Uninsured, 2003) is used by some states, and many states use a combination of methods. Medicaid payments are supplemented by Medicaid Disproportionate Share Hospital (DSH) payments to offset losses for hospitals with high levels of uncompensated care. These payments are extremely variable, and in many states DSH money is diverted to wholly unrelated areas, such as long term care (Ku and Coughlin, 1995; IOM, 2003). It is of note that hospitals that serve a large proportion of Medicaid patients but few uninsured will fare better than hospitals that serve few Medicaid patients but a large proportion of uninsured (Fagnani and Toblert, 1999; IOM, 2003). Current legislative proposals would fold DSH payments into block grants, further diluting their contribution to funding safety net emergency and trauma care.

According to AHA, 73 percent of hospitals lose money providing emergency care to Medicaid patients while 58 percent lose money for care provided to Medicare patients (AHA, 2002).

Medicare

Medicare enrollees represent 16.3 percent of ED utilization and visit the ED at a rate in between Medicaid and uninsured patients, 52.4 per 100 enrollees in 2003. Medicare reimburses hospitals through a prospective payment system that pays a set amount for a given type of care. Over 80 percent of ED care falls under the five emergency care CPT codes that are based upon the intensity of the service—from Code 99281 for a self-limited or minor problem, through Code 99285 for an ED visit of high severity that requires urgent evaluation and poses an immediate and significant threat to the patient's life or physiological function (AMA, 2003). However, when ED patients are admitted to the hospital, the emergency care payment is subsumed by the hospital DRG payment instead of using the CPT-based payment. Medicare considers all emergency care given within 72 hours prior to a hospital inpatient admission as related to that admission. From the perspective of the hospital's accounting ledger, the ED may appear to be less profitable because the hospital can readily tabulate the costs of operating the ED, but revenue for admissions that enter the hospital through the ED are credited to its inpatient units (MedPAC, 2003).

Medicare DSH payments are a percentage addition to the basic DRG payments and are applied to hospitals that have a certain level of uncompensated care. The calculation of DSH payments is determined by a complex formula (CMS, 2004).

Private Health Insurance

Privately insured individuals represent the largest single group in terms of visits to the ED, but the lowest rate of use (21.5 per 100). Private insurance companies use a wide variety of reimbursement methods, and payment rates are not generally known to the public. In some cases, services are not reimbursed because of a denial of payment by the insurer. According to guidelines established in the Medicare Modernization Act (MMA), payment is to be based on Medicare's "reasonable and necessary" requirement on the basis of signs and symptoms at the time of treatment, and not retrospective evaluation of the primary diagnosis (ACEP, 2003b). Nonetheless, a recent study of two HMOs in California found that one of the categories of most

frequent denials was emergency care (17 percent, and 16 percent of these requests were denied) (Kapur et al., 2003). The reason cited for almost every denial was that the visit was not deemed an emergency according to the "prudent layperson standard".[1] But a follow-up study found that patients prevailed in over 90 percent of appeals involving emergency department care (Gresenz and Studdert, 2004).

Payment for services may be denied for a number of reasons. Insurers may have some incentive to delay physician credentialing, because it may offer a legally valid reason to deny payment if patients have not seen a "participating provider." There may be some instances where payment is denied if a patient's primary care provider was not contacted, although the more stringent forms of gate keeping of the 1990s have faded.

Undocumented Aliens

A recent change in Medicare represents some attempts to provide funding for undocumented aliens. The estimated annual cost to emergency care providers (hospitals and prehospital EMS) nationwide for undocumented aliens is $1.45 billion; the cost to the 28 counties along the boarder in Texas, New Mexico, Arizona, and California is $232 million (MGT of America, 2002). The MMA provides $250 million per year for fiscal years 2005–2008 for payments for unreimbursed emergency health services provided to undocumented aliens and other specified aliens.

Trends in Reimbursement

According to data from the Medical Expenditure Panel Survey (MEPS),[2] there is a growing gap between charges and payments for emergency services. The average combined *charge* for physician and hospital/facility services in the MEPS 2001 sample was $943, a 49 percent increase since 1996. The average *payment* was $492, a 29 percent increase since 1996. Thus, payments have increased but have not kept pace with charges, with average reimbursement rates declining from approximately 60 percent in 1996 to 52 percent in 1998.[3]

THE FINANCIAL IMPACT ON EMERGENCY AND TRAUMA CARE

In most hospitals, if reimbursements fail to cover ED and trauma costs, these operations are cross-subsidized by the admissions that originate in the ED. But uncompensated care is an extreme burden at many large, urban, safety net hospitals that have large numbers of uninsured patients (Burt and Arispe, 2004). These hospitals often bear an increasing burden as surrounding community hospitals go on diversion to preserve the relative calm of their EDs. Further, surrounding hospitals tend to transfer complex, high-risk patients to the large safety net hospitals

[1] This standard says that health insurers must cover emergency services obtained by patients if a reasonable layperson would have interpreted the symptoms as requiring such emergency care, regardless of whether the patient seeks prior authorization from the insurer. The prudent layperson standard has been adopted by 47 states (Sloan and Hall, 2002).

[2] MEPS data is based on Tsai and colleagues (Tsai et al., 2003) and calculations by McConnell and Lindrooth, reported in their commissioned paper for this study, *The Financing of Hospital-Based Emergency Department Services and Emergency Medical Service*s (available upon request).

[3] It should be noted that neither the charge nor the payment represents the true cost of care, which is very difficult to determine. The concern with the growing gap is based on an assumption that the increase in charges is a reflection of the increase in true costs.

for specialized care (Reilly et al., 2005). In many cases, the condition of these patients has deteriorated considerably since arriving at the first hospital (Byrne and Bagan, 2004). The spate of hospital, ED, and trauma center closures in California and elsewhere is indicative of the severity of the problem (Lambe et al., 2002; Vogt, 2004; Melnick et al., 2004; Kellermann, 2004; Fields, 2004; Dauner, 2004).

Public hospitals, which provide a substantial amount of safety net care, are especially hard hit. A member survey conducted by the National Association of Public Hospitals (NAPH) found that while NAPH member hospitals represent only 2 percent of all U.S. hospitals, they provided almost a quarter (24 percent) of all uncompensated hospital care in the U.S. (Huang et al., 2005). Twenty-one percent of NAPH hospitals' costs were uncompensated, versus 5.5 percent for all hospitals. For 56 percent of NAPH hospitals, Medicaid payments did not cover costs, and for 90 percent of NAPH hospitals Medicare payments did not cover costs—in the aggregate, Medicare covered only 80 percent of costs. A significant part of the losses of public hospitals was associated with the provision of emergency and trauma care—on average these hospitals had 3 times the volume of emergency visits than all U.S. acute care hospitals.

While these problems are national in scope, certain localities have seen particular problems. For example, Los Angeles has seen nine hospital EDs close since 2003 (Robes, 2005), bringing the total ED closures to over 60 in the last decade (California Medical Association, 2003). That includes the recent closure of the East Los Angeles hospital, in operation for 90 years, and mostly serving the Latino population. It lost more than $800,000 in ED operations in 2001–2002 (Coalition to Preserve Emergency Care, 2004). In addition, Los Angeles has lost 10 trauma centers since the 1980s (Chong, 2004). This reflects a statewide trend in ED financial losses; California EDs lost $460 million statewide in FY 2001–2002, an increase of 18 percent from the year before and 58 percent since the 1998–1999 FY (California Medical Association, 2004).

Trauma services represent a particular financial drain in safety net hospitals. For example, in Houston, the two level I and five level III trauma centers had $32 million in unreimbursed costs in FY 2001, resulting in losses of 19 million (Bishop+Associates, 2002a). Statewide, there were losses of $181 million in direct trauma costs in the state's 21 trauma centers, not including standby/readiness costs (Bishop+Associates, 2002b).

A separate study examined trauma costs in 5 public and five private/non-profit trauma centers in Texas for FY 2001. Public trauma centers had a median operating loss of $18.6 million, a 54 percent increase over the previous year. The private/non-profit trauma centers had a median operating loss on trauma care of 5.5 million dollars. The trends were attributed to the increasing number of uninsured in Texas—Texas leads the nation with 24 percent of the population uninsured—and a decline in DSH payments by $26 million over the previous year (Clifton, 2002).

In Florida, an analysis of 18 of the state's 21 trauma centers in 2003–2004 found that these centers had an aggregate loss of $92 million in combined uncompensated direct care and standby/readiness costs (e.g., the costs of maintaining standby ICU, staff, and on-call specialists for trauma services on a 24/7 basis) (The University of South Florida, 2005). One study measured three components of the cost of maintaining readiness for trauma—including 24/7 specialist coverage, costs of verification, and costs of outreach and prevention. The median annual costs were 2.7 million dollars, and the majority of this was stipends for specialist coverage (median = $2.1 million) (Taheri et al., 2004).

Consistent with all of these findings was a study of a single medical center in 1999 that found that the mean reimbursement of trauma was only 36 percent of charges. No reimbursement

was obtained for 26 percent of the patients, and reimbursement did not cover costs in 56 percent of patients. Transfers had significantly lower reimbursement than other trauma cases, indicating the potential dumping of patients from community hospitals (Lanzarotti et al., 2003). In contrast to these findings for safety net hospitals, one study found that trauma services contributed substantially to the profitability of hospital with a favorable payor mix—43 percent of trauma patients in this study had private insurance (Breedlove et al., 2005).

The evidence suggests that the burden of providing uncompensated services is placing communities at risk by failing to ensure the continued financial viability of a critical public safety asset—the 24 hour availability of critical life-saving emergency and trauma services. Consequently, the committee believes that the emergency care system requires a special funding source, separate from the regular DSH formula, to adequately compensate hospitals and physicians for the burden of providing services to uninsured and underinsured populations. To ensure the continued viability of a critical public safety function, the committee recommends that **Congress establish dedicated funding, separate from DSH payments, to reimburse hospitals that provide significant amounts of uncompensated emergency and trauma care for the financial losses incurred by providing those services.**

The committee considers it to be beyond its expertise to accurately determine the optimal amount of funding to allocate for this purpose, which could run in the hundreds of millions of dollars. It further recommends that **Congress initially appropriate $50 million for the purpose, to be administered by the Centers for Medicare and Medicaid Services. CMS should establish a working group to determine the allocation of these funds, which should be targeted to providers and localities at greatest risk; the working group should then determine funding needs for subsequent years.** This will help to staunch the loss of ED capacity in many communities, protect nearby hospitals from a domino effect of spikes in demand, and help to ensure the continued viability of the nation's vital emergency and trauma system. The new funding, however, should be targeted only to hospitals that provide a substantial amount of unreimbursed care to uninsured or underinsured patients in their EDs. Also, this new funding should be tied to hospital performance reporting, participation in coordinated regional systems, improvements in efficiency, reduced boarding and diversion, and improved quality of emergency and trauma care.

State Funding for Emergency and Trauma Capacity

EMS, emergency, and trauma care are often supported through local and state taxes. But only a handful of states have established dedicated funding sources to support emergency care. A description of funding approaches used by the states is shown in Table 2-1. Maryland, for example, imposes a surcharge on motor vehicle registration fees to fund its state-wide trauma and EMS system (National Conference of State Legislatures, 2005). Pennsylvania uses fees from the accreditation process to support a state agency charged with verifying and accrediting all trauma centers on a three year basis. In addition this agency must meet or exceed the standards for trauma centers, programs, providers, data reporting and performance improvement of the American College of Surgeons. The results of the process are public and reported to the state department of health. Pennsylvania guaranteed support to its trauma system by modifying its insurance statutes to ensure that accredited trauma centers receive hospital and professional reimbursement at the charges level, rather than the more common and lower Medicare level, for all motor vehicle crash-related care and workmen's compensation patients.

Other states rely on a wide range of funding mechanisms. California collects funds from traffic fines, but in the last election, voters declined to impose an additional 3 percent surcharge on telephone bills to support emergency medical services. Ohio uses penalties from failure to wear a seat belt, license reinstatement fines, and forfeited bails. Wisconsin has considered adding one dollar to the vehicle registration fee or driver's license renewal. Surcharges for 9-1-1 phone service have also been used to generate funds to subsidize trauma care. Firearms registration and fines for illegal discharge of firearms are two other potential sources of subsidies that are directly related to the incidence of trauma. It is extraordinary that more states do not support EMS, trauma, and emergency care in this manner. This may relate to the wide gap between public perception and the reality of the emergency care system. A recent survey found that the public has extremely high expectations of the trauma system, but has limited appreciation of the problems that exist (Harris Interactive, 2004).

TABLE 2-1 Revenue Statutes to Fund Trauma Care Organized By Topic

Statute	AZ	CO	FL	IL	KS	MD	MI	NE	OH	OK	PA	TX	UT	VA	WA
911 System Surcharges												X			
Controlled Substances Act Violations				X											
Court Fees, Fines, and Penalties				X	X				X				X		
Intoxication Offenses - Not Limited to Motor Vehicles												X			
Motor Vehicle Fees, Fines, and Penalties		X	X	X		X	X	X	X	X	X	X		X	X
• motor vehicle registration		X				X		X		X					
• tax on motor vehicle license			X												
• DUI related				X								X		X	
• distinctive license tags fee							X								
• violation of child restraint laws									X			X			
• seatbelt violations									X			X			
• open container violation										X					
• drivers license fee										X					
• reinstating revoked license fee									X	X					
• driving with revoked or suspended license										X					
• fine on specific traffic violation											X	X			X
• non-motor vehicle intoxication												X			
• sale or lease on new															X

Statute	AZ	CO	FL	IL	KS	MD	MI	NE	OH	OK	PA	TX	UT	VA	WA
vehicle															
Sales Surtax			X												
Tobacco Tax	X														
Trauma Facility Penalty		X													
Tribal Gaming	X														
Weapons Violations				X											

SOURCE: HRSA, 2004.

THE CHALLENGES OF MENTAL HEALTH AND SUBSTANCE ABUSE

Patients with mental health and substance abuse problems constitute a small proportion of ED utilization, but they place an inordinate burden on the emergency care system. There is also evidence that the psychiatric and substance abuse care received in EDs is sometimes less than optimal. On the other hand, it fills a critical need, as the broader health system often fails to provide adequate access to this care.

Mental Illness

Patients with mental illness represent a considerable and growing number of all ED visits. Between 1992 and 2001, the percent of visits related to mental health problems grew from 6.5 percent to 8.1 percent of all ED visits; however, less than half of those patients (3.3 percent) had a primary diagnosis of mental illness (Larkin et al., 2004). It is estimated that over 200,000 children present to the ED with mental health problems each year (Melese-d'Hospital et al., 2002). The prevalence of impaired mental status among elderly patients is also high; studies indicate that 26 to 27 percent of patients age 70 or older present to the ED with an impaired mental state (Hustey et al., 2001, 2003) and 10 percent suffer from delirium (Hustey and Meldon, 2002; Hustey et al., 2003). In a recent national survey, 70 percent of ED physicians reported an increase in patients with mental illness boarding in the ED. Most attribute this trend to state health care budget cutbacks and a decrease in the number of psychiatric beds (ACEP, 2004).

There is some evidence suggesting that the quality of care provided to these patients is substandard. Evidence suggests that mental illness often goes unrecognized and untreated in hospital EDs (Horowitz et al., 2001). One study reported a failure to document mental status for 56 percent of psychiatric patients admitted to one community hospital (Tintinalli et al., 1994). The authors suggested the lack of documentation may be due to a tendency of ED staff to attribute psychiatric symptoms to physical problems. The inability or refusal of psychiatric patients to respond to a list of questions may also result in an incomplete evaluation (Tintinalli et al., 1994). A study of elderly ED patients with mental illness found that documentation of any mental impairment by the emergency physician was uncommon and that many elderly mentally impaired patients were discharged home (including patients with delirium) without plans for addressing the impairment. The authors suggest that the lack of documentation and referrals indicates a lack of recognition of mental illness by emergency physicians (Hustey and Meldon, 2002). A third study found that emergency physicians failed to detect depression in most of the geriatric patients identified as depressed through a validated self-rated depression scale (SRDS). As a result, few of those patients received a mental health or psychiatric referral (Meldon et al.,

1997).

Studies have also pointed to shortcomings in the care of children with mental illness in the ED. A mid-1990s survey of hospitals revealed that formal mental health services for children are unavailable in most EDs (U.S. Consumer Product Safety Commission, 1997). In a study of pediatric ED records from 10 hospitals, evaluation of pediatric patients with mental health problems appeared to be inconsistent with presenting classifications (Melese-d'Hospital et al., 2002). Three-fourths of emotionally disturbed children received an evaluation by a mental health professional at the ED compared to 69 percent who had attempted suicide (Melese-d'Hospital et al., 2002). Studies also indicate that proper management of adolescent suicide attempts in the ED is lacking. While the importance of follow-up psychiatric treatment has been demonstrated, psychotherapy is recommended to less than half of adolescent suicidal patients evaluated in the ED (Piacentini et al., 1995). Additionally, adolescents with somatic complaints are infrequently screened for depression (Porter et al., 1997).

Training and Capacity

ED providers often lack the training, skills, and resources to effectively deal with mentally ill patients. Standardized psychiatric training is not required of emergency medicine and pediatric emergency medicine residents. Less than one quarter of EM residency programs provide formal psychiatric training for residents (Santucci et al., 2003). Surveys of nurses—even those working in designated pediatric emergency departments—show that they are uncomfortable with pediatric psychiatric emergencies (Fredrickson et al., 1994). ED physicians may not have the time to perform a thorough mental health evaluation and many rely on psychiatrists, psychologists, or social workers to perform the evaluation. When that assistance is not available, patients may not receive an evaluation at all. The ED setting also makes it difficult to care for a mentally ill patient. The lack of privacy and the noisy, high stimulus environment may make it uncomfortable for patients to participate in a mental health evaluation (Hoyle and White, 2003).

Impact on the ED

However, patients with mental illness have an important impact on EDs. They tend to require resource intensive care and their admission rates are high, 22 percent in one study (Larkin et al., 2004). These patients are also more likely to arrive by ambulance and be classified as "urgent" than ED patients who present without mental health problems (Larkin et al., 2004). Because hospital EDs often do not have specialized psychiatric facilities or specialists available, and find it difficult to place psychiatric patients—many of whom are indigent or uninsured—in outside psychiatric facilities, emergency department staff spend more than twice as long looking for beds for psychiatric patients than for non-psychiatric patients. Psychiatric patients board in hospital emergency departments more than twice as long as other patients (ACEP, 2004).

According to the administrator of the Division of Mental Health and Developmental Services for the State of Nevada, the single overarching challenge facing the agency is the number of mentally ill patients who are crowding EDs in the southern part of the state. In 2004, the state had an average of 42 patients waiting 61 hours in emergency departments for an inpatient mental health bed. More recently, the average has been 62 people waiting an average of 93 hours for an inpatient bed (Ryan, 2005). In a recent national survey, six in ten emergency physicians said that the increase in psychiatric patients seeking care at EDs is negatively affecting access to emergency care for all patients by generating longer waiting times and limiting the availability of

ED staff and ED beds for other patients (ACEP, 2004).

Substance Abuse

Data from the 2004 National Survey on Drug Use and Health indicates that 50 percent of the U.S. population age 12 or older were current drinkers of alcohol in 2004; 23 percent were binge drinkers, meaning that they had five or more drinks on at least one occasion in the 30 days prior to the survey; and 7 percent were heavy drinkers, defined as binge drinking on 5 or more days in the past month. The survey data also indicates that 8 percent of the U.S. population over age 12 were illicit drug users in 2004 (SAMHSA, 2005).

Alcohol and other drug-related dependence is a pervasive problem in patients presenting to the ED. Between 1992 and 2000, approximately 8 percent of all ED visits each year were attributable to alcohol and the total number of alcohol-related visits increased 18 percent during that time (McDonald et al., 2004). Despite this statistic, a much higher percentage of patients would test positive for alcohol use if screened. One study found that one-third of adolescent patients tested as a part of routine care were alcohol-positive, but were not necessarily given an alcohol-related diagnosis (Barnett et al., 1998).

Estimates from the Drug Abuse Warning Network, a Substance Abuse and Mental Health Services Administration (SAHMSA) operated surveillance system that collects data on drug-related ED visits (including alcohol) across the country, indicate that there were approximately 628,000 drug-related ED visits in the United States in the second half of 2003. Of those visits, 33 percent were for an adverse reaction, 17 percent for overmedication, 10 percent for detox, and six percent for drug-related suicide attempts (SAMHSA, 2005). Among drug-related visits in 2002, 80 percent involved only seven categories: alcohol-in-combination with another drug (31 percent), cocaine (30 percent), marijuana (18 percent), heroin (14 percent); benzodiazepines, antidepressants, and analgesics combined accounted for 30 percent of drug mentions (SAMHSA, 2004).

But again, many more patients would likely test positive for drug use if screened. In a study of alcohol and drug use in seven Tennessee general hospital EDs, marijuana was identified in 15 percent of all patients willing and able to participate in a drug screen, benzodiazepines in 11 percent of patients, opioids in 9 percent of patients, and stimulants in 6 percent of patients (Rockett et al., 2003).

Often patients present to the ED with acute or chronic manifestations of alcohol or drug problems. Chronic problems related to alcohol and other drug use include skin infections from drug injections, cirrhosis and its complications, and gastrointestinal disorders. But alcohol and other drug use occur in the presence of, or may lead to, physical illness and injury. Among patients that present to the ED with injuries, those that report use of alcohol or drug use are significantly more likely to report violence associated with the episode (Cunningham et al., 2003). Drug abuse can complicate the evaluation of the injured patient by masking signs and symptoms of injury (Fabbri et al., 2001). Conversely, ED staff may also focus on the patients' injury and neglect to screen for drug abuse.

Screening and on-site interventions and referrals for alcohol have been demonstrated to reduce ED and hospital use and decrease the amount that patients drink in a variety of health care settings, including the ED (Bernstein et al., 1997; Wright et al., 1998; Monti et al., 1999; Helmkamp et al., 2003). In one study of 700 trauma patients admitted for alcohol-related injuries, patients that received 30 minutes of counseling at the hospital experienced a 47 percent reduction in serious injuries requiring trauma-center admission in the following three years and a

48 percent reduction in less serious injuries requiring ED care (Gentilello et al., 1999). A recent meta-analysis on screening and brief intervention identified 39 published studies, 30 of which found a positive effect (D'Onofrio and Degutis, 2002). Additionally, studies have shown that ED patients are often accepting of screening and brief intervention for alcohol problems (Cherpitel et al., 1996; Leikin et al., 2001).

However, research has shown that ED physicians to do not usually identify those at risk for problems with alcohol or provide them with an intervention (Gentilello et al., 1999; O'Rourke et al., 2001; Manley et al., 2002). Similar studies find that there is a high prevalence of undetected substance abuse and an unmet need for treatment among ED patients (Bernstein et al., 1999; Rockett et al., 2003). This trend has been demonstrated in a number of studies even though numerous federal and expert panels have recommended routine screening of injured patients in the emergency department and the provision of brief interventions to those that test positive (Gentilello, 2003). According to a survey sponsored by the West Virginia Chapter of ACEP, barriers to screening include provider attitudes of disinterest, avoidance, distain, and pessimism, as well as inadequate time, insufficient education, and a lack of resources. The survey found that a minority of ED physicians routinely screen and council ED patients on alcohol (Williams et al., 2000).

Reimbursement

Another important barrier for ED staff to screen patients for alcohol or drug use is that they may not receive reimbursement for that care if the screen is positive. In some states, insurance laws permit insurance companies to refuse payment for injuries sustained if the patient is found to be under the influence of alcohol or drugs. The intent of these laws is to punish drunk drivers, thereby reducing the cost of insurance for others (Gentilello, 2003). However, physicians may be reluctant to screen patients for alcohol or drugs because of the potential financial impact of the insurance regulations on patients, the hospital, and themselves.

Impact on the ED

Like mental health patients, those with identified substance abuse problems tend to be a resource-intensive group. In a statewide study, ED patients with unmet substance abuse treatment generated much higher hospital and ED charges than other patients (Rockett et al., 2005). But treatment for addiction requires continuing care, adherence to medications, and behavioral change (D'Onofrio, 2003), things that are not likely to be accomplished during the course of an ED visit. However, the ED does offer an opportunity to identify, intervene, and refer patients with substance abuse problems (D'Onofrio et al., 1998; Rockett et al., 2003).

Substance abuse patients not only require extra time and effort of ED staff, but drug-related emergency department visits have become a major cause of violence in the ED (Anonymous, 1990). For example, a patient who is primarily seeking drugs may turn violent if not able to obtain the desired drugs (van Steenburgh, 2002). The types of patient presentations most inclined to violence are intoxicant use, states of withdrawal from drugs, delirium, head injury, psychiatric causes, and social factors (Lavoie et al., 1988).

RURAL EMERGENCY CARE

According to the Census Bureau, more than 59 million people, or 21 percent of the total U.S. population, reside in rural areas (U.S. Census Bureau, 2000). Rural emergency departments face

a number of different problems than the urban hospitals, including limited availability of hospitals and equipment, inadequate supply of qualified staff, unfavorable payor mix, and long distances and emergency response times. A recent IOM study, *Quality through Collaboration: The Future of Rural Health*, documented the difficulties faced by rural communities in providing high quality medical services, particularly emergency care (IOM, 2004).

Availability of Hospitals and Equipment

There are nearly 2200 rural community hospitals in the U.S., comprising 44 percent of all community hospitals (AHA, 2005a). Between 1980 and 2002, more than 400 rural hospitals closed. Rural hospitals are smaller than urban counterparts with a median of 58 beds compared to 186 for urban hospitals (Lewin Group, 2002). Smaller hospitals tend to have lower margins than larger hospitals; more than 50 percent of hospitals with fewer than 25 beds have negative margins while only 13 percent of hospitals with 200 or more have negative margins (Lewin Group and AHA, 2000). The modest size of rural hospitals and their correspondingly small capital and financial assets make them less able to survive significant changes in financial performance—when the financial survival of a hospital is at stake, investments in the latest technologies and recruitment of highly qualified personnel are assigned low priority.

With the high cost of maintaining a trauma center and the difficulty of maintaining them even in busy, urban areas (Taheri et al., 2004), it is unrealistic to expect that each rural emergency department will have the full spectrum of trauma resources available. When caring for a traumatized patient, the rural emergency physician's focus is primarily on rapid patient assessment, stabilization, and transfer. Rural EDs also lack many of the newer diagnostic modalities. Such shortages impair the establishment of definitive diagnoses as well as the application of the latest potential improvements in emergency practice. For example, acute stroke treatment with Tissue Plasminogen Activator (TPA) requires immediate access to a CT scanner and a fast accurate reading, both of which may not available at most rural EDs (Drummond, 1998).

Payor Mix

The population served by rural hospitals tends to be poorer, be uninsured, and make greater use of various forms of public health insurance. While 72 percent of urban residents had private insurance coverage in 1998, only 60 percent of those living in remote rural areas did. Rural workers tend to be self-employed, work for smaller companies and earn lower wages. These factors compromise access to private health insurance. The impingement of private health insurance and managed care, public and private, is a major factor in determining the financial environment in which rural hospitals are situated (Kaiser Commission on Medicaid and the Uninsured, 2003).

In 2001, over seven million people living in rural areas were uninsured, including 24 percent of those living in remote rural areas, defined as rural counties non-adjacent to a county with an urban center. This high level of uninsured is compounded by the fact that rural uninsured tend to lack insurance for longer periods of time than their urban counterparts. They are also older and their self-reported health is poorer. One quarter of rural uninsured are 45-64 years of age and 42 percent of rural uninsured residents report less than very good health compared to 38 percent of urban, uninsured residents (Kaiser Commission on Medicaid and the Uninsured, 2003). The large numbers of uninsured in rural areas can have 'spillover effects' on the community,

reducing access to emergency services, trauma care, specialists, and hospital-based services (Kellermann and Snyder, 2004). Additionally, non-reimbursed care for emergency physicians and hospitals is substantial for those serving a large underinsured population, and can result in cutbacks, closure, or service relocation (Irvin et al., 2003a).

The low levels of private insurance and low incomes contribute to the important role that Medicaid and other forms of public insurance play in rural America. Public programs insure 16 percent of those in rural areas, compared to 10 percent in urban settings. Therefore, rural hospitals are much more dependent on these programs for their existence. The Balanced Budget Act (BBA) of 1997 and the Balanced Budget Refinement Act (BBRA) of 1999 have had significant impact on the access to emergency care in rural environments. The BBA mandated that Medicare outpatient payments become prospective payments, saving $110 billion from 1998 to 2004. Medicare payment reductions to rural hospitals were projected to have a cumulative impact of $16.7 billion over this time frame (IOM, 2000). The BBRA preferentially re-instated cost-based reimbursement for some services to rural hospitals and included higher payments to Medicare-dependent hospitals.

The restoration of these payments is expected to reduce the cumulative impact of the BBA by $1.8 billion to approximately $15 billion overall. Yet, the impact on rural hospitals is tremendous nonetheless, as these acts have projected Medicare margins in rural hospitals to decrease between 3.3 percent and 8.4 percent by 2004. Particularly hard hit are outpatient services, expected to decrease by 20-28 percent (IOM, 2000). When considering the marginal financial existence that many rural hospitals have, these reductions can have detrimental affects on hospital survival and provision of services, including outpatient ED, and may even precipitate closure.

In order to increase the access of rural residents to urgent and emergency services, Congress established the Critical Access Hospital (CAH) program as part of the Balanced Budget Act of 1997. A CAH is exempt from the prospective payment system for both inpatient and outpatient care. Instead, hospitals that receive this designation bill Medicare on a fee-for-service basis. Medicare will reimburse at a rate of 100–101 percent of reasonable and customary charges. CAHs are specially designated under the Medicare Rural Hospital Flexibility Grant Program. These rural, low volume hospitals must meet distinct criteria in location, number of available beds, and average length of stay or, may be state certified as a ‘Necessary Provider’. Emergency services must also be available 24 hours daily. A hospital can be designated as a CAH if it is located in a rural area, provides 24-hour emergency services, has an average length of stay of 96 hours or less, is more than 35 miles from a neighboring hospital or 15 miles in areas with mountainous terrain; or certified as a necessary provider (prior to 2006), and has less than 25 acute care beds (as of January 2004). It is still too early to assess whether the CAH program has been successful at increasing access to emergency care. More research is needed to determine whether new capacity is being built, or if hospitals are changing in order to qualify for the CAH program. For example, a hospital may have to cut the number of acute care beds in order to be designated as a CAH. Others hospitals may add 24 hour care, which, in turn, will add to the existing ED capacity.

Workforce Supply

The limited supply of the medical workforce in rural areas affects many areas of medicine, not just emergency care. The most difficult aspects of rural emergency care are finding qualified emergency physicians, specialists to provide on-call services, and ancillary staff. Many rural

EDs have only part-time physicians on staff, and are often not available 24 hours. Although 21 percent of Americans live in rural areas, only slightly more than twelve percent of emergency physicians, regardless of training or certification status, practice in this setting (Moorhead et al., 2002). The maldistribution has worsened since 1997 when 15 percent of emergency physicians practiced in rural areas (Moorhead et al., 1998; Williams et al., 2001). The proportion of physicians who are board certified in emergency medicine is also very low in rural areas—67 percent of rural emergency medicine physicians are neither emergency medicine residency trained nor board certified. Rural EDs have lower levels of staffing, and when staffed by physicians, these physicians are much more likely to be trained in family practice or other primary care specialties than in emergency medicine. In one study, rural EDs were shown to have only forty-four percent of the average specialists and referral sources of an urban, academic center with the sub-specialties in shortest supply being neurosurgery, gastroenterology, neurology, and cardiology (Sklar et al., 2002).

But even when the resources for appropriate treatment are available, the medical care provided in rural EDs may fall short of established guidelines. In one study of acute stroke care in non-urban EDs, treatment was found to be inconsistent with AHA recommendations. For example, hypertension was often treated too aggressively and inappropriate medications were sometimes used. Additionally, it was suggested that non-motor symptoms were less likely to be recognized or treated with less urgency than motor symptoms (Burgin et al., 2001). Although this data is far from conclusive, studies such as this may explain in part the stigma of decreased levels of competence attributed to rural emergency physicians (Leap, 2000).

Yet, the reality is that rural emergency physicians are often called upon to single-handedly care for critically ill and injured patients in a challenging setting typically lacking in manpower, equipment, and access to consultants. The fact that patient census in a rural ED may be very low likely contributes to the difficulty physicians and mid-level providers have in maintaining a high level of EM proficiency.

Distance and Time Factors

Long distances and time in the transportation of acutely ill and traumatized patients in rural regions likely adversely affect health outcomes. The negative correlation between the prolonged response times and ultimate outcomes, inherent in many rural EMS systems, has been a focal point of some studies (Bachman et al., 1986; Eitel et al., 1988). In one study of 566 patients with primary cardiac arrest in Wisconsin, the average response time for survivors was 3.7 minutes, while non-survivor's response time averaged 7.3 minutes. There were no survivors when the response time was greater than eight minutes (Olson et al., 1989).

Other studies have demonstrated that poor survival rates in the rural patient population are not exclusively related to prolonged response times. Vukmir described a study in which ACLS response time was not predictive of survival from refractory prehospital cardiac arrest. Although rural patients in the study had the lowest survival rate and longest response time (9 percent and 10.6 minutes compared to 23 percent and 8.7 minutes for urban sites), the suburban locale survival rate was only 14 percent, despite having the fastest response of 6.9 minutes (Vukmir and Sodium Bicarbonate Study Group, 2004). Adverse outcomes are likely related to multiple factors in rural emergency care systems. These include the absence of a 9-1-1 system, low rates of bystander CPR performance, lack of full-time EMTs and paramedics, and less equipped emergency facilities (Vukov et al., 1988; Gallehr and Vukov, 1993; Richless et al., 1993).

Training

Rural emergency care practice involves unique challenges with respect to professional training. Access to university-based centers is usually limited, making it more difficult for rural providers to maintain and upgrade knowledge and skills. Special training is needed in a number of areas, including: care and treatment given limited staff and resources; treatment telemedicine; making appropriate transfer decisions; and addressing patient needs with respect to local versus regional delivery site decisions. Encouragement of conjoint training programs with rural hospitals, and funding for rural training programs are current approaches to addressing rural needs.

Quality of Care

Disparities in the quality of care between rural and non-rural areas and their potential for adverse events and suboptimal outcomes have been repeatedly demonstrated (Bachman et al., 1986; Vukov et al., 1988; Eitel et al., 1988; Olson et al., 1989; Gallehr and Vukov, 1993; Richless et al., 1993). Low population density has been strongly associated with increased trauma death rates (Rutledge et al., 1994) and preventable death rates have been demonstrated to be twice those of urban areas (Esposito et al., 1995). In some studies, traumatic death rates in rural children have been reported to be nearly double those of urban children (Svenson et al., 1996). Geriatric trauma patients in rural areas have higher complication rates and in-hospital mortality (Rogers et al., 2001). Killien and colleagues (1996) point out that in studies related to out-of-hospital cardiac arrest, survival to discharge rates has been reported to be as high as 32 percent in urban studies. However, most studies in rural areas report survival to discharge rates of less than 10 percent.

RECOMMENDATIONS

2.1: Congress should establish dedicated funding, separate from DSH payments, to reimburse hospitals that provide significant amounts of uncompensated emergency and trauma care for the financial losses incurred by providing those services.

2.1a: Congress should initially appropriate $50 million for the purpose, to be administered by the Centers for Medicare and Medicaid Services.

2.1b: CMS should establish a working group to determine the allocation of these funds, which should be targeted to providers and localities at greatest risk; the working group should then determine funding needs for subsequent years.

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3
Building a 21st-Century Emergency Care System

Hospitals are part of a continuum of emergency care services that includes 9-1-1 and ambulance dispatch, prehospital EMS care and transport, hospital-based emergency and trauma care, and inpatient services. While today's emergency care system offers significantly more medical capability than was available in years past, it continues to suffer from severe fragmentation, an absence of systemwide coordination, and a lack of accountability. These shortcomings diminish the care provided to emergency patients and often result in worsened medical outcomes To address these challenges and chart a new direction for emergency care, the committee envisions a system in which all communities will be served by well-planned and highly coordinated emergency care services that are accountable for performance and serve the needs of patients of all ages within the system.

In this new system, 9-1-1 dispatchers, EMS personnel, medical providers, public safety officers, and public health officials will be fully interconnected and united in an effort to ensure that each patient receives the most appropriate care, at the optimal location, with the minimum delay. From the patient's point of view, delivery of services for every type of emergency will be seamless. All service delivery will also be evidence-based, and innovations will be rapidly adopted and adapted to each community's needs. Hospital emergency department (ED) closures and ambulance diversions will never occur, except in the most extreme situations, such as a hospital fire or a communitywide mass casualty event. Standby capacity appropriate to each community based on its disaster risks will be embedded in the system. The performance of the system will be transparent, and the public will be actively engaged in its operation through prevention, bystander training, and monitoring of system performance.

While these objectives will require substantial, systemwide change, they are achievable. Early progress toward the goal of more integrated, coordinated, regionalized emergency care systems became derailed over the last two decades. Efforts stalled because of deeply entrenched interests and cultural attitudes, as well as funding cutbacks and practical impediments to change. These obstacles remain today, and represent the primary challenges to achieving the committee's vision. However, the need for change is clear. The committee calls for concerted, cooperative efforts at multiple levels of government and the private sector to finally achieve these goal objectives outlined above.

This chapter describes the committee's vision for a 21st century emergency care system. This vision rests on the broad goals of improved coordination, expanded regionalization, and increased transparency and accountability, each of which is discussed in turn. The chapter then profiles current approaches of states and local regions exhibit these features. Finally, the chapter details the committee's recommendation for a federal demonstration program to support additional state and local efforts aimed at attaining the vision of a more coordinated and effective emergency care system.

THE GOAL OF COORDINATION

The value of integrating and coordinating emergency care has long been recognized. The 1996 National Academy of Sciences/National Research Council (NAS/NRC) report *Accidental Death and Disability* called for better coordination of emergency care through Community Councils on Emergency Medical Services that would bring together physicians, medical facilities, emergency medical services (EMS), public health agencies, and others "to procure equipment, construct facilities and ensure optimal emergency care on a day-to-day basis as well as in disaster or national emergency" (NAS and NRC, 1966, p. 7). The National Highway Traffic Safety Administration's (NHTSA) 1996 report *EMS Agenda for the Future* also emphasizes the goal of system integration:

> EMS of the future will be community-based health management that is fully integrated with the overall health care system. It will have the ability to identify and modify illness and injury risks, provide acute illness and injury care and follow-up, and contribute to treatment of chronic conditions and community health monitoring….patients are assured that their care is considered part of a complete health care program, connected to sources for continuous and/or follow-up care, and linked to potentially beneficial health resources….EMS maintains liaisons, including systems for communication with other community resources, such as other public safety agencies, departments of public health, social service agencies and organizations, health care provider networks, community health educators, and others….EMS is a community resource, able to initiate important follow-up care for patients, whether or not they are transported to a health care facility (NHTSA, 1996, pp. 7, 10).

In 1972, an NAS/NRC report *Roles and Responsibilities of Federal Agencies in Support of Comprehensive Emergency Medical Services* promoted an integrated, systems approach to planning at the state, regional, and local levels and called for the Department of Health, Education and Welfare (DHEW) to take an administrative and leadership role in federal EMS activities. The Emergency Medical Services Systems Act of 1973 (P.L. 93-154) created a new grant program in DHEW's Division of EMS to foster the development of regional EMS systems. The Robert Wood Johnson Foundation added support by funding the development of 44 regional EMS systems. Although the drive toward system development waned after the demise of the DHEW program and the subsequent absorption of federal EMS funding into federal block grants in 1981, the goals of system planning and coordination remained paramount within the emergency care community.

Limited Progress

While the concept of a highly integrated emergency care system as articulated in NHTSA's *EMS Agenda for the Future* is not new, progress toward its realization has been slow. Prehospital EMS, hospital-based emergency and trauma care, and public health have traditionally worked in silos (NHTSA, 1996), a situation that largely persists today. For example, public safety and EMS agencies often lack common communications frequencies and protocols for communicating with each other during emergencies. Jurisdictional borders contribute to fragmentation under the current system. For example, one county in Michigan has 18 different EMS systems with a range of different service models and protocols. Coordination of services across state lines is particularly challenging.

Trauma systems provide a valuable model for how such coordination could and should operate. The inclusive trauma system is meant to ensure that each patient is directed to the most

appropriate setting, including a level I trauma center, when necessary. To this end, many elements within the regional system—community hospital, trauma centers, and particularly prehospital EMS—must coordinate the regional flow of patients effectively. Such coordination not only improves patient care, but also is a critical tool in reducing overcrowding in EDs.

Unfortunately, only a handful of systems nationwide coordinate transport effectively throughout the region. Short of formally going on diversion, there is typically little information sharing between hospitals and EMS regarding overloaded emergency and trauma centers and availability of ED beds, operating suites, equipment, trauma surgeons, and critical specialists—information that could be used to balance the load among EDs and trauma centers in the region.

Too often hospitals are located such that one is overloaded with emergency and trauma patients, while yet just several blocks away another works at a comfortable 50 percent of capacity. There is little incentive for ambulances to drive by a hospital to take patients to a facility that is less overloaded.

The benefits to patients of better regional coordination have been demonstrated. Furthermore, the technologies needed to facilitate such approaches exist; police and fire departments are ahead of the emergency care system in this regard. The main impediment appears to be entrenched interests and a lack of sufficient vision to change the current system.

The problem is exacerbated in some regions by turf wars between firefighters and EMS personnel that were documented in a series of articles for *USA Today* (Davis, 2003). Moreover, air medical services typically operate outside the control of the EMS system and has had a poor record of safety and effectiveness in transporting patients. The situation is further confused in cities with both private and public EMS agencies that sometimes compete for patients and transport based on hospital ownership of the agency rather than what is best for the patient. Even within EDs, there may be friction between emergency staff trying to admit patients and personnel on inpatient units who have no incentive for speeding the admissions process. Lack of coordination between EMS and hospitals can result in delays that compromise care, and emergency physicians sometimes clash with on-call specialists and admitting physicians over delays in response.

Linkages with Public Health

The ED has a special relationship with the community and state and local public health departments because it serves as a community barometer of both illness and injury trends (Malone, 1995). In her analysis of heavy users of ED services, Malone argues that "emergency departments remain today a 'window' on wider social issues critical to health care reforms." (Malone, 1995, p. 469) A commonly cited example is the use of seat belts. We now know that increased utilization of seat belts reduces the number of seriously injured car crash victims in the ED—the ED served as an incubator for documenting the results of pre- and post-seat belt enforcement initiatives. Although prevention activities have been limited in the emergency care setting, that setting represents an important "teachable moment." To take advantage of that teaching opportunity, emergency care providers would benefit from the resources and experiences of public health agencies and experts in establishing injury prevention activities.

Perhaps now more than ever, with the threat of bioterrorism and outbreaks of such diseases as avian influenza and severe acute respiratory syndrome (SARS), it is essential that EMS, EDs, trauma centers, and state and local public health agencies partner to conduct surveillance for disease prevalence and outbreaks, and other health risks. Hospital EDs can recognize the diagnostic clues that may indicate an unusual infectious disease outbreak so that the public health

authorities can respond quickly (GAO, 2003c). However, a solid partnership must first be in place—one that allows for easy communication of information between emergency providers and public health officials.

Linkages with Other Medical Care Providers

Emergency departments fill many existing gaps within the health care network, serving as key safety net providers in many communities (Lewin and Altman, 2000). Studies have shown that a significant number of patients use the ED for nonurgent purposes because of financial barriers, lack of access to clinics after hours, transportation barriers, convenience, and lack of a usual source of care (Grumbach, 1993; Young et al., 1996; Peterson and Burstin, 1998; Koziol, 2000; Cunningham and May, 2003). There is also evidence that clinics and physicians are increasingly using EDs as an adjunct to their practice, referring patients to the ED for a variety of reasons, including their own convenience after regular hours, reluctance to take on a complicated case, the need for diagnostic tests they cannot perform in the office, liability concerns, and so on (Berenson et al., 2003; Studdert et al., 2005).

Unfortunately, in many communities there is little interaction between emergency care services and community safety net providers, although they share a common base of patients, and their actions may affect one another substantially. The absence of coordination represents missed opportunities for enhanced access; improved diagnosis, patient follow-up, and compliance; and enhanced quality of care and patient satisfaction.

Successes Achieved

While progress toward a highly integrated emergency care system has been slow, there have been some important successes in the coordination of emergency care services, which point the way toward solutions to the fragmentation that dominates the system today. For example, the trauma system in Maryland, described in more detail later in this chapter, provides a comprehensive and coordinated approach to the care of injured children. Children's hospitals have also been successful at regional coordination to ensure the transport and appropriate care of children needing specialized services. The pediatric intensive care system is a leading example of regional coordination among hospitals, community physicians, and EMTs (Gausche-Hill and Wiebe, 2001). These are but a few examples that demonstrate the possibilities for enhancing coordination of the system as a whole.

One promising public health surveillance effort is Insight, a computer-based clinical information system at the Washington Hospital Center (WHC) in Washington, D.C., designed to record and track patient data, including geographic and demographic information. The software proved useful during the 2001 anthrax attacks, when it enabled WHC to transmit complete, real-time data to the Centers for Disease Control (CDC), while other hospitals were sending limited information with a lag of one or more days. The success of Insight attracted considerable grant funding for the system's expansion; WHC earmarked $7 million for Insight to link it to federal and regional agencies and to integrate it with other hospital systems (Kanter and Heskett, 2002).

Many communities have established primary care networks that integrate hospital EDs into their planning and coordination efforts. A rapidly growing number of communities, such as San Francisco and Boston, have developed regional health information organizations that coordinate the development of information systems to facilitate patient referrals and tracking the sharing of medical information between providers to optimize the patient's care across settings. The San Francisco Community Clinic Consortium brings together primary care and specialty care

providers and EDs in a planning and communications network that closely coordinates the care of safety net patients throughout the city.

The Importance of Communications

Communications are a critical factor in establishing systemwide coordination. An effective communications system is the glue that can hold together effective, integrated emergency care services. It provides the key link between 9-1-1/dispatch and EMS responders, and is necessary to ensure that on-line medical direction is available when needed. It enables ambulance dispatchers to tell callers what to do until help arrives and to track the patient's progress following the arrival of EMS responders. An effective communications system also enables ambulance dispatchers to assist EMS personnel in directing patients to the most appropriate facility based on the nature of the patient's illness or injury and the capacity of receiving facilities. It links the emergency medical system with other public safety providers—such as police, fire and emergency management, and public health—and facilitates coordination between the medical response system and incident command in both routine and disaster situations. It helps hospitals communicate with each other to organize interfacility transfers and arrange for mutual aid. And it facilitates medical and operational oversight and quality control within the system.

THE GOAL OF REGIONALIZATION

The objective of regionalization is to improve patient outcomes by directing patients to facilities with optimal capabilities for any given type of illness or injury. Substantial evidence demonstrates that doing so improves outcomes and reduces costs across a range of high-risk conditions and procedures, including cardiac arrest and stroke (Grumbach et al., 1995; Imperato et al., 1996; Nallamothu et al., 2001; Chang and Klitzner, 2002; Bardach et al., 2004). The literature also supports the benefits of regionalization for severely injured patients in improving patient outcomes and lowering costs (Jurkovich and Mock, 1999; Mann et al., 1999; Mullins and Mann, 1999; Chiara and Cimbanassi, 2003; Bravata et al., 2004; MacKenzie et al., 2006), although in this regard the evidence is not uniformly positive (Glance et al., 2004). MacKenzie and colleagues (2006), however, have provided the strongest evidence to date, which strongly suggests the benefits of such regionalized trauma systems. In their study, differences in mortality between patients receiving trauma and comparable nontrauma center care in 14 states were compared after adjustment for differences in case mix. Mortality among patients with serious injuries was significantly lower at trauma centers. Other studies have also documented the value of regionalized trauma systems to improve outcomes and reduce mortality from traumatic injury (Jurkovich and Mock, 1999; MacKenzie, 1999; Mullins, 1999; Nathens et al., 2000). Organized trauma systems have also been shown to add value in facilitating performance measurement and promoting research. Formal protocols within a region for prehospital and hospital care contribute to improved patient outcomes as well (Bravata et al., 2004).

While regionalization to distribute trauma services to high-volume centers is optimal when feasible in terms of transport, Nathens and Maier (2001) argue for an inclusive trauma system in which smaller facilities have been verified and designated as lower-level trauma centers. They suggest that care may be substantially better in such facilities than in those outside the system, and comparable to national norms (Nathens and Maier, 2001). An inclusive trauma system addresses the needs of all injured patients across the entire continuum of care and utilizes the

resources of all committed and qualified personnel and facilities, with the goal of ensuring that every injured patient is triaged expeditiously to a level of care commensurate with his or her injuries.

Research has demonstrated a number of additional benefits of regionalization. Regionalizing inventories (pooling supplies at regional warehouses) has been shown to reduce inventories, improve the capacity to serve the target population, and save money. Regionalization may also be a cost-effective strategy for developing and training teams of response personnel. Regionalization benefits outbreak investigations, security management, and emergency management as well. Both the Health Resources and Services Administration (HRSA) and CDC have made regional planning a condition for preparedness funding (GAO, 2003a).

Concerns about Regionalization

Not all aspects of regionalization are positive. If not properly implemented, regionalizing key clinical services may adversely impact their overall availability in a community. For example, regional allocation of patients with suspected acute myocardial infarction could result in the closure of a cardiac unit or even an entire hospital, particularly in rural areas. The survival of small, rural facilities may require identification and treatment of those illnesses and injuries that do not require the capacities and capabilities of larger facilities, as well as repatriation to the local facility for long-term care and follow-up after stabilization at the tertiary center. A systems approach to regionalization considers the full effects of regionalizing services on a community. Determining the appropriate metrics for this type of analysis and defining the process for applying them within each region represent significant research and practical issues. Nonetheless, in the absence of rigorous evidence to guide the process, planning authorities should take these factors into account in developing regionalized systems of emergency care.

The committee believes communities will best be served by emergency care systems in which services are organized so as to provide the optimal care based on the patient's location and condition. To the extent that the movement toward specialty hospitals impacts the configuration of services and therefore the ability of the system to optimize emergency services, it is an appropriate subject for the committee to address. While the committee does not advocate for or against the further development of specialty hospitals, it does believe that their development would potentially impact emergency care, and that this impact, which in some cases could be adverse, should be considered in the regionalization of emergency care. Specialty hospitals that do not provide emergency care can drain financial resources from those that do (GAO, 2003b; Dummit, 2005). Also, specialty hospitals present an attractive option for some specialists, potentially luring them away from the medical staffs of general hospitals. In such cases, general hospitals may be forced to subsidize specialists, or recruit new ones, to remain EMTALA-compliant (Asplin, and Knopp, 2001; Iglehart, 2005; Johnson et al., 2001). Specialty hospitals may also siphon commercially insured patients away from general hospitals, while retaining the option of sending their sickest patients to the nearest general hospital ED.

Despite these problems, the movement toward specialty hospitals is gathering strength. The number of ambulatory surgery centers increased by about 6 percent per year between 1997 and 2003, to a total of 3,735 recorded nationally in 2003; the number of specialty hospitals increased by approximately 20 percent per year between 1997 and 2003, to a total of 113 in 2003 (Iglehart, 2005). In December 2003, Congress declared an 18-month moratorium on the development of new specialty hospitals partly owned by physicians who refer their patients to them. Federal agencies were directed to study these facilities and recommend an extension of the moratorium

or a new policy. The moratorium expired in 2005, but the Centers for Medicare and Medicaid Services (CMS) is studying how to revise its payment rates and procedures for approving specialty hospitals.

Configuration of Services

The design of the emergency care system envisioned by the committee bears similarities to the inclusive trauma system concept originally conceived and first proposed and developed by CDC, and adapted and disseminated by the American College of Surgeons. Under this approach, every hospital in the community can play a role in the trauma system by undergoing verification and designation as a level I to level IV/V trauma center, based on its capabilities. Trauma care is optimized in the region through protocols and transfer agreements that are designed to direct trauma patients to the most appropriate level of care available given the type of injury and relative travel times to each center.

The committee's vision expands this concept beyond trauma care to include all serious illnesses and injuries, and extends beyond hospitals to include the entire continuum of emergency care—including 9-1-1 and dispatch and prehospital EMS, as well as clinics and urgent care providers. In this model, every provider organization can potentially play a role in providing emergency care services according to its capabilities. Provider organizations undergo a process by which their capabilities are identified and categorized in a manner not unlike trauma verification and designation, which results in a complete inventory of emergency care provider organizations within a community. Initially, this categorization may simply be based on the existence of a service—for example, capacity to achieve cardiac reperfusion or perform emergency neurosurgery. Over time, the categorization process may evolve to include more detailed information, such as the times specific emergency procedures are available; the arrangements for on-call specialty care; service-specific outcomes; or general emergency service indicators, such as time to treatment, frequency of diversion, and ED boarding. Prehospital EMS services are similarly categorized according to ambulance capacity; availability; credentials of EMS providers; advanced life support (ALS) and pediatric advanced life support; treat and release, and search and rescue capabilities; disaster readiness (e.g., extrication capability and personal protective equipment); and outcomes for sentinel indicators, such as out-of-hospital cardiac arrest.

A standard national approach to the categorization of emergency care providers is needed. Categories should reflect meaningful differences in the types of emergency care available, yet be simple enough to be understood easily by emergency care organizations and the public at large. The use of national definitions will ensure that the categories are understood by providers and by the public across states or regions of the country, and will also promote benchmarking of performance.

The committee concludes that a standard national approach to the categorization of emergency care, defined in the broadest possible sense, is essential for the optimal allocation of resources and provision of critical information to an informed public. Therefore the committee recommends that **the Department of Health and Human Services and the National Highway Traffic Safety Administration, in partnership with professional organizations, convene a panel of individuals with multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.** The results of this process will be a complete inventory of emergency care assets for each community, which should be updated regularly to reflect the rapid changes in

delivery systems nationwide. The development of the initial categorization system should be completed within 18 months of the release of the release of this report.

Treatment, Triage, and Transport

Once the basic classification system proposed above is understood, it can be used to determine the optimal destinations for patients based on their condition and location. However, more research and discussion are needed to determine the circumstances under which patients should be brought to the closest hospital for stabilization and transfer as opposed to being transport directly to the facility offering the highest level of care, even if that facility is farther away. A debate remains over whether EMS providers should perform advanced life support procedures in the field or whether rapid transport to definitive care is best (Wright and Klein, 2001). It is likely that this answer depends, at least in part, on the type of emergency condition. It is evident, for example, that whether a patient will survive out-of-hospital cardiac arrest depends almost entirely on actions taken at the scene, including rapid defibrillation, provision of cardiopulmonary resuscitation (CPR), and perhaps other advanced life support interventions. Delaying these actions until the unit reaches a hospital results in dismal rates of survival and poor neurological outcomes. Conversely, there is little that prehospital personnel can do to stop internal bleeding from major trauma. In this instance, rapid transport to definitive care in an operating room offers the victim the best odds of survival. For example, a recent study showed that bypassing a level II trauma center in favor of a more distant level I trauma center may be optimal for head trauma patients (McConnell et al., 2005).

EMS responders who provide stabilization before the patient arrives at a critical care unit are sometimes subject to criticism because of a strongly held bias among many physicians that out-of-hospital stabilization only delays definitive treatment without adding value; however, there is little evidence that the prevailing “scoop and run” paradigm of EMS is always optimal (Orr et al., 2006). For example, in cases of out-of-hospital cardiac arrest, properly trained and equipped EMS personnel can provide all needed interventions at the scene. In fact, research has shown that failure to reestablish a pulse on the scene virtually ensures that the patient will not survive, regardless of what is done at the hospital (Kellermann et al., 1993). On the other hand, a scoop and run approach makes sense when a critical intervention needed by the patient can be provided only at the hospital (for example, surgery to control internal bleeding).

Decisions regarding the appropriate steps to take should be resolved using the best available evidence. The committee concludes that there should be a national approach to the development of prehospital protocols. It therefore recommends that **the National Highway Traffic Safety Administration, in partnership with professional organizations, convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients.** The transport protocols should also reflect the state of readiness of given facilities within a region at a particular point in time. Real-time, concurrent information on hospital resource and specialty availability should be made available to EMS providers to support transport decisions. Development of an initial set of model protocols should be completed within 18 months of the release of this report. Treatments may require modification to reflect local resources, capabilities, and transport times; however, the basic pathophysiology of human illness is the same in all areas of the country. Once in place, the national protocols could be tailored to local assets and needs. The process for updating the protocols will also be important because it will dictate how rapidly patients receive the current standard of care.

The 1966 report *Accidental Death and Disability* anticipated the need to categorize care facilities and improve transport decisions:

> The patient must be transported to the emergency department best prepared for his particular problem….Hospital emergency departments should be surveyed….to determine the numbers and types of emergency facilities necessary to provide optimal emergency treatment for the occupants of each region….Once the required numbers and types of treatment facilities have been determined, it may be necessary to lessen the requirements at some institutions, increase them in others, and even redistribute resources to support space, equipment, and personnel in the major emergency facilities. Until patient, ambulance driver, and hospital staff are in accord as to what the patient might reasonably expect and what the staff of an emergency facility can logically be expected to administer, and until effective transportation and adequate communication are provided to deliver casualties to proper facilities, our present levels of knowledge cannot be applied to optimal care and little reduction in mortality and/or lasting disability can be expected. (NAS and NRC, 1966, p. 20).

This concept was echoed in the 1993 Institute of Medicine (IOM) report *Emergency Medical Services for Children*, which stated that "categorization and regionalization are essential for full and effective operation of systems" (IOM, 1993, p. 171).

Once the decision has been made to transport a patient, the responding ambulance unit should be instructed—either by written protocol or by on-line medical direction—which hospital should receive the patient. This instruction should be based on developed transport protocols to ensure that the patient is taken to the optimal facility given the severity and nature of the illness or injury, the status of the various care facilities, and the travel times involved. Ideally, this decision will take into account a number of complex and fluctuating factors, such as hospital ED closures and diversions, and traffic congestion that hinders transport times for the EMS unit (The SAFECOM Project, 2004). Some potential transport options in a coordinated, regionalize system are described in Figure 3-1.

In addition to the use of ambulance units and the EMS system to direct patients to the optimum location for emergency care, hospital emergency care designations should be posted prominently to improve patients' self-triage decisions. Such postings can educate the public about the types of emergency services available in their communities and enable patients who are not using EMS to direct themselves to the optimal facility.

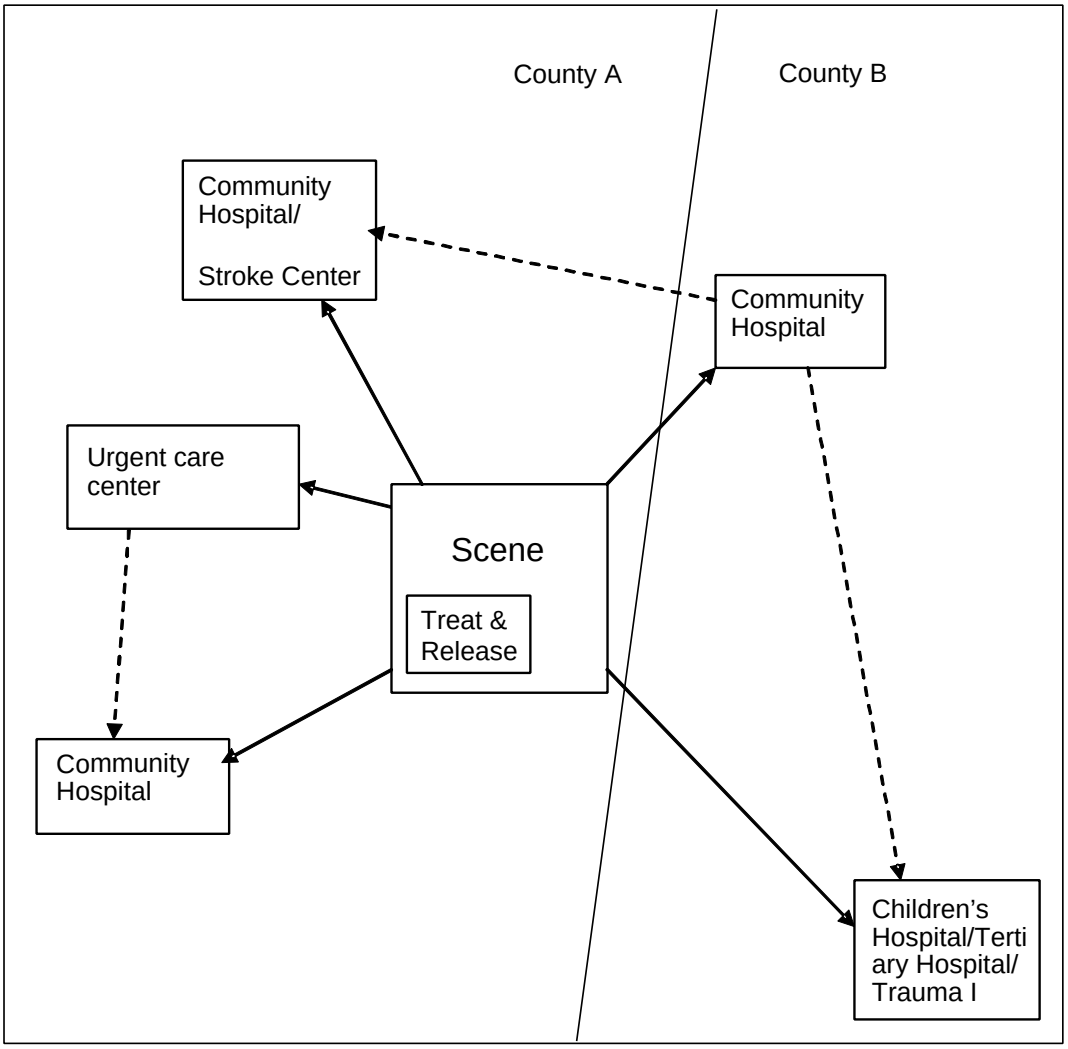

FIGURE 3-1 Service configurations in regionalized systems. Some potential transport options within a regional system are illustrated above. The basic structure of current EMS systems is not altered. Protocols in this system will be refined to ensure that the patient goes to the optimal facility given the type of illness or injury, the travel time, and facility status (e.g., ED and ICU bed availability). For example, instead of taking a stroke victim to the closest general community hospital or to a tertiary medical center that is farther away, there may be a third option—transport to a community hospital with a stroke center. Over time, based on evidence on the effectiveness of alternative delivery models, some patients may be transported to a nearby urgent care center for stabilization, or treated on the street and released. Whichever pathway the patient follows, communications will be enhanced, data collected, and performance of the system evaluated and reported so that future improvements can be made.

THE GOAL OF ACCOUNTABILITY

Accountability is perhaps the most important of the three goals of the emergency care system envisioned by the committee because it is necessary to achieving the other two. Lack of accountability has contributed to the failure of the emergency care system to adopt needed changes in the past. Without accountability, participants in the system need not accept responsibility for failure, and can avoid making changes necessary to avoid the same outcomes in the future.

Accountability is difficult to establish in emergency care because it is dispersed across many different components of the system; thus it is difficult for policy makers to determine when and where breakdowns occur and how they can be prevented in the future. Ambulance diversion is a good example. Because diversion statistics are rarely published or announced, the problem is likely to remain outside the public eye. When a city finally recognizes it has an unacceptably high frequency of diversion, whom should it hold accountable? EMS can blame the hospitals for crowded conditions and excessively long offload times; hospitals can blame the on-call specialists or the discharge sites that are unwilling to take additional referrals; and everyone can blame the public health department for inadequate funding of community-based clinics.

The unpredictable and infrequent nature of emergency care contributes to the lack of accountability. Most people have limited exposure to the emergency care system—for most Americans, an ambulance call or a visit to the ED is a relatively rare event. Further, public awareness is hindered by the lack of nationally defined indicators of system performance. Few localities can answer basic questions about their emergency care services, such as "What is the overall performance of the emergency care system?"; "How well do 9-1-1, ambulance services, hospital emergency and trauma care, and other components of the system perform?"; and "How does performance compare with that in other parts of the state and the country?" Consequently, few understand the crisis presently facing the system. By and large, the public assumes that the system functions better than it does (Harris Interactive, 2004).

The committee believes several steps are required to bring accountability into the emergency care system. These include the development of national performance indicators, implementation of performance measurement, and public dissemination of performance information.

Development of National Performance Indicators

There is currently no shortage of performance measurement and standards-setting projects. For example, ED performance measures have been developed by Qualis Health and Lindsay (Lindsay et al., 2002). In addition, the Data Elements for Emergency Department Systems (DEEDS) project and Health Level Seven (HL7) are working to develop uniform specifications for ED performance data (Pollock et al., 1998; Centers for Disease Control and Prevention and National Center for Injury Control and Prevention, 2001).

The EMS Performance Measures Project is working to develop consensus measures of EMS system performance that will assist in demonstrating the system's value and defining an adequate level of EMS service and preparedness for a given community (measureEMS.org, 2005). The consensus process of the project has sought to unify disparate efforts previously undertaken nationwide to measure performance that have lacked consistency in definitions, indicators, and data sources.

Work undertaken by the committee in 2004 under the EMS Performance Measures Project resulted in the development of 138 indicators of EMS performance. This list was pared down to 25 indicators in 2005. The list included system measures, such as "What are the time intervals in a call?" and "What percentage of transports is conducted with red lights and sirens?", and clinical measures, such as "How well was my pain relieved?" The questions were defined using data elements from the National EMS Information System (NEMSIS) dataset so that results could be compared with validity across EMS systems. The EMS Performance Measures Project is coordinated by the National Association of State EMS Officials in partnership with the National Association of EMS Physicians, and is supported by NHTSA and HRSA. CDC, the Association of American Medical Colleges, and Emory University are currently developing a simple cardiac arrest registry that will allow communities across the United States to determine their rate of successful resuscitations and identify opportunities for improvement.

In addition, statewide trauma systems and EMS systems have been evaluated by the American College of Surgeons Committee on Trauma, NHTSA's Office of EMS, and until it was recently defunded, HRSA's Division of Trauma and EMS Systems. There are also various components of the system with independent accrediting bodies. Hospitals, for example, are accredited by the Joint Commission on Accreditation of Healthcare Organizations. Ambulance services are accredited by the Commission on Accreditation of Ambulance Services. Air medical services are voluntarily accredited by the Commission on Accreditation of Medical Transport Systems. Each of these organizations collects performance information.

What is missing is a standard set of measures that can be used to assess the performance of the full emergency care system within each community, as well as the ability to benchmark that performance against statewide and national performance metrics. A credible entity to develop such measures would not be strongly tied to any one component of the emergency care continuum.

One approach would be to form a collaborative entity that would include representation from all of the system components, including hospitals, trauma centers, EMS agencies, physicians, nurses, and others. Another approach would be to work with an existing organization, such as the National Quality Forum (NQF), to develop a set of emergency care-specific measures. NQF grew out of the President's Advisory Commission on Consumer Protection and Quality in the Health Care Industry in 1998. It operates as a not-for-profit membership organization made up of national, state, regional, and local groups representing consumers, public and private purchasers, employers, health care professionals, provider organizations, health plans, accrediting bodies, labor unions, supporting industries, and organizations involved in health care research or quality improvement. NQF has reviewed and endorsed measure sets applicable to several health care settings and clinical areas and services, including hospital care, home health care, nursing-sensitive care, nursing home care, cardiac surgery, and diabetes care (NQF, 2002, 2003, 2004, 2005).

The committee concludes that a standard national approach to the development of performance indictors is essential, and therefore recommends that **the Department of Health and Human Services convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency and trauma care system performance.** This should be an independent, national process with the broad participation of every component of emergency care, and the federal government should play a lead role in promoting and funding the process. The development of the initial set of performance indicators should be completed within 18 months of the release of the release of this report.

The measures developed should include structure and process measures, but evolve toward outcome measures over time. They should be nationally standardized so that statewide and national comparisons across can be made. Measures should evaluate the performance of individual providers within the system, as well as that of the system as a whole. Measures should also be sensitive to the interdependence among the components of the system; for example, EMS response times may be adversely affected by ED diversions.

Furthermore, because an episode of emergency care can span multiple settings, each of which can have a significant impact on the final outcome, it is important that patient-level data from each setting be captured and combined. Currently it is difficult to piece together a complete picture of an episode of emergency care. To address this need, states should develop guidelines for the sharing of patient-level data from dispatch through posthospital release. The federal government should support such efforts by sponsoring the development of model procedures that can be adopted by states to minimize their administrative costs and liability exposure as a result of sharing these data.

Measurement of Performance

Performance data should be collected on a regular basis from all of the emergency care providers in a community. Over time, emerging technologies may support more simplified and streamlined data collection methods, such as wireless transmission of clinical data and direct links to patient electronic health records. However, these types of technical upgrades would likely require federal financial support, and EMS personnel would have to be persuaded to transition from paper-based run records, which are less amenable to efficient performance measurement. The data collected should be tabulated in ways that can be used to measure, report on, and benchmark system performance, generating information useful for ongoing feedback and process improvement. Using their regulatory authority over health care services, states should play a lead role in collecting and analyzing these performance data.

While a full-blown data collection and performance measurement and reporting system is the desired ultimate outcome, the committee believes a handful of key indicators of regional system performance should be collected and promulgated as soon as possible. These could include, for example, indicators of 9-1-1 call processing times, EMS response times for critical calls, and ambulance diversions. In addition, consensus measurement of EMS outcomes could be applied to two to three sentinel conditions. For example, emergency care systems across the country might be tasked with providing data on such conditions as cardiac arrest (See Box 3-1), pediatric respiratory arrest, and major blunt trauma with shock. Data from the different system components would allow researchers to measure how well the system performs at each level of care (9-1-1, first response, EMS, and ED). In addition, registries can provide a rich source of data that can be used for research and identification of trends.

BOX 3-1 Cardiac Arrest Registry to Enhance Survival

A new 18-month initiative funded by the Centers for Disease Control and Prevention (CDC) is under way in Fulton County, Georgia. Cardiac Arrest Registry to Enhance Survival (CARES is intended to develop a prototype national registry to help local EMS administrators and medical directors identify when and where cardiac arrest occurs, which elements of their EMS system are functioning properly in dealing with these cases, and what changes can be made to improve outcomes. The initiative is engaging Atlanta-area 9-1-1, EMS, and first responder services, and EDs in systematically collecting minimum data essential to improving survival in cases of cardiac arrest and submitting these data to the registry. Area hospitals log on to a simple, Health Insurance Portability and Accountability Act (HIPAA)-compliant website to report each patient's outcome. Data compilation and analysis are being conducted by researchers at Emory University. Using information gathered from the CARES registry, a community consortium organized by the American Heart Association (AHA) will orchestrate various community interventions to reduce disparities and improve outcomes among victims of cardiac arrest. CARES is designed to enable cities across the country to collect similar data quickly and easily, and use these data to improve cardiac arrest treatment and outcomes.

Sudden cardiac arrest (SCA) results from an abrupt loss of heart function and is the leading cause of death among adults in the United States. Its onset is unexpected, and death occurs minutes after symptoms develop (AHA, 2005). Survival rates in the event of sudden cardiac arrest are low, but vary as much as 10-fold across communities,. Victims' chances of survival increase with early activation of 9-1-1 and prompt handling of the call, early provision of bystander cardiopulmonary resuscitation (CPR), rapid defibrillation, and early access to definitive care. CARES is designed to allow communities to measure each link in their "chain of survival" quickly and easily and use this information to save more lives.

Public Dissemination of Information on System Performance

Public dissemination of performance data is crucial to drive the needed changes in the delivery of emergency care services. Dissemination can take various forms, including public report cards, annual reports, and state public health reports, which can be viewed either in hard copy format or on line. A key to success is ensuring that important information regarding the performance of the community's emergency care system can be retrieved by the public with a minimum of effort in a format that is highly organized and visually compelling.

Public dissemination of health care information is still in a state of development, despite the proliferation of such initiatives over the past two decades. Problems include the costs associated with data collection, the sensitivity of individual provider information, concerns about interpretation of data by the public, and lack of public interest. There are many examples from which to learn—the Health Plan Employer Data and Information Set (HEDIS), which reports on managed care plans to purchasers and consumers; CMS's reports on home health and nursing home care, the *Home Health Compare* and *Nursing Home Compare* websites, respectively (CMS, 2005a); and *Hospital Compare* from the Hospital Quality Alliance, which reports comparative quality data on hospitals (CMS, 2005b). A number of states and regional business coalitions have also developed report cards on managed care plans and hospitals (State of California Office of the Patient Advocate, 2005). Because of the unique status of the emergency care system as an essential public service, and the public's limited awareness of the significant problems facing the system, the public is likely to take an active interest in this information. The

committee believes dissemination of these data will have an important impact on public awareness and the development of integrated regional systems.

Public reporting can be at a detailed or aggregate level. Because of the potential sensitivity of performance data, they should initially be reported in the aggregate at the national, state, and regional levels, rather than at the level of the individual provider. Prematurely reporting provider performance data may inhibit participation and divert providers' resources to public relations rather than corrective efforts. At the same time, however, individual providers should have full access to their own data so they can understand and improve their individual performance, as well as their contribution to the overall system. Over time, information on individual provider organizations should become an important part of the public information on the system. Eventually, the data may be used to drive performance-based payment for emergency care.

Approaches for Reducing Barriers to Implementation

Institutional barriers to the adoption of integrated, regionalized care exist. These include payment systems and the legal framework that defines much of the structure of emergency care delivery.

Aligning Payments with Incentives

No major change in health care can take place without strong financial incentives. The way that emergency care services are reimbursed reinforces certain modes of delivery that are inefficient and stand in the way of achieving the committee's vision of emergency care. For example, under Medicare and Medicaid, prehospital providers do not receive payment unless they transport a patient to the hospital. This payment system makes it difficult for regional systems to innovate in "treat and release" or other non-transport approaches that may result in better care for patients and more efficient system design. CMS and all other payors should eliminate this requirement and develop a payment system for prehospital care that reflects the costs of providing those services.

Similarly, many hospitals do not have a strong economic motivation to address the problems of ED crowding, boarding, and ambulance diversions. In fact, these practices may even financially benefit them. There are several payment approaches that could eliminate perverse incentives that degrade emergency care. One is to eliminate the discrepancies in reimbursement between scheduled and ED admissions that relate to differences in both payor mix and severity of illness. CMS should evaluate the effect of existing DRG payments for elective admissions versus patients admitted from the ED. For example, DRG payments could be adjusted to reflect the average costs of scheduled surgical admissions versus ED medical admissions at safety net hospitals. Care must be exercised to insure that this does not result in physicians simply admitting their elective patients through the ED. Another method is to assess direct financial rewards or penalties on hospitals based on their management of patient throughput. CMS, through its purchaser and regulatory power, has the ability to drive hospitals to address and manage patient flow and assure timely access to quality care for its clients. All payors, including Medicare, Medicaid, and private insurers could also develop contracts that penalize hospitals for chronic delays in treatment, ED crowding, and EMS diversions. One strategy would be to refuse to pay for inpatient care unless it is provided in a designated inpatient unit. CMS and JCAHO should lead the way in the development of innovative payment approaches that accomplished these objectives. All payors should be encouraged to do the same. States with strong CON laws could use include boarding and diversion as criteria in CON decisions.

Adapting the Legal and Regulatory Framework

The way that hospitals and EMS agencies deliver emergency care is largely shaped by federal and state laws—in particular, EMTALA, HIPAA and medical malpractice laws. The application of these laws to the actual provision of care is guided by regulatory rules and advisories, enforcement decisions, and court decisions, as well as by providers' understanding of them. EMTALA and HIPAA are discussed below, and medical malpractice is discussed in Chapter 6.

The Emergency Medical Treatment and Active Labor Act (EMTALA). EMTALA was passed in 1986 order to prevent hospitals from refusing to serve uninsured patients and "dumping" them on other hospitals. EMTALA requires that hospitals provide every patient with a medical screening exam and, if needed, treatment or transfer to an appropriate facility (U.S. General Accounting Office 2001). EMTALA establishes a mandate for hospitals and physicians who provide emergency and trauma care to provide a medical screening exam to all patients and appropriately stabilize or transfer patients if an emergency medical condition exists. This is required regardless of patients' ability to pay. This aspect of EMTALA, and its impact on the availability of EDs, trauma centers, and on–call specialists, are described in Chapter 2.

EMTALA also has implications for the regional coordination of care. EMTALA was written to provide individual patient protections—it focuses on the obligations of an individual hospital to an individual patient (Rosenbaum and Kamoie, 2003). The statute is not clearly adaptable to a highly integrated regional emergency care system in which the optimal care of patients may diverge from conventional patterns of emergency treatment and transport.

Until recently, EMTALA appeared to hinder the regional coordination of services in several specific ways—for example, requiring a hospital-owned ambulance to transport a patient to the parent hospital, even if it is not the optimal destination for that patient; requiring a hospital to interrupt the transfer to administer a medical screening exam for a patient being transferred from ground transport to helicopter, and using the hospital's helipad; limiting the ability of hospitals to direct non-emergent patients who enter the emergency department to an appropriate and readily available ambulatory care setting. Interim guidance published by CMS in 2003, however, appeared to mitigate these problems (DHHS, 2003). It established, for example: that a patient visiting an off-campus hospital site that does not normally provide emergency care does not create and EMTALA obligation; that a hospital-owned ambulance need not return the patient to the parent hospital if it is operating under the authority of a community-wide EMS protocol; that and that hospitals are not obligated to provide treatment for clearly non-emergency situation as determined by qualified medical personnel. Further, hospitals involved in disasters need not strictly adhere to EMTALA if operating under a community disaster plan. Despite these changes, uncertainty surrounding interpretation and enforcement of EMTALA remains a damper to the development of coordinated, integrated emergency care systems.

A technical advisory group was convened by CMS in 2005 to study EMTALA and address additional needed changes (CMS (Centers for Medicare and Medicaid Services) 2005a; CMS (Centers for Medicare and Medicaid Services) 2005b; CMS (Centers for Medicare and Medicaid Services) 2005c). To date, the advisory group has focused incremental modifications to EMTALA.

While the recent CMS guidance and deliberations of the EMTALA Advisory Group are positive steps, the committee envisions a more fundamental rethinking of EMTALA that would support and facilitate the development of regionalized emergency systems, rather than simply addressing each obstacle on a piecemeal basis. This new EMTALA would continue to protect

patients from discrimination in treatment, while enabling and encouraging communities to test innovations in emergency care system design, for example, direct transport of patients to non-acute care facilities, such as dialysis centers and ambulatory care clinics, when appropriate.

The Health Insurance Portability and Accountability Act (HIPAA). HIPAA was enacted to facilitate electronic data transmission between providers and payers while protecting the privacy of patient health information. In protecting patient confidentiality, HIPAA can present certain challenges for providers, for example, making it more complicated for a physician to send information about a patient to another physician for a consultation. Regional coordination is based on the seamless delivery of care across the multiple provider settings. Patient specific information must flow feely between these settings—from dispatch to emergency response to hospital care—in order to ensure that appropriate information is available for clinical decision-making and coordination of services in emergency situations. Current interpretations of HIPAA would make it difficult to achieve the degree of information fluidity that is required.

Both EMTALA and HIPAA protect patients from potential abuses and serve invaluable purposes. But, as written and frequently interpreted, they can impede the exchange of life-saving information and hinder the development of regional systems. The committee believes that appropriate modifications can be made to both EMTALA and HIPAA that preserve their original purpose while reducing their adverse impact on the development of regional systems. The committee recommends that **the Department of Health and Human Services adopt regulatory changes to the Emergency Medical Treatment and Active Labor Act (EMTALA) and the Health Insurance Portability and Accountability Act (HIPAA) so that the original goals of the laws are preserved but integrated systems may further develop.**

CURRENT APPROACHES

There are a number of current efforts to establish systems that achieve some or all of the committee's goals of regionalization, coordination and accountability. Some are purely voluntary approaches, others have the force of state regulation. Some are local and regional efforts, others are statewide or national. This section highlights several different approaches that provide insights for the development of future such initiatives.

The Maryland EMS and Trauma System

Maryland has a unique statewide system that coordinates all EMS and trauma activity throughout the state. The Maryland Institute for EMS Systems (MIEMSS) is an independent state agency governed by an 11 member board that is appointed by the governor. The system provides training and certification, established statewide EMS protocols, coordinates care through a central communications center, and operates the air medical system in coordination with the Maryland State Police. The system is partially funded through a surcharge on state driver's license fees.

Regionalization

While EMS and 9-1-1 are operated locally, they utilize statewide protocols that promote regionalization of services to designated centers. In addition to multiple trauma levels, these include stroke, burn, eye, pediatric, perinatal, and hand referral centers. A relatively new stroke protocol, for example, designates regional stroke care centers according to three levels: level I

includes comprehensive stroke care; level II includes initial emergency management, including fibrinolytic therapy; and level 3 includes screening and immediate transport to a level I or II center. There is also a designated center for the injury of hands, a common form of trauma that requires specialized expertise, within a non-trauma center.

The control of air medical services by the state facilitates the regionalization of care through the active operation of dispatch.

Coordination

The key to coordination in Maryland is the statewide communications center, which coordinates all communications between EMS and other components of the system. The system links ambulances, helicopters, and hospitals and enables direct communications between components at any time. For example, a paramedic in western Maryland can talk directly with a local ED physician or obtain on-line consultation with a specialty hospital in Baltimore. While the local 9-1-1 centers initiate dispatch, they are usually too busy to follow patients through the continuum of care. The central communication center provides support by maintaining communications links, providing medical direction, and maintaining continuity of care. The communications center has direct links to incident command to facilitate management of EMS resources as an event unfolds.

The state also is developing a new wireless digital project which connects emergency medical services with other public safety entities (police, fire, emergency management, public health) throughout the state.

In addition, the state has developed a County Hospital Alert Tracking System (CHATS) that enables it to monitor the status of hospitals and EMS assets so that ambulances can be directed to less crowded facilities. This can also apply to individual services—for example, patients with acute coronary syndrome can be directed to facilities based on the current availability of reperfusion suites. The Facility Resource Emergency Database (FRED) system was designed to electronically gather detailed information from hospitals on bed availability, staffing, medications, and other critical capacity issues during disasters, but is also used to monitor and report on system capacity issues on a regular basis.

The state ensures coordination and protocol compliance through its statewide training, provider designation, and licensure functions. In addition to providing EMS training and certification, the system provides statewide disaster preparedness training for members of the National Disaster Medical System.

Accountability

The state monitors performance at the provider and system levels through a provider review panel that regularly evaluates the operation of the system. As a state agency, the system reports on its performance goals and improvements. Also, the CHATS system enables participating hospitals and the public to view the status of hospitals at all times through the web site, including data on availability of cardiac monitor beds, ED beds and trauma beds. The system is replacing paper ambulance run sheets with an electronic system so that system data can be collected and analyzed quickly to facilitate real-time performance improvement.

While Maryland is relatively advanced in achieving the goals of regionalization, coordination and accountability, it is not clear how easily the Maryland system could be replicated in other states. It has benefited from strong and stable leadership in the state office, adequate funding, a

high concentration of resources, and limited geography—features that many states do not currently enjoy.

Austin/Travis County, Texas

Austin/Travis County and four surrounding counties agreed to form a single EMS and trauma system to provide seamless care to emergency and trauma patients throughout the region. The initiative, ten years in the making, started with a fragmented delivery system consisting of the Austin EMS system, 13 separate fire departments, and a 9-1-1 service run through the sheriff's office that lacked any unified protocols. These different entities agreed to come together to form a unified system that coordinates all emergency care within the region. It operates through a Combined Clinical Council that includes representatives of the different agencies and providers within the geographic area, including fire, 9-1-1, EMS, air medical services, and corporate employers. This is a "third service" system—it is separate from fire and other public safety entities. The system is financially supported by the individual entities.

Regionalization

The system supports the regional trauma system through clinical operating guidelines that determine the care and transport of all patients within the system. But the system is more focused on coordination and medical direction of EMS than on regionalizing care.

Coordination

The coordination of care is achieved through several means. A unified set of clinical guidelines were developed and are maintained by the system based on current clinical evidence. These guidelines provide a common framework for the care and transport of patients throughout the system. Any changes to the guidelines must be evaluated and approved by the Combined Clinical Council.

All providers in the region have a common set of credentials and are given badges that identify them as certified providers within the system, substantially reducing the multi-jurisdictional fragmentation that is common across metropolitan areas. In addition, there is no distinction within the system between volunteer and career providers. The integrated structure facilitates both incident command and disaster planning.

Accountability

There is a Healthcare Quality Committee that is charged with reviewing the performance of the system and recommending specific actions to improve quality.

Palm Beach County, Florida

An initiative currently underway in Palm Beach County, FL is more limited in scope than the Maryland and Austin systems. The goal of the Palm Beach initiative is to find regional solutions to the limited availability of physician specialists who provide on-call emergency care services. In spring 2004, physician leaders, hospital executives, and public health officials formed the Emergency Department Management Group (EDMG) to address this problem. The initiative is in the early stages of development, and approaches are evolving. One approach is to attack the rising cost of malpractice insurance for emergency care providers, which discourages specialists from serving on on-call panels. The organization is developing a group captive insurance

company to supply physician liability coverage to physicians providing care in county emergency departments.

Regionalization

The group is exploring the regionalization of certain high-demand specialties, such as hand surgery and neurosurgery, so that the high costs of maintaining call coverage can be concentrated in a few high volume hospitals, where the volume of cases makes it feasible to maintain full on-call coverage. Hospitals throughout the county would pay a "subscription fee" to support the cost of on-call coverage at designated hospitals. The fee would be set at a level below what it would cost to have hospitals manage their on-call coverage problems individually.

Coordination

The group is developing a web-based, electronic ED call schedule so the EMS system can track which specialists are available at all hospitals throughout the county. This will enable the system to direct transport to the most appropriate facility based on the type of injury or illness of the patient.

Accountability

The initiative includes the development of a countywide quality assurance program under which all hospitals would submit certain data elements for assessment. It is unclear at this time how far this system would go toward public disclosure of system performance.

San Diego County, California

San Diego County has a regionalized trauma system that is characterized by a strong public-private partnership between San Diego County and its 5 adult and 1 children's' trauma centers. Public health, assessment, policy development, and quality assurance are core components of the system. The system operates under the auspices of the state EMS Authority.

Regionalization

The County is divided into 5 service areas, each of which has at least a level II trauma center. Adult trauma patients are triaged and transported to the appropriate trauma center, while the children's' hospital provides trauma care to all seriously injured children below the age of age 14. Serious burns are taken to the UCSD Burn Center. The county is considering regionalization of other diseases, such as stroke and heart attack based on the trauma model. The system includes the designation of regional trauma centers, designation of base hospitals to provide medical direction to EMS personnel, establish regional medical policies and procedures, and licensure of EMS services

Coordination

A county-wide electronic system (QA Net) provides real time status of every trauma center and emergency department in the County, including the reason for diversion status, ICU bed availability, trauma resuscitation capacity. The system has been in place for over 10 years and is a critical part of the coordination of emergency medical and trauma care in the County.

A regional communication system serves as the backbone of the EMS and trauma system both for day-to-day operations and disasters. It includes an enhanced 911 system and a county-

wide communication network that allows all ambulance providers and hospitals to communicate. The network is used to coordinate EMS destination decisions and bypass information, and allows each hospital and EMS provider to know the status of each other hospital and provider on a real time basis. Because the system's authority comes from the state to the local level, all prehospital and emergency hospital services are coordinated through one lead agency. This provides continuity of services, standardized triage, treatment and transport protocols, and an opportunity to improve the system as issues are identified.

Accountability

Accountability is driven by quality improvement program in which a medical audit committee meets monthly to review system-wide patient deaths and complications. The committee includes trauma directors, trauma nurse managers, the county medical examiner, the chief of EMS, and representatives of key specialty organizations, including orthopedic surgeons, neurosurgeons, as well as a representative for non-designated facilities. A separate prehospital audit committee also meets monthly and discusses any relevant prehospital issues. It includes ED physicians and prehospital providers.

FEDERAL, STATE, AND LOCAL COLLABORATION

States and regions face a variety of different situations, and there is no "one size fits all" approach to building EMS systems that will achieve the desired goals. There is, for example, substantial variation across states and regions in the level of development of trauma systems, the effectiveness of state EMS offices and regional EMS councils, in the degree of coordination and integration between fire, EMS, hospitals, trauma centers, and emergency management. The baseline conditions and needs also vary. For example, rural areas face very different problems than urban areas, and the approach that works for one may be counterproductive in the other.

In addition to the varying needs and conditions, the problems are too complex for an a priori solution to be prescribed by the committee. A number of different avenues should be explored and evaluated to determine what works and what doesn't. Over time, and over a number of controlled initiatives, such a process should lead to important insights about what works and under what conditions. These insights will provide "best practice" models that can be widely adopted to advance the nation toward the committee's vision.

The process described is one that can be supported effectively through federal demonstration projects. Demonstration projects can provide funding critical to the success of the project, guidance in the design and implementation, waivers from federal laws that might otherwise impede the process, and standardized, independent evaluations of projects and overall national assessment of the program. At the same time, the demonstration approach allows for significant variation in approach according to state and regional needs and conditions, within a set of clearly defined parameters. The IOM report, *Fostering Rapid Advances in Health Care: Learning from System Demonstrations*, articulated the benefits of the demonstration approach, "There is no accepted blueprint for redesigning the health care sector, although there is widespread recognition that fundamental changes are needed….For many important issues, we have little experience with alternatives to the status quo…the committee sees the launching of a carefully crafted set of demonstrations as a way to initiate a "building block" approach" (IOM, 2002).

The committee therefore recommends that **Congress establish a demonstration program, administered by the Health Resources and Services Administration, to promote**

regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate $88 million over 5 years to this program. The essential features of this program are described below.

Recipients

Grants would be targeted at states, which could define the projects at the state, regional, or local levels, and cross-state collaborative proposals would be encouraged. Projects would be selected so as to ensure that each of the three goals is well represented in the final set of projects. Grantees would be selected through a competitive process that is based on the quality of proposals, an assessment of the likelihood of success in achieving the stated goal(s), and the potential sustainability of the approach after the grant period ends. Proposals should explicitly consider the implications for both pediatric and adult patients within the proposed project.

Purpose of the Grants

Grantees could propose approaches that address one, two or all three of the goals of regionalization, coordination, or accountability. It would not be necessary for proposals to address more than one goal, but neither would it be discouraged.

Initiatives could be statewide, regional or local, and could include collaborations between adjacent states. Each proposal would be required to describe the proposed approach in detail, explain how the approach will achieve the stated goal(s), identify who will carry out the responsibilities associated with the initiative, identify the costs associated with its implementation, and describe how success will be measured. The proposals should describe the state's current stage of development and sophistication with regard to the selected goal, and explain how the grant will be used to significantly increase its system performance in that regard. Grants could be used in a number of different ways. Grant dollars could be used to enhance communications for the purpose of improving coordination of services, particularly for the development of centralized communications centers at the regional or state levels. Grants could be used to establish convening and planning functions, such as the creation of a regional or state advisory group composed of stakeholders for the purposes of building collaboration, and designing and executing plans to improve coordination. They could be used to hire consultants and staff to manage the planning and coordination functions. They could also be used to pay for data collection, analysis, and public reporting. In very limited circumstances, they could also be used to implement information systems for the purpose of improving coordination of services. But they should not be used for routine functions that would be performed in the absence of the demonstration project, such as the hiring or training of EMS providers, or the purchase of EMS equipment. Funds could also be used to enhance linkages between rural and urban emergency services within broadly defined regions in order to improve rural emergency care through communications, telemedicine, training, and coordination activities.

Funding Levels

The committee proposes a two-phase program. In phase I, the program would fund up to 10 projects at up to $6 million over three years. Ten projects will likely result in considerable variation in the types of projects proposed and the range of lessons learned. Based on successful results that appear to be reproducible in other states, the program would launch Phase II, in which a smaller, 2-year demonstration grant—up to $2.0 million each, would be made available to up to 10 additional states. This would be combined with a technical assistant program

designed to disseminating results and practical guidance to all states. Program administration would include evaluation of the program throughout its five years, including reports and public comments at 2.5 years and 5 years after project initiation. The committee estimates funding for the program as follows:

- Phase I grants: $60 million (over 3 years)
- Phase II grants: $20 million (over 2 years)
- Phase II technical assistance: $4 million (over 2 years)
- Overall program administration: $4 million (over 5 years)
- Total program funding: $88 million (over 5 years)

Granting Agency

No single federal agency that has responsibility for the various components of our nation's emergency care system. As noted earlier, this responsibility is currently shared among multiple agencies—principally NHTSA, HRSA, CDC, and DHS. If, as recommended elsewhere in this report, a lead agency is established that consolidates funding and leadership for these multiple activities, that would be the appropriate agency to lead this effort. Until that consolidation occurs, however, the committee believes that this demonstration program should be placed within HRSA. HRSA currently directs a successful, related demonstration program, Emergency Medical Services for Children, and sponsors the Trauma-EMS Systems Program, both of which share many of the broad goals of the proposed demonstration project. HRSA has already demonstrated a willingness and ability to collaborate effectively with other relevant federal agencies, including NHTSA, CDC, and, increasingly, DHS, and should be encouraged to consider them as partners in this enterprise.

SUPPORTING SYSTEM INTEGRATION

In order for the process to be successful, it must be supported. As stated in *Fostering Rapid Advances*, "…we must both plant the seeds of innovation and create an environment that will allow success to proliferate. Steps must be taken to remove barriers to innovation and to put in place incentives that will encourage redesign and sustain improvements." This must include payment policies that reward successful strategies. It must recognize the interdependencies within emergency care and address systems problems with systems. It must balance the interests of many different stakeholders. And it must involve leadership at many levels taking responsibility for creating change.

Underlying the committee's vision of regionalized, coordinated, and accountable emergency care is the recognition that it is a complex system with many interdependent components. To function effectively requires that these components be highly integrated. Operationally this means that all of the key players in a given region—hospital emergency departments, EMS dispatchers, state public health officials, trauma surgeons, EMS agencies, ED nurses, hospital administrators, firefighters, police, and community safety net providers, and others—must work together to make decisions, deploy resources, and monitor and adjust system operations based on performance feedback.

As documented throughout this report, however, fragmentation, silos, and entrenched interests prevail throughout emergency care. The organization of federal government programs that support and regulate emergency services to a large degree reflect the fragmentation of

emergency services at the state and local levels. Prehospital EMS, hospital-based emergency care, trauma care, injury prevention and control, and medical disaster preparedness are scattered across numerous agencies within DHHS, DOT, and DHS. Furthermore, while most of these programs attempt to develop programs within a system-wide framework, the divisions make it difficult to plan and allocate federal dollars in the most effective manner. For example, continuing to fund EMS grants through the fire service (FEMA, DHS) has led to limited overall EMS funding and neglect of its role in both day-to-day planning and disaster preparedness. There is also substantial overlap in the responsibilities of these agencies—for example, almost every agency is involved in disaster preparedness, and some of those efforts, overlap considerably. For example, programs addressing hospital surge capacity are currently taking place in AHRQ, CDC's CIPC, HRSA's Office of Domestic Preparedness, and DHS.

It should be noted that interagency cooperation and coordination among most agencies is currently good. The informal FICEMS process existed for several years before the statutory version that recently took its place. Further, there is a substantial amount of collaborative funding of activities among federal partners. But these successes are dependent on strong leadership of key individuals; there is no guarantee that the current structure can sustain such cooperation as normal turnover in personnel occurs. In addition, the current structure limits the resources that can be combined for concerted federal initiatives. And finally, the fact that multiple agencies are involved in emergency services diffuses the political power base and reduces the opportunities for the public to advocate for system improvement.

FEDERAL LEAD AGENCY

The committee's vision of a coordinated, regionalized and accountable emergency and trauma care system for adults and children is impeded by the structure of federal programs that currently support emergency and trauma care. To function effectively, the components of the emergency and trauma care system must be highly integrated. Operationally this means that all of the key players in a given region—hospital emergency and trauma departments, EMS dispatchers, state public health officials, trauma surgeons, EMS agencies, ED nurses, hospital administrators, firefighters, police, and community safety net providers, and others—must work together to make decisions, deploy resources, and monitor and adjust system operations based on performance feedback.

As documented throughout this report, however, fragmentation, silos, and entrenched interests prevail throughout emergency and trauma care. The organization of federal government programs that support and regulate emergency and trauma care services to a large degree reflect the fragmentation of emergency and trauma care services at the local level. Responsibility for emergency and trauma care is widely dispersed among multiple federal agencies within DHHS, DOT and DHS. This reflects the history and inherent nature of emergency and trauma care—emergency and trauma care are essential public services that operate at the intersection of medical care, public health, and public safety (police, fire and emergency management). Furthermore, the mounting toll of highway deaths in the 1960s led the National Highway Traffic Safety Administration (NHTSA) to become the first government home for EMS, where it has remained. Thus, while EMS is primarily a medical discipline, federal responsibility for it rests with the Department of Transportation. This was recently reinforced by the elevation of NHTSA's EMS program to the status of an Office of EMS within the agency. Today, NHTSA sponsors a number of workforce and research initiatives, the development of the National EMS

Information System, and recently received funding for a major nationwide initiative to promote the development of next generation 9-1-1 service.

DHHS has played an important supporting role in the development of EMS, and has taken the leading role with respect to hospital-based emergency and trauma care. For many years, it housed the Division of Emergency Medical Services and the Division of Trauma and EMS, and most recently the Trauma/EMS Systems Program. All of these programs have been eliminated; the latter was recently zeroed out of the federal budget for FY 2006. DHHS continues to support the CDC Center for Injury Prevention and Control, the Emergency Medical Services for Children (EMS-C) program and the National Bioterrorism Hospital Preparedness Program. These programs have made important contributions to emergency and trauma care, despite inconsistent funding the frequent threat of elimination. AHRQ, another DHHS agency, has historically been the principal federal agency funding research in emergency care delivery, including much of the early research on management of out-of-hospital cardiac arrest. Recently, AHRQ has funded important studies of ED crowding/operations management/patient safety issues. It is also active in funding research on preparedness, bioterrorism planning and response.

DHS also plays an important role in emergency and trauma care. The Federal Emergency Management Administration (FEMA), once an independent cabinet-level agency that is now housed in DHS, provides limited amounts of grant funding to local EMS agencies through the U.S. Fire Administration. DHS also houses the Metropolitan Medical Response System (MMRS), a grant program designed to enhance emergency and trauma preparedness in major population centers. This program was migrated from DHHS to DHS in 2003. DHS also houses the Disaster Medical Assistance Team (DMAT) program, through which health professionals volunteer and train as locally organized units in order to be able to rapidly deploy, under federal direction, in response to disasters nationwide.

Efforts have been made to improve inter-agency collaboration at the federal level, especially in recent years. Over the last decade, federal agencies have worked collaboratively to provide leadership to the emergency and trauma care field, to minimize gaps and overlaps across programs, and to pool resources in order to jointly fund promising research and demonstration programs. For example, NHTSA and HRSA jointly supported the development of the *EMS Agenda for the Future*, which was published in 1996. This degree of collaboration has not been universal, however, and has been evident in some agencies more than others. Furthermore, collaborative efforts are limited by the constraints of agency authorization and funding. At some point, agencies must pursue their own programmatic goals at the expense of joint initiatives. Furthermore, to the degree that successful collaboration has occurred, it has generally depended on the good will of key individuals in positions of leadership, limiting the sustainability of these efforts when personnel changes occur.

In an effort to enhance the sustainability of collaborative initiatives, a number of agencies have participated in informal planning groups. For example, the "Interagency Committee on EMSC Research" (ICER), which is sponsored by HRSA, brings together representatives from a number of federal programs involved in research issues for the purposes of information sharing and improving research in emergency and trauma care for children.

A broader initiative is the Federal Interagency Committee on EMS (FICEMS), a planning group designed to coordinate the efforts of the various federal agencies involved in emergency and trauma care. FICEMS was established in the late 1970s. After a subsequent period of dormancy, it was reconstituted in the mid-1980s. The organization had no statutory authority until 2005, when it was given formal status by the Emergency Medical Services Support Act

(Public Law 109-59). While the focus of FICEMS is EMS, it has in practice reached beyond the strict boundaries of prehospital care to facilitate coordination and collaboration with agencies involved in other aspects of hospital-based emergency and trauma care. (See Box 3-2.) NHTSA is charged with providing the administrative support for FICEMS, which must submit a report to Congress annually. The central aims of this group are to:

- Ensure coordination among the federal agencies involved with state, local or regional emergency medical services and 9-1-1 systems.
- Identify state, local or regional emergency medical services and 9-1-1 needs.
- Recommend new or expanded programs, including grant programs, for improving state local or regional emergency medical services and implementing improved emergency medical services communications technologies, including wireless 9-1-1.
- Identify ways to streamline the process through which federal agencies support state, local or regional emergency medical services.
- Assist state, local or regional emergency medical services in setting priorities based on identified needs.
- Advise, consult, and make recommendations on matters relating to the implementation of the coordinated state emergency medical services programs.

BOX 3-2 FICEMS Membership

The 2005 Emergency Medical Services Support Act designated the following agencies as members of FICEMS. Each year, members elect a representative from one of these member organizations as the FICEMS chairperson.

- National Highway Traffic Safety Administration (DOT)
- Preparedness Division, Directorate of Emergency Preparedness and Response (DHS)
- Health Resources and Services Administration (DHHS)
- Centers for Disease Control and Prevention (DHHS)
- U. S. Fire Administration, Directorate of Emergency Preparedness and Response (DHS)
- Centers for Medicare and Medicaid Services (DHS)
- Under Secretary of Defense for Personnel and Readiness (DoD)
- Indian Health Service (DHHS)
- Wireless Telecommunications Bureau, Federal Communications Commission
- A representative of any other federal agency appointed by the Secretary of Transportation or the Secretary of Homeland Security through the Under Secretary for Emergency Preparedness and Response, in consultation with the Secretary of Health and Human Services, as having a significant role in relation to the purposes of the Interagency Committee
- A State emergency medical services director appointed by the Secretary

In addition, FICEMS is developing an advisory council composed of non-federal representatives, which will solicit public input on key emergency and trauma care issues.

Problems with the Current Structure

Despite recent efforts at improved federal collaboration, there is widespread agreement that the various components of emergency and trauma care (EMS, trauma, EMS-C, hospital-based care) individually have not received the sufficient attention, stature and funding within the

federal government. The scattered nature of federal responsibility for emergency care limits the visibility necessary to secure and maintain funding within the federal government. The result has been marked by fluctuations in budgetary support, and the constant risk that key programs will be dramatically downsized or eliminated. The lack of a clear point of contact for the public and for stakeholders makes it difficult to build a unified constituent base that can advocate effectively for funding and provide feedback to the government on system performance. The lack of a unified budget has created overlaps, gaps and idiosyncratic funding of various programs (e.g., separate hospital surge capacity initiatives are currently taking place in AHRQ, CDC, HRSA, and DHS). Finally, lack of unified accountability disperses responsibility for system failures, and perpetuates divisions between public safety and medical-based emergency and trauma care professionals.

The degree to which the scattered responsibility for emergency and trauma -care at the federal level has contributed to this disappointing performance is unclear. But the committee believes that a new approach is warranted.

Alternative Approaches

Strong federal leadership for emergency and trauma care is at the heart of the committee's vision for the future, and continued fragmentation of responsibility at the federal level is unacceptable. To that end, the committee considered two alternatives: (1) maintain the status quo, giving the FICEMS approach time to strengthen and mature, or (2) designate or create a new lead agency in the federal government for emergency and trauma care. Some of the key differences between these competing approaches are summarized in Table 3-1.

TABLE 3-1 Comparison of the Current Approach and the Lead Agency Proposal

	Current Approach/FICEMS	Lead Agency
Description	• Current agencies retain autonomy, but the FICEMS process fosters collaboration in planning.	• Combines emergency care functions from several agencies into a new lead agency.
Authority	• Has the authority to convene meetings; but no authority to enforce planning, evaluation and coordination of programs and funding.	• Would have planning and budgetary authority over the majority of emergency care activities at the federal level.
Funding	• No guarantee of coordinated program funding. • Distributed responsibility for federal functions means that if programs are cut, others remain, reducing the risk of losing all federal support for emergency and trauma care.	• Consolidates visibility and political representation of emergency care, enhancing federal funding opportunities. • Emergency care funding is fully coordinated. • Risk of losing significant funding for emergency care in a hostile budget environment.

	Current Approach/FICEMS	Lead Agency
Collaboration	• Brings together the key emergency and trauma care agencies. • Cannot enforce coordination or collaboration.	• Unified agency will drive collaboration among all components of emergency and trauma care to achieve system-wide performance goals.
Public Identity	• Still lacks unified point of authority from the public's perspective. • FICEMS, especially through its advisory council, facilitates response to the public.	• Provides for a unified federal EC presence for interaction with the public and stakeholder groups.
Professional Identity	• Fragmented federal representation makes it hard to break down silos in the field	• Provides a home for emergency and trauma care, which can project and enhance the professional identity of emergency care providers over time. • Lead agency can consolidate constituencies and engender stronger political representation
Efficiency	• May reduce redundancy through enhanced collaboration. • Very low administrative overhead costs.	• Eliminates redundant administrative structure, reducing administrative overhead costs. • Consolidated funding would allow for better allocation of federal dollars across the various emergency care needs (e.g. Eliminates overlapping programs)
Transition	• FICEMS is established in law and implementation is underway. • Due to FICEMS' limited powers, risks to individual programs and constituencies are minimal.	• Substantial start-up costs associated with the transition to a single agency. • Potential for changes in program and funding emphasis during transition which could create winners and losers. • Potential dissension among emergency care agencies and constituencies could impact the organization's effectiveness.

Maintain the Status Quo, Allow FICEMS to Strengthen

The committee considered the ramifications of maintaining the status quo. The problems associated with fragmented federal leadership of emergency care are documented above. These include variable funding, periodic program cuts, programmatic duplications, and critical program gaps. But with the recent enactment of a statutory framework for FICEMS, the committee considered the possibility that the need for a lead federal agency has diminished. The rationale for delaying the movement toward a lead federal agency and allowing FICEMS time to gain strength was carefully considered by the committee. The central argument in support of this strategy is that there have been a number of positive recent improvements in the level of

collaboration at the federal level, and these should be given an opportunity to work before pushing ahead with an unproven and politically risky approach. A number of recent developments support this: the recent enactment of a statutory framework for FICEMS; the current development of a public advisory committee within FICEMS; the increasing level of collaboration among some federal agencies; the substantial new NHTSA funding for a next generation 9-1-1 initiative; and the elevation of the NHTSA EMS program to the Office of EMS, which has the potential to improve visibility and funding for EMS, and perhaps other aspects of emergency and trauma care, within the federal government.

While the committee applauds these positive developments, it notes that setbacks have occurred as well. Recently, DHHS' Division of Emergency Medical Services, Division of Trauma and EMS, and most recently the Department's Trauma/EMS Systems Program were zeroed out of the federal budget. Federal funding to AHRQ, non-bioterrorism programs at the CDC and other federal programs related to emergency and trauma care at the federal level have been cut. These observations suggest that a fragmented organizational structure at the federal level will significantly hinder the development of a coordinated, regionalized, accountable emergency and trauma care system. FICEMS can be a valuable body, but it is a poor substitute for formal agency consolidation. FICEMS is expressly focused on EMS, and ultimately has limited power over even this sphere. It is not a federal agency and therefore cannot regulate, spend or withhold dollars. It cannot even hold its own member agencies accountable for their actions, or a lack of action.

New Federal Lead Agency

The possibility of a lead agency has been discussed for years, and was highlighted in the 1996 report*, EMS Agenda for the Future.* While the concept of a lead agency promoted in the *EMS Agenda* was focused on prehospital emergency medical services, the committee believes that a lead agency should include all components involved in the provision of emergency and trauma care. This lead federal agency would unify federal policy development related to emergency and trauma care, provide a central point of contact for the constituencies within emergency and trauma care, serve as a federal advocate for emergency and trauma care within the government, and coordinate grants so that federal dollars are allocated efficiently and effectively.

A lead federal agency could better move the emergency and trauma care system toward improved integration, unify decision-making and funding decisions, and represent all emergency and trauma care patients, providers, and settings, including prehospital EMS (both ground and air), hospital-based emergency and trauma care, pediatric emergency and trauma care, rural emergency and trauma care, and medical disaster preparedness. Specifically, a federal lead agency could:

- Provide consistent federal leadership on policy issues that cross agency boundaries;
- Create unified accountability for the performance of the emergency and trauma care system;
- Rationalize funding across the aspects of emergency and trauma care in order to optimize the allocation of resources in achieving system outcomes;
- Coordinate programs to eliminate overlaps and gaps in current and future funding;
- Create a large combined federal presence, increasing the visibility emergency and trauma care within the government and to the public;

- Provide a single point of contact for stakeholders and the public, resulting in consolidated and efficient data collection and dissemination, program information, coordinated messages, and a recognizable identity;
- Enhance the professional identity and stature of emergency and trauma care practitioners;
- Bring together multiple professional groups and cultures under one roof will create cross-cultural, and interdisciplinary interaction and collaboration that will model and reinforce the integration of services that are envisioned by the committee in the field.

Although creating a lead agency could produce many benefits, such a move also involves significant challenges. Numerous questions must be addressed regarding the location of such an agency in the federal government, the structure and functions of the new agency, and the possible risk of weakening or losing current programs. HRSA's rural EMS and EMS/Trauma System programs have already been de-funded, and the EMS-C program is under the constant threat of elimination. There is a real concern that proposing an expensive and uncertain agency consolidation might jeopardize programs that are already at risk, such as EMS-C, as well as cripple new programs that are just getting started, such as NHTSA's enhanced 9-1-1 program. This is particularly likely if there is resistance to the consolidation from within the current agency homes for these programs.

A related concern is that the priority currently given to certain programs may shift, resulting in less support for existing programs. EMS advocates have expressed concern that in a unified agency, hospital-based emergency and trauma care issues would dominate the agenda of the new agency. The pediatric community worries about getting lost in a new agency—they fought hard to establish and maintain strong categorical programs supported by historically steady streams of funding. There is a concern that under this new structure, the current focus of the EMS-C program might get lost or diminished, or simply lose visibility in the multitude of programs addressed by the new agency.

There is also the potential for administrative and funding disruptions. Combining similar agencies may be straightforward, particularly those that reside within the same department. But combining agencies with different missions across departments with different cultures may prove very difficult. The problems that were experienced during the consolidation of programs in DHS increase anxiety about this proposal.

Another concern is that pulling medical-related functions out of DHS and DOT will worsen fragmentation rather than reduce it. Operationally, nearly half of EMS services are fire-based. Thus, there is concern that separating EMS and fire at the federal level may splinter relationships, rather than strengthen them.

The Committee's Recommendation

Despite these fears, the Committee believes the potential benefits of consolidation outweigh the potential risks. A lead federal agency is required to fully realize its vision of a coordinated, regionalized, and accountable emergency and trauma care system. It recognized that there are a number of challenges associated with the establishment of a new lead agency, though it believes that these concerns can be mitigated though appropriate planning for the new agency. It therefore recommends that **Congress establish a lead agency for emergency and trauma care within two years of this report. The lead agency should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical**

9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency care.

The Objectives of the Lead Agency

The agency's mission would be to enhance the performance of the emergency and trauma care system as a whole, as well improve the performance of the various components of the system, for example, prehospital EMS, hospitals, trauma systems, pediatrics, prevention, rural emergency and trauma care, and disaster preparedness efforts. The lead agency would set the overall direction for emergency and trauma care planning and funding, would be the key collector and repository of data about the field, and would be the key source of information about emergency and trauma care for the public, the federal government and the practitioners themselves. The lead agency would be responsible for allocating federal resources across all of emergency and trauma care to achieve system-wide goals, and should be held accountable for performance of the system and its components.

The Location of the Lead Agency

The lead agency would be housed within the Department of Health and Human Services. The committee considered many factors in its selection of the DHHS over the Department of Transportation and the Department of Homeland Security. The factor that drove this decision above all others was the need to unify emergency and trauma care within a public health/medical care framework. Emergency and trauma care is by its very nature involved in multiple arenas—medical care, public safety, public health, emergency management. The multiple identities that result from this reinforce the fragmentation that is endemic to the emergency and trauma care system. For too long, the gulf between EMS and hospital care has hindered efforts at communication, continuity of care, patient safety and quality of care, data collection and data sharing, collaborative research, performance measurement and accountability. It will be difficult for emergency and trauma care to achieve seamless and high quality care across the system until all of the system is organized within a medical/public health framework, while retaining its operational linkages with public safety and emergency management.

Only DHHS, as the Department responsible for medical care and public health in the U.S., can effectively encompass these functions. Although DOT has played an important role in both EMS and acute trauma care, and has collaborated effectively with other agencies, its EMS and highway safety focus is too narrow to represent all of emergency and trauma care. The Department of Homeland Security houses the Fire Service, which is closely allied with EMS, particularly at a field operations level. But the focus of DHS on disaster preparedness and bioterrorism is also too narrow to encompass the broad scope of emergency and trauma care concerns.

Because emergency and trauma care functions would be consolidated in a public health/medical-oriented department, there is a risk that public safety and emergency management components may receive less attention, stature, or funding. Therefore the committee considers it to be imperative that the mission of this new agency be understood and clearly established by

statute so that the public safety and emergency management aspects of emergency and trauma care are not neglected.

The Programs Included in the Lead Agency

In the committee's vision, the lead agency would have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. The focus of the new lead agency would be on program development and strategic funding to improve the delivery of emergency and trauma care nationwide.

It would not be primarily a research funding agency, with the exception of existing grant programs mentioned above. Funding for basic, clinical, and health services research in emergency and trauma care will remain the primary responsibility of existing research agencies, including NIH, AHRQ, and the CDC. Because of the very limited research focus of the lead agency, it is important that existing research agencies, NIH in particular, work closely with the new lead agency and strengthen their commitment to emergency and trauma care research. On the other hand, it may be appropriate to keep certain clinical and health services research initiatives with the programs in which they are housed, and therefore bring them into the new agency. For example, the Pediatric Emergency Care Applied Research Network (PECARN) could be moved into the new agency along the rest of the EMS-C program.

In addition to existing functions, the lead agency would become the home to future programs related to emergency and trauma care, including new programs that would be dedicated to the development of inclusive systems of emergency and trauma care.

Working Group

While the committee envisions a consolidation of most of the emergency care-related functions currently residing in other agencies and departments, the committee recognizes that there are many complex issues involved in determining which programs should be combined and which left in their current agency homes. A deliberate process would be established to determine the exact composition of the new agency and to coordinate an effective transition to it. For these reasons, the committee has recommended the establishment of an independent working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and to coordinate and monitor the transition. The working group would have representation from federal and state agencies and professional disciplines involved in emergency care. The committee considered whether or not FICEMS was an appropriate entity to assume this advisory and oversight role, and concluded that, as currently constituted, FICEMS lacked the scope and the independence to effectively serve in this role.

The Role of FICEMS

FICEMS is a highly promising entity that is complementary to the lead agency. FICEMS would play a vital role during the interim two-year period by continuing to enhance coordination and collaboration between agencies and provide a forum for public input. In addition, it can play an important advisory to the independent working group. Once the lead agency is established, FICEMS would continue to coordinate work between the lead agency and other agencies, such as NIH, CMS, and DOD that remain closely involved in various emergency and trauma care issues.

The Structure of the Lead Agency

While the principal of integration across components of emergency and trauma care should drive the structure, operation, and funding of the agency, the committee envisions distinct program offices to provide focused attention and programmatic funding for key areas, for example:

- Prehospital EMS, including 9-1-1, dispatch, and both ground and air medical services;
- Hospital-based emergency and trauma care;
- Trauma systems;
- Pediatric emergency and trauma care;
- Rural emergency and trauma care;
- Disaster preparedness.

In order to ensure that current programs do not lose visibility and stature within the new agency, each program office should have equal status and reporting relationships within the agency's organizational structure. The committee envisions a national dialogue over the coming year, coordinated by the independent working group, aided with input from FICEMS, and with the involvement of the Office of Management and Budget, Congressional Committees with jurisdiction, to specify the organizational structure in further detail and implement the recommendation.

Funding for the Lead Agency

Existing programs transferring to the new agency would take their full current and projected funding with them to the new agency. While some funds may not be able to migrate, for example, Highway Trust Funds that contribute to the operational funding for the Office of EMS.

Congress should also establish additional funding to cover the costs associated with the transition and with the new administrative overhead associated with the new agency. In addition, Congress should add new funding for the offices of hospital-based emergency and trauma care, rural emergency and trauma care, and trauma systems. In light of the pressing challenges confronting emergency care providers and the American public, this would be money well spent. While the committee is unable to estimate the costs associated with establishing a unified agency; it recognizes that it would be substantial. But the committee believes that there would be countervailing cost savings resulting from reduced duplication and lower overhead. Consequently, new funding that flows into the agency would result in new programming, rather than an increase in existing overhead.

Mitigating Concerns Regarding the Establishment of a Lead Federal Agency

The Committee recognizes that transitioning to a single lead agency is a difficult challenge under any circumstances, but will be especially difficult for an emergency and trauma care system that is already under duress from funding cutbacks, elimination of programs, growing public demand on the system, and pressure to enhance disaster preparedness. During this critical period, it is important that support for emergency and trauma care programs already in place in the various federal agencies be sustained. In particular, the Office of EMS within NHTSA has ongoing programs which are critical to the emergency medical services system. Similarly,

existing emergency care-related federal programs such as those in HRSA's EMS for Children Program and Office of Rural Health Policy and at CDC should be supported during the transition. In order to be successful, the constituencies associated with established programs must not perceive that they are being politically weakened during the transition period.

The committee believes that the proposed consolidation of agencies will enhance support for emergency and trauma care across the board, benefiting all current programs. But it also considers it critically important to avoid disruptions that could adversely affect established programs. Therefore the committee believes that legislation creating the new agency should protect current levels of funding and visibility for existing programs. The agency should balance its funding priorities by adding to existing funding levels, not by diverting funds away from existing programs.

The committee recognizes that there are concerns that pulling medical-related emergency and trauma functions out of DHS and DOT will create additional fragmentation. The committee believes that the public safety aspects of emergency and trauma care must continue to be addressed as a core element of the emergency and trauma care identity. But the primary focus of emergency and trauma care should be medical and public health oriented in order to ultimately achieve the recognition, stature, and outcomes that are critical to its success.

RECOMMENDATIONS

3.1: The Department of Health and Human Services and the National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.

3.2: The National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients.

3.3: The Department of Health and Human Services should convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance.

3.4: The Department of Health and Human Services should adopt regulatory changes to the Emergency Medical Treatment and Active Labor Act (EMTALA) and the Health Insurance Portability and Accountability Act (HIPAA) so that the original goals of the laws are preserved but integrated systems may further develop.

3.5: Congress should establish a demonstration program, administered by the Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate $88 million over 5 years to this program.

3.6: Congress should establish a lead agency for emergency and trauma care within 2 years of the publication of this report. The lead agency will be housed in the Department of

Health and Human Services, and will have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress will establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency and trauma care.

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4
Improving the Efficiency of Hospital-Based Emergency Care

The emergency care system is but one component of the larger health care delivery system, and of the even larger social safety net system. As such, it is subject to many forces far beyond its direct control. There is little that emergency care providers and advocates can do to alter environmental factors such as: increasing utilization of the ED by the uninsured; the increasing age and number of chronic conditions of patients; staffing shortages in many key areas, especially nurses and on-call specialists; malpractice insurance rates that grew on average more than 50 percent between 2002 and 2003 (AMA, 2003), declining public and private reimbursements, not to mention disasters, both the natural and man-made.

There is a great deal, however, that the emergency care system can do to anticipate, prepare for, and manage the effects of these broader trends. This chapter will explore strategies to improve the efficiency of hospital-based emergency care within the context of the broader health care delivery system. It examines the special issue of patient flow in emergency care, describes approaches to improving efficiency by managing patient flow throughout the hospital, and discusses approaches to overcome barriers to improving operational efficiency. Finally, the chapter outlines the compelling need for regulatory and policy changes to increase accountability and incentivize the efficient management of patient flow throughout the hospital, and beyond.

THE ED IN THE CONTEXT OF THE HEALTH CARE DELIVERY SYSTEM

Medical science in the United States is arguably the most advanced in the world, but the organization and delivery of health care in the U.S. lags well behind many other industries in terms of innovation, information technology (IT), and management practices. J.D. Kleinke describes medical delivery in the United States as "…a miracle of disorganization, held together through the sheer collective will of overworked professionals tasked with managing tens of millions of patients by memory, pen scrawl, Post-It note, and telephone call" (Kleinke, 1998). It is a system that, to quote Donald Berwick, "is perfectly designed to achieve exactly the results it gets" (Berwick, 1996). The results, as documented by the IOM reports, *To Err Is Human* and *Crossing the Quality Chasm*, include an estimated 98,000 deaths and more than one million injuries each year as a result of health care process and system failures (Starfield, 2000; IOM, 2000, 2001). According to the joint National Academy of Engineering/Institute of Medicine report, *Building a Better Delivery System: A New Engineering/Health Care Partnership*, "an estimated thirty to forty cents of every dollar spent on health care…a half trillion dollars a year…is spent on costs associated with: overuse, underuse, misuse, duplication, system failures…and inefficiency" (National Academy of Engineering and IOM, 2005). While confidence in American medicine remains strong, patients understand that the delivery system is failing. In a survey conducted by the Picker Institute, 75 percent of patients described a system that was fragmented, difficult to navigate, and inconsistent in terms of information, evidence, and treatment (Picker Institute, 2000).

According to the NAE/IOM report, the U.S. health care system retains a "cottage industry" structure, with physicians and other health care providers operating semi-autonomously. As a

result, hospitals and other provider organizations lack the hierarchical control of the typical business enterprise, making it difficult to introduce efficiency principles to streamline flows of production, inputs, inventory, etc. as in other industries. In addition, the prevalent payment structures in health care, which focus on individual encounters and practice settings, tend to reinforce silos, reward inefficient practices, and discourage investment in new technologies and process improvements.

As a result, innovations that have swept through other sectors of the economy, including banking, airlines, and manufacturing, have failed to take hold in health care delivery—a sector of the economy that now consumes 16 percent of our nation's GDP and is growing at twice the rate of inflation. Health care information technology has advanced considerably in the last decade, but mainly in the administrative and financial arenas, as opposed to the core processes of delivering clinical services (National Academy of Engineering and IOM, 2005).

Other industries have made use of a number of tools derived from engineering and operations research, which we collectively refer to as operations management (see Box 4-1).

BOX 4-1 Operations Management Tools

There are many operations management methodologies that could be applied to better managing patient flow, including:

Quality Functional Deployment. This is an iterative process that links stakeholder needs to the resources to meet those needs throughout the organization. Conflicting demands on the organization emerge and are resolved with all relevant stakeholders looking at the tradeoffs from a system perspective. It has been used in a variety of industrial applications, including integrated circuit and automobile design.

Failure-Mode and Effects Analysis (FMEA). This is a formal process for analyzing potential failures that might occur under varying conditions so that they can be avoided through design features. It has been used in manufacturing for more than 30 years. Its use was and has recently been applied to health care. The Veterans Administration encourages its accredited hospitals to use FMEA or hazard analysis tools in a required annual proactive risk assessment of at least one high risk process each year. **Root cause analysis** is a qualitative, retrospective variation of FMEA that has been widely used to analyze industrial accidents. The Joint Accreditation of Health Care Organization requires accredited hospitals to use the method to evaluate sentinel patient safety events.

Human Factors Engineering. This set of techniques attempts to integrate human behavior and limitations into process design. Human factors research has been widely used across industries, and has many recent applications in health care, such as medication administration, diagnosis, handoffs of patients between shifts, and telemedicine.

Queuing theory. Queuing theory is used to determine the capacity of services that are subject to variable demand over time. It has been used widely in a number of service industries, such as banking and public transportation. It has had limited use in health care, but has been used to optimize scheduling and staffing in primary care, operating rooms, nursing homes, radiology departments and emergency departments (Huang, 1995; Siddharthan et al., 1996; Reinus et al., 2000; Lucas et al., 2001; Gorunescu et al., 2002; Murray and Berwick, 2003; McManus et al., 2004; Green et al., 2006).

Supply-chain management. Supply chain management techniques help match resources with demands in highly complex production processes. Companies such as Dell, Toyota, and Proctor & Gamble represent enormously complex systems that use supply-chain management tools such as linear integer programs to optimize performance. Airlines use these models to assign crews to thousands of flights per day across hundreds of cities. These techniques have revolutionized production in many industries, but have had very little impact in the hospital environment, despite substantial successes. For example, both Vanderbilt University Medical Center and the Deaconess Hospital in Evansville, Indiana, have achieved substantial savings using these techniques. McKesson

estimated that the health care industry could save $11 billion by using supply chain management.

Statistical Process Control. This technique involves plotting the outcomes of a process over time to see if variations fall within an acceptable range or fall outside that range and require corrective action. It is widely used in manufacturing.

Manufacturers, airlines, banks, the military, and others have adopted systems that employ a number of these tools. For example, Motorola's Six Sigma process and the Toyota Production System combine statistical and process controls with worker empowerment and cultural change to minimize defect rates and achieve high levels of quality.

Some of these approaches have been promoted and implemented by health care organizations. For example, JCAHO, the VA, Kaiser, NAPHHS, AHRQ, and several hospital organizations have begun to use and promote these approaches. But they have yet to be widely adopted (Gabow et al., 2005; JCAHO and Institute for HealthCare Improvement, 2005; National Association of Public Hospitals and AHRQ, 2005).

A common thread among these tools is the systems concept, in which the interdependence of every component upon the others is recognized. In order to achieve the maximum performance of a system, each unit must not only achieve high individual performance, but it must also cooperate with interdependent units to optimize system objectives. The tools of operations management facilitate the understanding of complex systems and make it possible for managers to control and improve overall system performance.

HOSPITAL-BASED EMERGENCY CARE AS A COMPLEX SYSTEM

Nowhere is the interdependence of individual components more evident, and the need for tools to manage complex systems more needed than in the hospital emergency department. Taking care of emergency patients involves many discreet components—registration, emergency physicians, nurses, laboratory services, imaging, inpatient departments, on-call specialists, etc. These components are highly interdependent—optimizing the performance of any one of these units without considering the broader objective is unlikely to improve overall performance of the delivery of emergency care. For example, optimizing care in an inpatient department may slow admissions from the ED, worsen ED crowding, and create a host of associated problems. Indeed, that is what often happens.

Understanding Patient Flow through the Hospital System

Crowding in the nation's emergency departments presents a serious threat to the quality, safety and timeliness of emergency care. While many of the factors contributing to ED crowding are outside the immediate control of the hospital, many more are the result of operational inefficiencies in the management of hospital patient flow. EDs receive an almost steady stream of patients. If an individual arriving by ambulance cannot be quickly transferred to an ED stretcher, efficiently triaged, and then rapidly evaluated, stabilized and admitted or discharged, ED crowding will quickly develop and patient care will be compromised.

There are a number of promising options that hospital administrators and policymakers have at their disposal to identify and resolve the patient flow problems that contribute to ED crowding and its consequences. But these leaders must first be compelled to take action. This will only occur after the causes of ED crowding are clearly understood, and administrators realize that the strategies required to address it go well beyond the ED itself. More than 15 years ago, Lynn and

Kellermann described approaches to improving management of the ED in an overcrowded hospital**.** The key element of their thesis, then as now, was that crowding is an inpatient problem that manifests itself in the ED. Accordingly, measures to address crowding should begin on inpatient units, rather than with diversion of inbound ambulances (Lynn and Kellermann, 1991). Moreover, administrators, policymakers and the public must have the knowledge, incentives, and regulatory obligations needed to inspire change.

From arrival in the ED to hospital admission or discharge, emergency care patients receive treatment at multiple points along the delivery process. Patient flow, defined as the movement of patients through this system, is an important indicator of the timeliness, safety, and quality of care receiving during the course of care. Efficient patient flow assures maximum throughput (the number of patients treated and discharged from the ED per day), minimizing delays at each point along of the delivery process**,** without any decrement in the quality of care. Impaired patient flow, on the other hand, results in bottlenecks that prolong delays for patients already in the process, as well as those awaiting entry into system.

Input/Throughput/Output Model

Based on engineering principles from queuing theory and compartmental models of flow, the Input/Throughput/Output (I/T/O) model of patient care applies operations management concepts to patient flow within the acute care system. (See Figure 4-1.) The I/T/O model defines the acute care system to include unscheduled ambulatory care, urgent care, ED care and its ancillary services, inpatient care for those admitted through the ED, and out-of-hospital EMS care. In this way, the I/T/O model allows for the identification of all health care systems components that contribute to, or are affected by, ED crowding (Asplin et al., 2003; Solberg et al., 2003).

Under the I/T/O model, ED input, or demand, is comprised of three distinct categories of care: emergency care (i.e., treatment of seriously ill or injured patients), unscheduled urgent care (i.e., treatment of patients unable to receive needed care in a timely manner from other components within the acute care system), and safety net care (i.e., treatment of patients who experience substantial barriers to accessing unscheduled care from other components of the health care system). Variations in the demand for each of these types of care, both patient- and systems-driven, determine the input fluctuations at the ED. That is to say, ED input levels depend on both the volume of critically ill and injured patients, and the ability of the overall health care system to care for non-emergent and safety net patients (Asplin et al., 2003; Solberg et al., 2003).

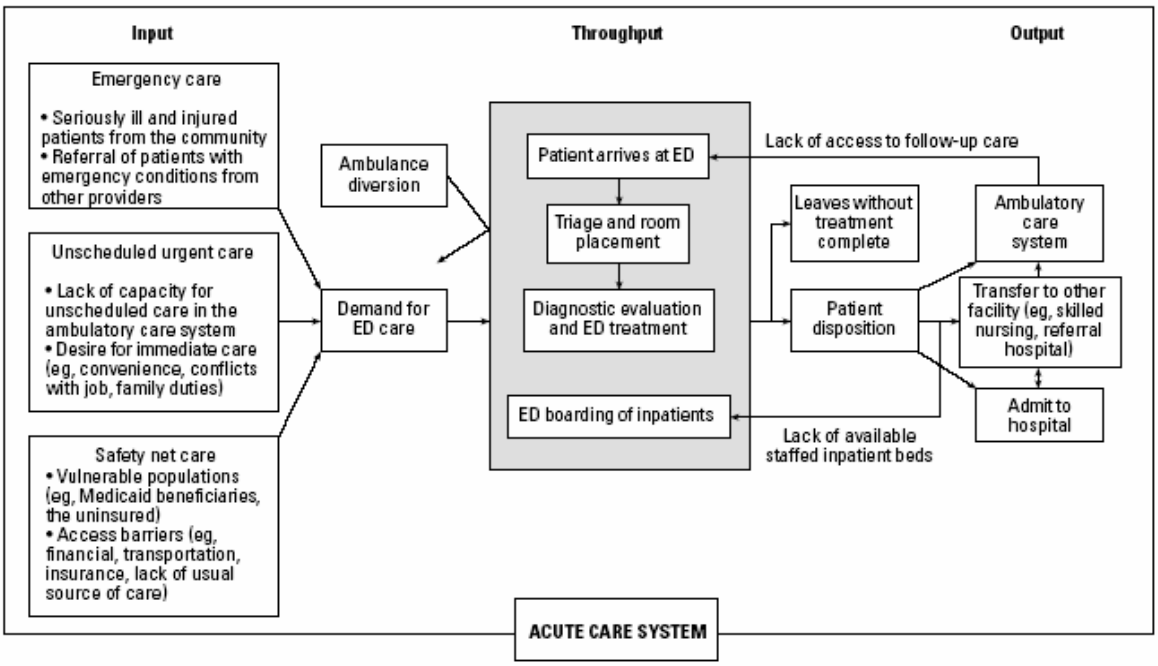

FIGURE 4-1 I/T/O model.
SOURCE: Reprinted from Annals of Emergency Medicine, 42, Asplin BR, Magid DJ, Rhodes KV, Solberg LI, Lurie N, Camargo CA Jr., A conceptual model of emergency department crowding © 2003, with permission form The American College of Emergency Physicians.

The throughput component of the I/T/O model represents a patient's length of stay (LOS) in the ED and is comprised on two key phases: (1) triage, room placement, and medical evaluation and (2) diagnostic testing and ED treatment. ED boarding is also featured in the throughput component is it extends ED length of stay. The output component of the I/T/O model represents the disposition of ED patients. It includes both hospital admission, transfer to another facility, and patient discharge. It also includes the ability of the ambulatory health care system to provide timely and appropriate post-discharge care (Asplin et al., 2005).

As designed, the structure of the I/T/O model allows hospitals to systematically identify and resolve impediments to patient flow across a spectrum of acute care settings. It also provides direction for researchers, policymakers and hospital administrators seeking to understand and alleviate ED crowding as way to improve access and quality of care (Asplin et al., 2003; Solberg et al., 2003; Wilson et al., 2005).

IMPEDIMENTS TO EFFICIENT PATIENT FLOW IN THE ED

While hospitals are unable to control forces outside the facility that contribute to high levels of demand, they can understand the impact of those forces on operations, and structure their organization to best respond to these pressures. Hospitals have direct control over operational efficiency, and have a number of variables within their control. They include such factors as inpatient bed capacity, ancillary service delays, the scheduling of surgeries and support staff, and provision of adequate physical space in the emergency department to permit evaluation and treatment (GAO, 2003). By applying variability methodology, queuing theory and the I/T/O model, hospitals can identify and eliminate many of the patient flow impediments caused by

operational inefficiencies (Litvak and Long, 2000; Litvak, 2005). Additional information about both pressures is provided below.

One of the most important factors that is currently outside the control of most hospitals is control over the regional flow of patients. Short of going on diversion, there is typically little information sharing between hospitals and EMS regarding overloaded emergency and trauma centers, availability of ED beds, operating suites, equipment, trauma surgeons, and critical specialists—information that could be used to effectively balance the load among EDs and trauma centers in the region. Doing this effectively requires that many elements within the regional system—community hospitals, trauma centers, and particularly prehospital EMS—effectively coordinate the regional flow of patients. In addition to improving patient care, coordinating the regional flow of patients is a critical tool in reducing overcrowding in EDs. Unfortunately, only a handful of systems around the country coordinate transport effectively throughout the region. Some examples were described in Chapter 3.

Factors within the Control of Hospitals

Inpatient Admissions Bottlenecks

The most commonly cited contributor to ED crowding is the inability to move admitted patients from the ED into inpatient hospital beds, and in particular ICU beds. This lack of inpatient beds has the immediate effect of forcing ED staff to "board" admitted patients until an inpatient ICU or Med-Surg bed is available. Placing ED patients who require hospital admission temporarily in hallways or exam spaces until an inpatient bed becomes available is a poor substitute for inpatient care. EDs are not intended to provide privacy to hallway boarders, and the staff are often too busy to meet an admitted patient's needs in a timely manner. Boarding is the primary cause of ambulance diversion, a practice that delays access to emergency care and can send inbound patients to a hospital where the medical staff does not know them and has no access to the patient's medical record. And, ambulance diversion contributes to reduced EMS capacity as ambulances seeking to offload patients are forced to find an open emergency department, and once there, to wait until the ED staff are able to find an empty stretcher (Gallagher and Lynn, 1990; Thorpe, 1990; Andrulis et al., 1991; Derlet and Richards, 2000; Epstein and Slate, 2001; Derlet et al., 2001; Henry, 2001; Viccellio, 2001; Lewin Group, 2002; McManus et al., 2003; Asplin et al., 2003; GAO, 2003; Schull et al., 2003; Solberg et al., 2003; Weissert et al., 2003; Eckstein and Chan, 2004; JCAHO, 2004; Kennedy et al., 2004). By failing to effectively manage patient flow, hospitals allow the most time critical access point in the facility—the emergency department—to become blocked and ultimately inaccessible.

Financial Incentives

In addition to contributing to an overall shortage of bed space, the current reimbursement structure discourages hospitals from making provision of inpatient beds to ED admissions a management priority. Within the hospital, ED patients compete for beds, staff, and services with patients who have been scheduled for elective admission, particularly elective surgical patients and those being admitted for invasive diagnostic or therapeutic procedures. When beds are scarce, elective admissions generally prevail because they pay better margins and promote loyalty among admitting physicians. ED admissions typically generate less revenue for the hospital, and may even cost the hospital money. Furthermore, since these patients are "already in the system" they are unlikely to leave, whereas an elective admission can choose to go to another

hospital. Finally, because hospitals benefit financially from increased volume (up to a point), there is a financial disincentive to hold vacant beds open for ED admissions.

Ancillary Services Delays

Enhanced standards of care and improved medical technology mean that today's ED patients routinely receive a number of complex diagnostic and screening services (McCaig and Burt, 2005). Whether complex or routine, the timely administration of these ancillary services, and the prompt availability of test results, is imperative to smooth hospital operations and efficient patient flow. Data suggest, however, that delays in diagnostic and screening tests for ED patients are both common and strongly associated with prolonged lengths of stay in the ED. In fact, nearly one-half of all ED service delays were related to wait-times for radiology and laboratory results, according to one survey conducted by the Emergency Nurses Association (Derlet and Richards, 2000; Weissert et al., 2003; JCAHO, 2004). Housekeeping is also frequently a problem, as most ED admissions occur in the late afternoon to early morning hours, while housekeeping staffs are usually reduced after 5 pm.

Overuse of ED Services

Physicians treating patients in the ED have access to a wide range of complex medical screening and evaluation tools—all within the confines of a single physical space, i.e., the hospital. This means that ED patients often also have access to the best technology in the community, as hospitals are frequently more able to purchase and operate expensive medical equipment than local providers or smaller health clinics. These factors have resulted in the dual effect of some patients opting to seek care in the ED, and some primary or specialty care providers referring their patients to the ED as a means of streamlining the medical testing process. In short, the ED is assuming, by default, another new role—that of "one-stop shop" for complex medical work-ups, a phenomenon that improves the efficiency of office-based practitioners, but contributes to ED crowding and hinders the safety and timeliness of true emergency care. Also, because EDs often have limited access to patient records, there are often redundant workups and diagnostic tests performed.

Defensive Medicine

The rise in the number and severity of medical malpractice claims, especially in high-risk fields such emergency medicine, has led to an increasingly defensive approach to providing care in the ED. Because emergency physicians have such a range of tests and diagnostic technologies at their fingertips, they are more likely to be blamed if they don't use them and ultimately miss a diagnosis. For example, missed myocardial infarction has been the leading cause of malpractice claims in emergency medicine, yet definitively excluding the possibility of an MI or acute coronary syndrome requires a minimum of 6–12 hours of evaluation and diagnostic tests costing more than a thousand dollars. Fearing potential litigation, ED physicians and on-call specialists may order additional tests or prolong monitoring periods, slowing patient flow and contributing to service delays. ED staff may also hospitalize patients in "borderline" condition rather than running the risk that a discharged patient will have an adverse outcome. This is even more likely to happen when the physician is concerned that the patient may not be able to secure outpatient follow up care in a timely manner (Asplin et al., 2005). It should be noted, however, that it is difficult to quantify the increment of care over and above appropriate evaluation in emergency care that constitutes "defensive medicine."

Staffing Requirements

In contrast to the strict nurse-to-patient ratios on many inpatient units and ICUs, most hospitals have declined to adopt nurse-to-patient ratios for the ED. As a result, an inpatient unit that has vacant beds, but has reached its maximum ratio of patients to nurses, may "block" admissions from an ED that may be caring for 2 or even 3 times as many patients per nurse. The merits of staffing ratios, in general, are discussed in Chapter 6.

Inadequate Physical Space

Unlike most high-risk enterprises, health care has been slow to embrace principles of ergonomics or human factors engineering in the design and maintenance of its various workplaces. As a result, ED providers often face limitations on the amount of space available in which to provide care, and they routinely encounter user-unfriendly spatial layouts and equipment placement and design. For example, in many hospitals, computed tomography (CT) scans, operating rooms, or ICUs are located at a significant distance from the ED, requiring the staffed transport of patients across multiple hospital divisions or floors. Similarly, desktop-only registration, whiteboard tracking, and land-line phone paging systems routinely pull physicians and other staff away from the bedside, extending patients' LOS and leading to disruptions in the course of care. Fortunately, many of these design failures can be addressed through the adoption of new IT tools (McKay, 1999; Chisholm et al., 2000; Derlet and Richards, 2000; Wears and Perry, 2002). Additional information about these tools is provided in Chapter 6 of this report.

STRATEGIES FOR OPTIMIZING EFFICIENCY

Currently, there a number of initiatives aimed at improving patient flow in order to reduce ED crowding and its related effects, including: *Urgent Matters*, a $6.4 million, 10-hospital campaign supported by the Robert Wood Johnson Foundation that aims to eliminate ED crowding and improve public understanding of challenges facing the health care safety net; the *IHI IMPACT Network*, which, through its "Improving Flow" Learning and Innovation Community, seeks to increase patient throughput and minimize delays while ensuring that high performance in flow is not achieved at the expense of quality; and the *University HealthSystem Consortium (UHC) Patient Flow Benchmarking Project*, which targets in-hospital factors that impede or impair efficient patient flow. Recognizing the importance of managing patient flow to managing ED crowding, JCAHO published in 2005 a new standard for accredited hospitals: *LD.3.11. "The leaders develop and implement plans to identify and mitigate impediments to efficient patient flow throughout the hospital"* (JCAHO, 2004).

Based on the work of these groups, a wide range of tools have been developed and tested to address patient flow issues, with generally good success. While controlled studies have yet to be conducted, there is a growing body of anecdotal evidence that suggests that by smoothing the peaks and valleys of patient flow (the movement of patients into and between various hospital areas for care), hospitals can reduce crowding, while improving quality and reducing cost (JCAHO, 2004; Wilson and Nguyen, 2004). Boston Medical Center and St John's Regional Health Center in Springfield, MO, for example, reduced crowding by adjusting the elective surgery schedules so that they did not conflict with predictable peaks in emergency surgeries (Litvak and Long, 2000; Crute, 2005).

Techniques that Address Patient Flow Bottlenecks

The effective management of patient flow in the ED and between the ED and hospital inpatient units is essential to the quality and safety of patient care (Begley et al., 2004). By smoothing the inherent peaks-and-valleys of patient flow, and eliminating the artificial variabilities that unnecessarily impair patient flow, hospitals can improve patient safety and quality, while simultaneously reducing hospital waste and cost (Litvak and Long, 2000).

In the absence of variability, patient flow through the stations would be regular and no queues would occur. In the presence of variability, patient flow becomes impaired and queues appear. Some of these peaks and valleys are natural and the necessary ED capacity (number of beds, nurses, ancillary services) for these patient driven peaks can be determined by applying queuing theory. (See Box 4-2.) This, in turn, leads to greater predictability and control, and ultimately, to the improved quality, safety, and timeliness of care (Litvak and Long, 2000; National Academy of Engineering and IOM, 2005).

BOX 4-2 Queuing Theory

Queuing theory applies analytical expressions to problems involving waiting times, or queues, that develop because of limited resources. Its purpose is to understand and achieve a balance between fixed capacity and the random demands of customer services. Queuing models have long been used in a number of industries, including telecommunications, Internet, commercial banking, sales and public transportation. Increasingly, it is being recognized as a tool that can help identify and manage the variabilities in patient flow that contribute to ED crowding (Litvak, 2005; National Academy of Engineering and IOM, 2005).

Many basic queuing models are comprised of three variables: the arrival rate, service time, and number of servers. In the ED setting, the arrival rate is the frequency of patient arrival while service time is the average time spent caring for a particular type of patient at a specific point of care in the ED and its related sites. The number of servers can be the number of stations, beds, nurses, or work areas, providing similar services to all patients who enter those areas (National Academy of Engineering and IOM, 2005). The problem, however, is that service time frequently has two components: the average time spent caring for patients and boarding time. Since boarding time is frequently a result of artificial variability in hospital patient flow (artificial peaks in inpatient bed census), basic queuing models cannot be applied to determining adequate ED resources. Thus, to determine true (vs. inflated) resources needed one has to exclude boarding time from the service time (LOS in the ED).

A number of techniques have been tested to improve the flow of patients through the hospital, thereby reducing the ED-inpatient bottleneck. Examples are described in Boxes 4-3, 4-4, ands 4-5.

Coordinated Surgery Schedule

The two most common routes to hospital admissions today are through the ED (e.g., 50 percent) and through scheduled elective surgery in the operating room (OR) (e.g., 35 percent). Variability in admissions is well documented and leads to substantial fluctuations in inpatient capacity. For many hospitals, periods of limited capacity are often followed by periods of excess capacity, and therefore, managing this inflow of patients has the potential to significantly improve patient flow and ED crowding (DeLia, 2006). While the natural variability associated with emergency care might lead one to assume the ED was responsible for most of the

fluctuations in inpatient traffic, data demonstrate that it is scheduled elective surgery in the OR that, when adjusted for patient volume, is the more variable of the two admission routes, thereby creating a significant artificial component in case volume variability (Litvak and Long, 2000; Litvak, 2005). Coordinating surgery times for scheduled and unscheduled admissions, therefore, not only adds organization to the rate and flow of scheduled elective OR admissions, it allows hospitals to smooth variabilities in ED and OR patient flow—an effect which serves to alleviate ED crowding (Litvak and Long, 2000; Cedars-Senai Learns, 2004; Wilson and Nguyen, 2004; Litvak, 2005)**.**

Many of the hospitals participating in the *Urgent Matters, IHI,* and *UHC* patient flow initiatives have undertaken systematic reviews and revamping of OR scheduling as a way to improve patient flow and enhance the quality, safety and timeliness of emergency care, reduce unnecessary costs, and increase surgical revenue. Two related tactics are among those most frequently employed by these hospitals: (1) setting aside one OR for unscheduled surgical cases admitted through the ED and (2) smoothing the elective surgery schedule by more evenly distributing surgery times across the entire week (Litvak and Long, 2000). Both techniques have significantly reduced waiting times for surgical cases, especially among ED patients. This, in turn, has reduced the amount of time ED patients must wait for an inpatient bed, easing ED crowding and its effects. Improved coordination of surgery schedules also has been associated with increased revenue for surgeons. Such a by-product provides an important incentive as surgeon's schedules are negatively impacted by the various changes (Litvak, 2005; Crute, 2005).

BOX 4-3 CASE STUDY: Boston Medical Center, Boston, Massachusetts

Boston Medical Center (BMC) is a private, non-profit academic medical center which serves as the primary teaching affiliate for the Boston University School of Medicine. It has nearly 500 licensed beds and is the largest "safety net" hospital in New England, with an annual operating budget of $1.0 billion. BMC offers an array of medical services, including a level I trauma center, full service acute care, pediatric care and cardiothoracic surgery. Its emergency department (ED), staffed by 26 full-time physicians, treats over 120,000 patients annually.

As recently as 2003, BMC experienced significant ED crowding, ambulance diversion, and high rates of patients leaving without being seeing (LWBS). In an effort to alleviate these conditions, BMC initiated a comprehensive project to identify and address hospital operations inefficiencies, particularly those which inhibited patient flow. Before embarking, BMC Chief Executive Officer (CEO) Elaine Ullian established a project stakeholders group which included, among others, hospital leadership, the chiefs of surgery and anesthesiology, and key nursing staff. Ullian also convened several issue-focused teams, including an inpatient team, ED team, and a surgery schedule smoothing team.

BMC employed a rapid cycle change (RCC) model, in which small changes are rapidly implemented and evaluated by staff. The study team first identified a specific aim or goal intended to improve patient flow. They then developed, implemented and evaluated strategies on a small scale, modifying or rejecting the approach based on results. For example, one goal of the BMC team was to reduce ED throughput time. Based on suggestions from the nursing staff and nurse manager, the team decided to test a "zone nursing" approach in which nurses were assigned to patients in a particular area of the ED. Historically, ED nurses at BMC were assigned to patients randomly, meaning that each nurse typically was responsible for a number of patients located throughout the ED. After a week-long, small-scale trial, the zone approach was associated with a 70-minute reduction in ED throughput time. In response to this success, the BMC team subsequently decided to extend the zone approach to the entire ED.

Another BMC project goal was to smooth surgery schedule variations in order improve OR and ED throughput. The team worked with the Cardiothoracic Surgery Department and Vascular Surgery Section to reduce peaks in elective surgical case volume, place a daily cap on the number of elective surgeries, switch surgeons' clinic and surgery days, and dedicate one of the hospital's 8 ORs to emergent cases, with the other 7 open for block scheduling. The resulting improvements in patient flow through the ORs

were significant; the number of "bumped" surgical cases, for example, fell from 337 between April and September 2003, to 3 between April and September 2004. At the same time, BMC ambulance diversion rates fell 40 percent while overall ED throughput times declined 17 percent.

SOURCE: Wilson et al., 2005.

Coordinated Bed Management

Two strategies which have demonstrated success at smoothing patient flow and alleviating ED crowding are the creation of "bed czars" or "bed teams" charged with various aspects of bed management. Typically a nurse manager, the primary responsibility of a bed czar is accounting for inpatient beds and working with housekeeping to ensure rapid bed turnaround. To fulfill this responsibility, bed czars are given authority to notify staff of impending bed shortages, make decisions regarding inpatient bed transfers, cancel elective procedures, and initiate hospital diversion. Bed teams, on the other hand, usually consist of nurses from multiple units, each of whom has access to real-time hospital census data. Working collaboratively, these teams meet throughout the day to discuss the types of ED patients waiting for inpatient beds and the types of beds expected to become available, making flow changes as necessary (JCAHO, 2004; Wilson and Nguyen, 2004; Wilson et al., 2005).

Among its many advantages, the bed czar or bed team approach offers a consistent, timely mechanism through which hospital staff can be notified about bed status; a centralized patient placement process; and improve ability to anticipate bed needs across multiple settings. Use of coordinated bed management techniques has been associated with significant reductions in bed turnaround times at a number of ED nationwide. Among these, the Regional Medical Center in Memphis, Tennessee reduced its average bed turnaround time by nearly 70 percent, cutting wait times from 150 minutes to 47 minutes (JCAHO, 2004; Wilson and Nguyen, 2004; Wilson et al., 2005).

Efficiencies can also be achieved by use of a transfer center to coordinate referrals to a tertiary center. Such a center can reduce transfer patient delays in the ED, ensure the availability of timely resources needed by the transfer patient, and help coordinate transfers between facilities (Southard et al., 2005).

Clinical Decision Units (CDUs), or Observation Units

The CDUs, or observation units, are separate areas that allow for the observation of patients in order to determine whether or not admission is necessary. Originally, these units were developed to provide a method for monitoring patients with chest pain who had a low to intermediate probability of acute myocardial infarction (AMI) (Zwiche et al., 1982; Fineberg et al., 1984; Talbot-Stern et al., 1986; Vallee et al., 1988; de Leon et al., 1989; Henneman et al., 1989; Mikhail et al., 1997; Rydman et al., 1998; Graff et al., 2000). By observing patients for up to 23 hours, ED staff were able to "rule out" many patients at risk of AMI while using fewer resources than if these same patients were admitted to the ICU or an inpatient telemetry unit (Graff et al., 1997).

Today, observation units are most frequently used to efficiently mange patients with complaints of chest pain, abdominal pain, back pain, dehydration, CHF, asthma and shortness of breath (Hostetler et al., 2002; Ross et al., 2003). They are typically overseen full time by a nurse practitioner with assistance from an attending physician and other nursing staff. CDUs have been

shown to reduce costs relative to inpatient admissions (Mikhail et al.,1997; Rydman et al., 1998; Graff et al., 2000), although the net impact on hospital costs is unclear (Sinclair and Green, 1998). Approximately 30 percent of hospitals and two-thirds of teaching hospitals had opened or planned to open a CDU (Mace et al., 2003).

CDUs offer the potential to alleviate crowding in EDs and add elements of continuity to patient care. These units care for patients who would otherwise be admitted for inpatient stays 2-3 times as long. This frees up beds for other patients who would otherwise be "boarded" in the ED, and may allow the ED staff to downgrade the type of bed required for those who still need admission after a CDC stay—i.e., instead of a telemetry or stepdown bed, admit to a regular med-surg bed.

Observation units reduce the number of patients awaiting inpatient beds, thereby reducing patient boarding (Schneider et al., 2001). Reducing boarding in turn leads to a reduction in diversion hours (Dick et al., 2005). Additionally, the added element of case management associated with observation units offers the opportunity to address continuity difficulties faced by patients with chronic illness.

Some units combine the concept of a CDU with the concept of case management. Such units employ case managers to focus on patients with exacerbations of chronic diseases that are known as "ambulatory care sensitive conditions" (e.g., asthma, diabetes, CHF). The assumption is that a diabetic with a blood sugar of 700 mg/dL not only needs CDU care with the goal of avoiding hospitalization, but also needs case management, because the episode of hyperglycemia is a "sentinel event" for the failure of ambulatory care. While the patient is getting hydrated or an infusion of insulin, she is also being taught self care skills and reconnected with a primary care provider for close outpatient follow up. Case managers can follow up with the patients after discharge to make sure they keep their appointment. The goal is not only to prevent an expensive hospitalization, but to reduce relapse and repeat visits to the ED with the next hyperglycemic/asthma/CHF episode by reconnecting the patient to primary care. In this way, the CDU not only aids the hospital in managing patient flow and reducing crowding, but it contributes to the smooth functioning of the ambulatory care system for the safety net.

Hospitals can receive reimbursement for CDUs for three conditions: chest pain, asthma, and CHF. For other conditions, reimbursement for observation care is packaged or bundled into other APC rates and not listed separately. Many groups, including SAEM and ACEP, have encouraged CMS to expand separate payments for observation services beyond the three currently allowed claiming that published literature supports the effectiveness of observation services for many other conditions. Further, an APC advisory panel appointed by CMS unanimously recommended removing restrictions on diagnoses and conditions eligible for separate payment of observation, but CMS has not enacted the change (Personal communication, M.B. McClellan, July 8, 2005). While Medicare CDU payments will increase with the addition of eligible conditions, total costs of care should decline because of the reduction in the number of admissions. For Medicare, the change will be cost-saving.

Based on the foregoing evidence, the subcommittee concludes that CDUs reduce boarding and diversion, avoid expensive hospitalization, and appear to contribute to improved management of common ambulatory-care sensitive conditions. The committee believes that CDU payment should be available for all clinical conditions for which observation is indicated, and therefore recommends that **the Centers for Medicare and Medicaid Services remove current restrictions on the medical conditions that are eligible for separate clinical decision unit (CDU) payment.**

BOX 4-4 CASE STUDY: Grady Health Systems, Atlanta, Georgia

Comprised of Grady Memorial Hospital, Hughes Spalding Children's Hospital and 10 regional health centers, Grady Health Systems is one of the largest public hospitals in the southeast United States. Licensed for more than 1,000 beds, Grady Memorial Hospital (Grady) houses the only level I trauma center within a 100-mile radius, the state's only Poison Control Center, and the city of Atlanta's emergency medical services (EMS) ambulance fleet. Grady also serves as the teaching hospital for both Emory and Morehouse Schools of Medicine. More than 100,000 visits are made to the Grady ED each year.

In 2002, as ED patient satisfaction levels fell to historic lows, Grady found itself experiencing a number of significant ED crowding-related challenges. Average ED throughput times, for example, frequently exceeded seven hours, with Fast Track throughput times reaching10 hours. Rates of patients leaving the ED without being seen were estimated at 2.4 percent, or 200 patients per month. And, by 2003, Grady's ED was operating under diversionary status more than 20 percent of time.

Attempting to turn the tide on these trends, Grady used the Input/Throughput/Output (I/T/O) model to identify major bottlenecks in patient flow. Under the direction of a project steering committee, led jointly by the hospital Chief Executive Officer (CEO) and Chief Operating Officer (COO), the Grady team developed and implemented a number of approaches involving a wide range of staff. For example, Grady instituted a new diagnostic test ordering process whereby requests were handled by the unit clerk, rather than the charge nurse; under the new process, wait-times for test results were reduced by as much as 95 minutes during periods of ED crowding. In addition, Grady improved staff coordination and training in its Fast Track unit; changes that were associated with signification reductions in the average time from ED arrival to bed placement (from 219 minutes to 94 minutes) and average ED throughput time (from 340 minutes to 211 minutes) for Fast Track patients.

Finally, Grady implemented a Care Management Unit (CMU), consisting of seven beds staffed by four CMU nurses and four case managers to which patients diagnosed with one of four conditions—chest pain, heart failure, asthma and hyperglycemia—are assigned. This dual CMU-ED structure allows for faster treatment and longer-term observation of non-emergent patients. Following their CMU stay, which lasts an average of 19 hours, 85 percent of patients are discharged, while 15 percent are admitted as in-patients. Prior to hospital discharge, CMU patients are assigned a case manager who provides disease-specific education, coordinates primary care follow up (defined as between 48–72 hours of discharge), and directs follow-up via telephone, as well as various data management chores. Among other benefits, the establishment of the Grady CMU has resulted in decreases in the number of short-stay admissions, admissions to telemetry beds, and patient relapse rates. The CMU also has resulted in improved patient satisfaction with Grady's ED services.

SOURCE: Grady Health System, 2005; Wilson et al., 2005.

Unit Assessment Tools

Based on the traffic light concept, unit assessment tools can be used to determine and monitor the capacity of various units throughout the hospital system. The tool is comprised of graded, color-coded indicators that note the "workload tolerances" of each unit, based on a preset range of numerical scores. Under the system, green (go) indicates the unit is working at ≤85 percent of maximum capacity and therefore open for admissions; yellow (early caution) indicates the unit is working at >85 percent capacity and, though still able to accept admissions, alerts other units of current resource limitations; orange (late caution) indicates the unit is working immediately below its maximum capacity and suggests that capacity could be reached unless additional resources are made available; and red (stop) indicates the unit is at full capacity and

cannot accept additional admissions without risking patient safety and staff burnout (JCAHO, 2004).

Routine updates of the color grid allow for staff to reallocate resources in response to status changes. This is most easily accomplished by a "resource czar," typically the nurse supervisor, with the authority to redirect staff or cap a unit as necessary. Using the unit assessment tool model, Luther Midelfort, a Mayo Health Systems hospital in Eau Claire, Wisconsin, saw steady declines in the number of red codes and steady increases in the number of green codes during a recent six-month trial period (JCAHO, 2004).

Coordinated Patient Discharge

One the most widely recognized bottlenecks in patient flow is the discharge process. By expediting discharge in a coordinated way, hospitals can better prepare patients for discharge, improve turnaround of vacant beds, and more accurately align vacancies with bed demands; all of which help to alleviate crowding in the ED.

Hospitals can alleviate discharge-related patient flow impediments are the creation of "discharge coordinator" positions and "discharge resource rooms." Much like a bed czar, a discharge coordinator can monitor charts to determine which patients are ready for discharge and work to expedite the disposition process. This coordinator, usually a nurse, also can provide or facilitate case management services. A discharge resource room is an area of the hospital where staff help patients prepared for their home care after discharge in a comfortable, central location. Upon arrival at the discharge room, patients are considered discharged from the hospital, thereby opening their bed for rapid turnaround (JCAHO, 2004; Wilson and Nguyen, 2004; Wilson et al., 2005).

A number of hospitals have been able to reduce discharge delays and alleviate related ED crowding following establishment of a discharge coordinator or discharge ready room. For example, one Chicago-area facility was able to reduce average length of stay (ALOS) for some patients from 5.7 to 4.3 days, with concurrent reductions in ED crowding rates (JCAHO, 2004). Short of adopting coordinated discharge approaches, simply requiring physicians to write discharge orders earlier in the day can also result in a substantial improvement in patient flow.

BOX 4-5 CASE STUDY: St. John's Regional Health Center, Springfield, Missouri

Located in Springfield, Missouri, St. John's Regional Health Center is an 866-bed, not-for-profit hospital and trauma center that serves as the dominant health care center in southwest Missouri and parts of northwest Arkansas. There were 74,000 visits to St. John's ED in fiscal year 2005, with approximately 22 percent of all ED patients requiring hospital admission. During the same time, ED-based admissions accounted for roughly 20 percent of the hospital's total surgical load.

In 2002, hospital leaders faced two significant patient flow-related problems. First, an inflexible process for scheduling elective surgeries had resulted in unpredictable and excessive use of overtime. Second, mid-week peaks in surgery demands had resulted in admissions back-ups that were causing patients to be placed in beds on the wrong floors, jeopardizing the safe delivery of appropriate post-surgical care.

Seeking to resolve these issues, St. John's set aside a single OR for elective and unplanned surgery overflow. This required the hospital's trauma surgeons to give up an OR that historically had been set aside in case they decided to schedule a surgery the day after their on-call period The surgeons agreed on the condition that if no noticeable improvements were achieved during a 30-day trial period, the OR would be returned for their use. At the conclusion of the project trial, St. John's was able to increase the number of elective and unplanned surgeries by 5.1 percent, the number of OR rooms required after 3pm dropped by 45 percent, and hospital trauma surgeons experienced a 4.6 percent increase in revenue. Based on this success, the OR change was made permanent.

A second trial modified the elective surgery schedule, booking elective orthopedic surgeries evenly throughout the week. Although many surgeons initially objected to the plan, and the physical therapy staff were required to adjust their work schedules, the change resulted in a 13 percent increase in the number of patients able to move to the appropriate floor for recovery. It also provided a number of surgical specialties, including orthopedics, with additional hours of OR block time. As with the OR change, modifications to the surgery schedule were made permanent following the successful trial period. Due to these changes (unscheduled OR and smoothed surgical flow), this hospital was able to increase its surgical case volume by 7 percent to 11 percent annually with no capital investment over three years.

The hospital administration attributes a number of recent operational, financial, and quality improvements to the continued success of smoothing elective surgeries for all surgical subspecialties, including:

- A 45 percent reduction in waiting time for emergent and urgent surgical cases;
- An increase in appropriate inpatient placement for orthopedic patients from 83 percent to 96 percent;
- A 59 percent increase in inpatient capacity (excluding ICU) without the addition of a single staffed bed;
- A 33 percent increase in surgical volume;
- A 4.5 percent increase in revenues for surgeons who gave up block time;
- A 2.9 percent reduction in OR overtime (Personal communication, C. Dempsey, March 21, 2006).

SOURCE: Crute, 2005; St. John's Regional Health Center, 2005.

Techniques that Address Care of Patients in the ED

Fast-Tracks

An ED "fast track" is a dedicated area in or next to the ED that is specifically designed and designated for patients with minor illnesses or injuries. It is typically staffed by mid-level providers, such as physician assistants (PAs) and nurse practitioners working under the supervision of an emergency physician. Fast Tracks can operate during regular business hours or during the EDs busiest times (e.g., evenings and weekends). Currently, fast-tracks are in place at roughly 30 percent of all EDs, with approximately 30 percent of presenting patients being routed to the fast track for care (JCAHO, 2004; Wilson and Nguyen, 2004).

Identifying and re-routing nonurgent patients to the fast track allows the ED to treat them more quickly. It also frees non-fast track ED resources to care for the most seriously ill and injured, moving them quickly into appropriate inpatient units. In this way, fast tracks can reduce delays in care for both urgent and nonurgent patients, thereby improving patient flow across the ED. One example of the throughput time reductions associated with fast tracks is Grady Health Systems in Atlanta, Georgia. Using the fast track approach, Grady was able to reduce the time from arrival to bed placement for nonurgent patients from 219 minutes to 94 minutes, a 57 percent decrease (JCAHO, 2004; Wilson and Nguyen, 2004). It is important to note that the fast track capacity might be very different for different hospitals and should be determined based on the specific circumstances of each ED, such as volume, patient mix, and severity-of-illness levels.

Zone Nursing

Based on the engineering concept of co-location, zone nursing assures all of a nurse's patients are located in one area, thereby eliminating the need for nurses to traverse a unit in order to provide care (JCAHO, 2004; Wilson and Nguyen, 2004). Explored by a number of hospitals nationwide, the zone approach has been found to reduce ED crowding. For example, as part of a pilot project at Boston Medical Center, during which just one nurse received zone-approach assignments, the average patient throughput time was reduced by 70 minutes. Based on the success of the pilot, the approach was extended to the entire ED. Further, a new version of the concept was recently rolled out, wherein there is zone co-location of the ED residents as well as the nursing staff. Evaluation of this team approach is still underway (Wilson and Nguyen, 2004).

Bedside Registration

Bedside registration can help reduce long stays in the waiting room. Patients are quickly triaged in the reception area and immediately moved to a bed in the treatment area, where they can be seen immediately by a physician. While in the treatment area, a computer on wheels allows staff to register the patient and collect insurance and other administrative information at the bedside, even after treatment has begun.

Triage

Emergency department triage is typically performed by experienced emergency nurses, and sometimes by physicians. In crowded conditions staff can feel pressure to perform triage quickly, creating opportunities for error. Some EDs are dividing into separate areas, for example,

pediatrics, OB, and psychiatry, and triage is used to direct patients to the appropriate setting. Computer enhanced triage is also being adopted by some hospitals to improve the reliability of triage decisions and expedite patient flow. These are discussed in the next chapter.

Full Capacity Protocol (FCP)

These are plans that are put in place by hospitals to improve the treatment of patients and improve patient flow in conditions of extreme crowding due to full inpatient units. Rather than keeping patients in the ED, perhaps in hallways and unsafe areas, full capacity protocols allocate patients to inpatient beds in alternate units on a temporary basis. The approach recognizes the system-wide nature of ED crowding and requires that all departments share in the responsibility for addressing crowding. By giving up patients to several different departments, conditions in the already understaffed ED staffing are greatly improved, while the addition of 1 to 2 hall patients to several inpatient units has minimal impact on unit staffing ratios. For example, adding two patients to a 30 bed unit with a 6- to 30-nurse staffing requirement yields a staffing ratio of 6.4, i.e., less than half a nurse below full staffing.

The SUNY Stony Brook Hospital instituted this practice and found that a large percentage of patients never actually stayed in the hallway of the inpatient unit, because staff were motivated to make beds available more quickly. Others spent less time there than if they had remained in the ED. Early results showed that ED hallway patient ALOS was 6.2 hours, compared to unit hallway ALOS of 5.4 hours and patient satisfaction increased. A number of other institutions have adopted the practice and the practice is currently promoted by NY State Department of Health.

Admission/Discharge Units

An admission/discharge unit separate from the ED area has the potential to improve coordination of emergency patients and enhance patient flow. It provides several advantages to an ED: It rapidly responds to the needs of the ED since it will always have the physical capacity to add a patient to the expandable ward, and it is not dependent upon the location of a patient's physician for the writing of patient discharge orders. In addition, recently "discharged" patients remaining in the hospital are often poorly monitored, and represent a liability exposure. The discharge unit drastically reduces this risk. Further, patients being staged for admission are conveniently located in one site for the hospitalists to do their workups, without taking resources (nursing, space, etc) from the emergency department.

Information Technology

There are a number of important approaches involving information technology that can greatly enhance quality and efficiency. These include adoption of electronic health records with embedded error detection, patient tracking throughout the hospital system, "look up" displays in critical care bays, health system-wide scheduling directly from the ED, enhanced use of point-of-care testing and imaging.

While many of these techniques are well establish; others are in nascent stages of development, and while promising, the evidence of their effectiveness is unproven in many cases. Implementation should be supported and informed by a robust clinical and health services research agenda to drive these improvements and evaluate them.

Timely Support for Consults and Procedures

Just as patients often wait for lab results and pharmaceutical deliveries, it can often take excessive amounts of time for staff physicians to arrive for consults or for minor (non-operative) procedures. The causes for these delays are myriad, but the general cause in many cases is a simple lack of planning and coordination, for example, failure to anticipate and staff for periods of high demand. Arrangements for specialists who provide on-call services are also critical. Lack of adequate on-call coverage can cause serious delays and compromise patient care. This issue is dealt with extensively in the chapter on workforce issues.

Given the wide range of tools available to address the efficiency of hospitals, the potential benefit of these techniques on emergency and trauma care crowding and quality, and their limited application in these settings to date, the committee believes that their adoption is crucial to improving the delivery of emergency care services. The committee, therefore, recommends that **hospital chief executive officers adopt enterprise-wide operations management and related strategies, to improve the quality and efficiency of emergency care.**

OVERCOMING BARRIERS TO ENHANCING EFFICIENCY

While there is a growing body of evidence to support a range of strategies for improving patient flow and operations efficiency while reducing ED crowding, there are also a number of barriers to the adoption and implementation of these strategies within the hospital setting. The challenges to improving the efficiency of hospital-based emergency care are multiple, and the demands on physicians and administrators should not be taken lightly, particularly in light of the many other demands they face—for example, interdepartmental battles for resources, cost and revenue management, community relations, and a bewildering assortment of potential threats and opportunities. Despite the best of intentions, hospitals face an uphill battle to focus sufficient attention on emergency care in the face of these other demands. Some of the specific challenges include:

Hospital Leadership Issues

Hospitals are highly complex, highly political environments that present numerous leadership challenges for CEOs and other executives. In many facilities, the clinical staff consists largely of independent agents working outside the traditional full-time staff structure (National Academy of Engineering and IOM, 2005). As a result, the vast majority of U.S. hospitals rely on clinicians who essentially serve as independent agents with distinct, and often disparate, agendas. Changes in the healthcare marketplace have resulted in many hospitals facing budget shortfalls. And, the current reimbursement system offers little incentive for wholesale change. Add to these factors the tenuous nature of most CEO appointments—data suggest the average CEO tenure rate is just 6 years (American College of Healthcare Executives, 2004; Garman and Tyler, 2004)—and it is not surprising that many hospitals lack the leadership or support needed to embark on the systems-wide analysis, innovation and change necessary for patient flow improvements.

Despite these challenges, it is clear that hospital leaders must be willing to lead if efforts to reduce ED crowding through improved patient flow and operations efficiency are to succeed. Specifically hospital leaders must recognize that ED crowding is a system-wide issue that must be addressed across hospital settings and is not just a problem limited to the ED itself. They must be willing to send a strong, consistent message that improving patient flow is a hospital priority.

And, they must back up words with specific, demonstrable actions, including personal involvement in the development, implementation and evaluation of patient flow improvement strategies.

Hospital executives, including both CEOs and mid-level managers, have an opportunity to provide visionary leadership in promoting patient flow and operations management approaches to improve hospital efficiency. The traditional paradigm of the ED as a safety valve for hospital-wide bottlenecks and inefficiencies is rapidly giving way to a modern view of the ED as an integrated component of a highly interconnected, organic system. Hospital leaders should be open to learning from the experiences of industries outside of health care, and to be bold and creative in applying these and other new ideas. The early evidence from RWJ's *Urgent Matters* project, the Institute for Healthcare Improvement (IHI), and others suggests that not only does this make sense for patients and providers, it also makes sense for the bottom line.

In order to foster development of hospital leadership in improving hospital efficiency, the committee recommends that **training in operations management and related approaches be promoted by professional associations; accrediting organizations, such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the National Committee for Quality Assurance (NCQA); and educational institutions that provide training in clinical, health care management, and public health disciplines.**

Staff Buy-in

Hospital clinicians, including ED clinicians, tend to be conservative in nature and reluctant to embrace systemic change; efforts to identify and resolve barriers to patient flow through such strategies as those noted above are not likely to succeed without the early and strong support of hospital leaders, clinicians, and other staff. The recent failure of Cedars-Sinai Medical Center to implement a computerized provider order entry (CPOE) system demonstrates the magnitude and significance of this resistance. In November 2002, Cedars-Sinai began a fourteen-week, department-by-department rollout of its newly installed CPOE system. The rollout was called off and the system uninstalled less than two months later following what has been characterized as a "staff revolt" (Chin, 2003; Cedars-Sinai Learns, 2004; Connolly, 2005).

The identification and selection of a well-respected, highly-regarded individual to serve as a patient flow improvement "champion" is an important step in assuring the success of patient flow improvement strategies. Among other responsibilities, this champion can help to sell the necessary changes to medical staff and executive managers. He can also help exert the constant pressure needed to reshape the policies, processes, relationships, and cultural norms that have historically impeded patient flow throughout the hospital.

Data Collection

The collection and analysis of reliable, comprehensive data concerning all aspects of patient flow is imperative if hospitals are to understand and resolve the factors contributing to crowding in their EDs. Currently, however, most hospital data systems do not adequately monitor or measure patient flow. For example, few systems distinguish between when a patient is ready to move to an ancillary location for care and when that move actually takes place—a limitation which prevents the capture and analysis of data on ED boarding, as well as other ED throughput delays.

Rigorous data collection and analysis is essential to the success of any patient flow improvement strategy. Using the I/T/O model, hospitals can identify key performance indicators

(KPIs) to evaluate patient flow performance. Examples of patient flow KPIs used successfully by hospitals participating in the *Urgent Matters* initiative include, among others: time from inpatient bed assignment to bed placement; inpatient bed turnaround time; total ED throughput time; and time to thrombolysis for cardiac patients (Wilson et al., 2005). Other KPIs identified by the General Accounting Office as measures of ED crowding include: the number of hours an ED is on ambulance diversion; the percentage of patients and number of hours that patients "board" in the ED; and the number of patients who leave the ED after triage but before a medical evaluation as a percentage of ED visits (GAO, 2003).

Systems Approach

Research has shown that while the causes of ED crowding, boarding, and diversion are complex and multifactorial, the principle factors behind these problems lie not in the ED itself but in inpatient departments to which ED patients are referred (Asplin et al., 2003). As a result, it is increasingly understood that ED crowding is a system-wide issue that must be understood and addressed across multiple hospital and acute care settings (Richardson et al., 2002; Asplin et al., 2003; Schafermeyer and Asplin, 2003; GAO, 2003; Magid et al., 2004).

Not surprising, then, a key characteristic of successful patient flow improvement is the adoption of a system-wide approach to change. This includes, among other features, the development of a multi-disciplinary, hospital-wide team which can work collaboratively to identify problems, propose solutions, and oversee the implementation and evaluation of various improvement strategies. (An example of a hospital team is shown in Figure 4-2.) This also includes timely collection and analysis of multiple data points across several hospital settings in order to evaluate patient flow and assess operations changes. Results from these analyses and outcome measures should be shared within and outside the hospital setting. Such transparency increases ownership and accountability among hospital leaders and staff; it also improves patient understanding of the complex, multi-disciplinary nature of emergency care.

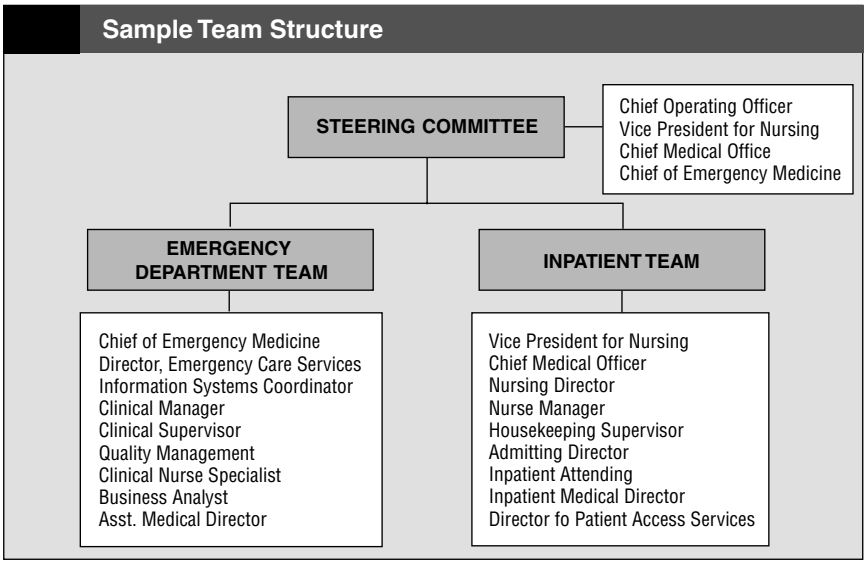

FIGURE 4-2 Sample team structure.
SOURCE: Reprinted, with permission, from Wilson M, Nguyen K. Bursting at the seams: improving patient flow to help America's hospitals. Washington (DC): Urgent Matters, The George Washington University Medical Center; 2004 Sep.

Aligning Incentives

The degree of crowding and boarding that occurs in the ED would not be tolerated in inpatient departments. While the strategies discussed above have the potential to significantly improve patient flow, enhance the quality, safety, and timeliness of emergency care, and produce related cost savings, history has demonstrated that little progress will be made toward achieving these goals unless hospitals are held accountable through regulatory and incentive-based policies. Without such policies, hospitals will continue to marginalize patient flow matters, relegating much of the related consequences to EDs and their patients through crowding, prolonged periods of boarding, and ambulance diversions. There are a number of steps that can be taken by hospital leaders to address these issues, as well as policy initiatives that should be considered to align payment incentives with the goals of enhanced efficiency and quality of care.

Positive Incentives

No major change in health care can take place without strong financial incentives, and today, there are almost no incentives for hospitals to address the myriad problems associated with inefficient patient flow or ED crowding. Patients admitted through the ED are more likely to be uninsured—indeed, in many private hospitals the only way an uninsured patient can be admitted is through the ED—and ED crowding has the effect of slowing the influx of uninsured and underinsured patients admitted through the ED. The ability to bottle up patients in the ED also helps inpatient departments by regulating the inflow of admissions. This, in effect, compartmentalizes the hospital's capacity problems within the ED, and away from inpatient departments, so that only those working in the ED and their patients suffer the consequences of crowding, boarding, and ambulance diversions.

Financial incentives must be put in place to ensure that hospitals act aggressively to eliminate ED crowding, boarding, and ambulance diversions. Rewarding hospitals that demonstrate efficient delivery practices that appropriately manage patient flow should be considered a factor in reimbursement. All payors, including Medicare, Medicaid, and private insurers should also develop contracts that reward hospitals for efficient ED operations, and penalize hospitals for delays in hospital admission, ED crowding, and ambulance diversions.

The Center for Medicare and Medicaid Service (CMS), through its purchaser and regulatory power, has the ability to drive hospitals to address and manage patient flow and assure timely access to quality care for its clients. Current CMS payment policies should be revised to reward hospitals that appropriately manage patient flow. Conversely, hospitals that fail to properly manage patient flow should be subject to penalties.

Finally, CMS should evaluate the effect that existing DRG payments might have on the relative priority afforded to elective patients versus emergency admissions. Patients admitted from the ED are more likely to have a higher severity of illness, be uninsured, or have lower rates of reimbursement. Research undertaken at a small group of hospitals indicates that patients transferred to inpatient and intensive care units from the ED are more costly than elective patients for selected surgical DRGs (Munoz et al., 1985; Henry et al., 2003). A similar study found that patients transferred acutely to tertiary surgical intensive care units were significantly more costly than elective admissions (Borlase et al., 1991). A disincentive to admit ED or transferred patients over elective patients may contribute to crowding and boarding in the ED. If such a disincentive exists, CMS should identify alternative payments methodologies to eliminate it.

Negative Incentives

Hospitals face virtually no reimbursement-related downsides for operating a crowded emergency department. Indeed, they may benefit financially if this reduces EMTALA mandated admissions and preserves their capacity to admit elective patients. In 2004, the Joint Commission of the Accreditation of Healthcare Organizations instituted new guidelines that would require accredited hospitals to take serious steps to reduce crowding, boarding, and diversion. This followed a July 2002 alert that tied treatment delays to more than 50 deaths. But under pressure from the hospital industry, these requirements were withdrawn (Morrissey, 2004). They were replaced in January 2005 with a patient flow standard that applies to the entire hospital, *Managing Patient Flow*. Among other things, this standard requires that hospitals develop plans and implement ways to monitor and manage patient flow that will reduce ED overcrowding and its consequences and assure acceptable quality of care. The Joint Commission Resources, an arm of JCAHO, has also published a document aimed at education and instructing hospital leadership on the Standard and providing guidance on how to comply (JCAHO, 2004).

While these new standards correctly acknowledge that patient flow is a systems issue that must be addressed on a hospital-wide basis, they allow hospitals to continue using the ED as a holding area. Therefore, the committee recommends that **the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) reinstate strong standards that sharply reduce and ultimately eliminate ED crowding, boarding, and diversion.**

Not only do hospitals face no financial penalties for crowding and boarding, there are several financial incentives that promote the practice. First, a hospital benefits financially from increased volume (up to a point). Operating at high capacity, however, is risky for any business because it means that there is limited capacity available to deal with spikes in demand. But the ED provides a convenient escape valve for hospitals operating at or near capacity. During periods of peak demand, patients can be cared for in the ED, in relative safety, because of the highly skilled and interdisciplinary staff that is available to deal with any exigency, staff that are used to a high-volume, high pressure environment.

Second, according to a recent GAO report, one reason that patients tend to back up in the ED is that elective admissions for surgery or other procedures tend to be more profitable than emergency admissions through the ED (GAO, 2003). While many hospitals may not intentionally favor scheduled admissions over ED admissions, which would potentially constitute a violation of EMTALA, the GAO report found that only a minority of hospitals that diverted ambulances took other measures, such as postponing or canceling elective admissions.

Third, when hospitals hold emergency admits in the ED and give the next elective patient the bed instead, they essentially get two inpatient reimbursements for the price of one, because ED staff (a fixed cost) provide inpatient care at no additional cost to the hospital, while the elective patient gets the bed. Putting the ED admission ahead of the elective loses that advantage. Also, if the elective admission doesn't get the bed, it is more likely that the patient's admitting physician will look elsewhere, to another hospital, for admission. ED admissions are "captive" in that they are already inside the facility, and are too sick or injured to go elsewhere, other than in extreme circumstances.

Finally, when EDs are crowded in a community, especially if ambulances are being diverted and patients are walking away from the local public hospital or nonprofit equivalent, it can be financially perilous under EMTALA to have a "wide open" ED, because uninsured and low reimbursement patients are likely to flood the available ED. Although there is little data on the practice, some hospitals have been known to adopt "defensive diversion" to shield themselves

from getting diverted ambulance patients from the local public hospital. Further, some hospitals divert on a "case by case" basis—meaning they accept ambulances if the patient's doctor is on the medical staff, and refuse otherwise. While this practice constitutes an EMTALA violation, it is very difficult to identify and pursue. In the absence of external regulatory mechanisms, monitoring of diversion status, and independent verification of how crowded the ED and hospital really are, it is impossible to limit this sort of practice.

The committee also would like to see improved monitoring by the CMS of hospital admission patterns to ensure that hospitals are not regularly using diversion while continuing to add elective admissions. Such a practice would be in violation of EMTALA and should be strictly enforced (Medical Advisory Committee, Pennsylvania Emergency Health Services Council, 2004). Furthermore, the committee concludes that the practices of boarding and diversion are so antithetical to quality medical care that the strongest possible measures must be taken to eliminate them. Therefore, the committee recommends that **hospitals end the practices of boarding patients in the ED and ambulance diversion, except in the most extreme cases, such as a community mass casualty event. The Centers for Medicare and Medicaid Services should convene a working group that includes experts in emergency care, inpatient critical care, hospital operations management, nursing and other relevant disciplines to develop boarding and diversion standards, as well as guidelines, measures, and incentives for implementation, monitoring, and enforcement of these standards.**

Public Awareness

A final step in implementing the changes recommended by this subcommittee is to make the public understand what is going on, appreciate the seriousness of the problem, know what questions to ask, and realize that it affects each individual, rich or poor, old or young, black or white, urban or rural. In short, the public needs to know what good performance is and understand who gets it and who does not. Hospitals should be required to measure key indicators of ED crowding and make those measures available to policymakers and the public. This can be accomplished through a variety of tools, including patient flow performance report cards, public notices regarding diversion, and educational efforts about the unique and critical role served by safety net hospitals. For example, a community could run "diversion alerts," similar to storm alerts to inform the public about EDs unable to accept new patients.

The reliance of EDs on other hospital units to eliminate ED crowding and its resultants through the effective management of patient flow demands a systems-wide approach supported by hospital leaders and staff, policy makers, and the American public. Without immediate intervention, the quality, safety and timelines of emergency care will continue to strain under the pressures of ED crowding, boarding and diversion. Eliminating these pressures is no longer just a matter or convenience; it is a matter of life and death.

RECOMMENDATIONS

4.1: Hospital chief executive officers should adopt enterprise-wide operations management and related strategies to improve the quality and efficiency of emergency care.

4.2: The Centers for Medicare and Medicaid Services should remove the current restrictions on the medical conditions that are eligible for separate clinical decision unit (CDU) payment.

4.3: Training in operations management and related approaches should be promoted by professional associations; accrediting organizations, such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the National Committee for Quality Assurance (NCQA); and educational institutions that provide training in clinical, health care management, and public health disciplines.

4.4: The Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) should reinstate strong standards that sharply reduce and ultimately eliminate ED crowding, boarding, and diversion.

4.5: Hospitals should end the practices of boarding patients in the ED and ambulance diversion, except in the most extreme cases, such as a community mass casualty event. The Centers for Medicare and Medicaid Services should convene a working group that includes experts in emergency care, inpatient critical care, hospital operations management, nursing and other relevant disciplines to develop boarding and diversion standards, as well as guidelines, measures, and incentives for implementation, monitoring, and enforcement of these standards.

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5
Technology and Communications

Daniel Conway is a 65-year-old male who has a sudden onset of excruciating back pain. He calls his primary caregiver, Dr. Thompson, who tells him to call an ambulance to bring him to the Eastern Hospital Emergency Department.

Dr. Thompson clicks on a Web page for the Eastern Hospital Emergency call-in program. He imports his last progress note with Mr. Conway's history and adds a personal note describing his concerns that the patient's uncontrolled hypertension could have led to a ruptured abdominal aortic aneurysm.

The ED immediately receives the online submission and begins preparations for the patient's arrival while the ambulance is still en route. Paramedics, using interoperable communications systems that give them equal capability to communicate with fire and police agencies on one hand and hospitals on the other, advise the ED that Mr. Conway's vital signs are stable but he is in severe pain. The emergency physician advises them to administer a dose of intravenous morphine and carefully monitor his blood pressure, oxygenation and respiratory rate. Upon arrival, Mr. Conway is rapidly transported into a pre-assigned room, where the emergency physician, Dr. Hendricks, and his team are waiting. While the nurses take his vital signs and the doctor examines him, a clerk arrives at the bedside with a wireless laptop. After the initial evaluation, she collects the necessary information to register him in the system without delay. The paramedics complete their run report on a tablet computer and use the wireless network to beam it into the hospital databases.

Mr. Conway is in too much pain to accurately recall all of his medications. Dr. Hendricks queries a clinical data-sharing network, which compiles a list from the computerized records of local pharmacies. The doctor has a question about which would be the best diagnostic test to order, given the specifics of Mr. Conway's history. He consults the hospital's digital library, and with several mouse clicks he confirms that a CAT scan is still the expert-recommended choice. He orders the study via the Computerized Physician Order Entry (CPOE) system and also orders some pain-relieving medication. The program alerts him that his choice could have a dangerous interaction with one of the medications Mr. Conway is taking. The computer suggests an alternative, which the doctor selects instead.

A few moments later, Dr. Hendricks sees that the patient is not in his room. He looks at the electronic dashboard, which is tracking the RFID tag on Mr. Conway's wristband. He learns that the patient was transported to radiology five minutes ago, and is currently undergoing the scan. Shortly thereafter, an alert on the dashboard warns him that the radiologist has reported an abnormality on the study. Luckily, the pain is being caused by a kidney stone, instead of something more serious. With a single click the emergency physician is able to view the digital images and confirm the findings.

Looking for assistance in managing Mr. Conway's kidney stone, Dr. Hendricks pages a urologist. Instead of wasting time waiting by the phone, he immediately goes to see another patient. He knows that whenever his call is returned, it will be routed to the digital communication device that he wears on his lapel.

Dr. Hendricks generates the documentation for the patient's ED visit through a wireless dictation system or wireless tablet system that allow him to note historical and physical findings, order lab tests and radiographs and submit via CPOE with integrated decision support. In either case, he does not have to search for a chart or wait for someone else to finish using it.

The dashboard is updated with Mr. Conway's pending discharge so that the housekeeping manager can ensure that the resources to clean the room will be available when needed. The triage nurse in the ED selects the next patient to use the room when it becomes available.

A short time later, Mr. Conway is feeling better and is ready to be discharged home. He receives a computer-generated instruction sheet with information about his diagnosis of kidney stones, including what warning signs to watch for as well as who to follow up with and when. Upon discharge, the system sends the patient's primary care physician, Dr. Thompson, and the consulting urologist a secure e-mail summarizing the emergency department visit and the patient's discharge instructions. The e-prescribing module, having screened for potential drug interactions and provided dosage guidance, electronically routes Mr. Conway's prescriptions to the pharmacy near his home, saving time and reducing risk of errors associated with legibility.

Mr. Conway uses his secure doctor/patient messaging application to communicate with Dr. Thompson two days later, letting him know he passed the stone and he's feeling much better. He also mentions how pleased he was with his emergency visit. Even though the emergency department seemed to be incredibly busy, everything went smoothly and efficiently, and he feels he got great care.

The story of Mr. Conway's visit to the ED sounds futuristic, but all of the technology described above exists today as both home-built and commercial products. But the diffusion of these technologies to date has been limited. The average community hospital, and even some large medical centers, lack basic information technology (IT) enhancements that have been shown to improve the efficiency of care and patient flow, inform clinical decision making, and enhance provider-to-provider and provider-to-patient communications.

This chapter therefore describes the current state-of-the-art in health care IT and highlights several specific IT tools that have proven ability to improve emergency care in four key areas: efficiency and patient flow, clinical decision making, communications, and documentation. It also considers some of the new clinical technologies that are expected to impact emergency care within the coming decade. Next, the chapter will discuss challenges and barriers hospitals may face in adopting these technologies. Finally, the chapter will discuss the critical need for a new federal initiative designed to assist hospitals with the purchase and implementation of technologies to improve emergency care today and in the future.

INFORMATION TECHNOLOGY IN THE HEALTH CARE DELIVERY SYSTEM

Early application of health care IT was limited almost exclusively to hospital accounting systems. As early as the 1960s, hospitals began to use various computer programs for business operations and financial management (Detmer, 2000; Shortliffe, 2005). By the mid-1970s, a small number of hospitals had equipped their programs to process data containing medical content (Henley and Wiederhold, 1975; Hospital Financial Management Association, 1976). During the 1980s and 1990s, many hospitals further enhanced their systems to include electronic

health records (EHRs), a trend that was also seen among a small percentage of private physician practices (IOM, 1991, 2003).

Despite these early advances, progress toward widespread adoption of health IT has been slow. This is especially true of applications aimed at improving the quality and timeliness of patient care, such as programs that assist with patient flow, clinical decision making, and medical communications. Today, it is estimated that fewer than one-third of hospitals and one-fifth of private physicians use EHRs. Computerized provider order entry (CPOE) systems usage is even less common, with only 12 percent of hospitals and 10 percent of private physicians using the technology (Brailer and Teresawa, 2003; Goldsmith et al., 2003; The Lewin Group, 2005; Healthcare Information and Management Systems Society, 2005; Burt and Hing, 2005; Bower, 2005). In comparison, more than one-half of primary care physicians in New Zealand and the United Kingdom report using both EHRs and CPOEs in their daily practices (Harris Interactive, 2001). Common barriers cited as restricting the adoption of these and other IT tools include prohibitive costs, lack of standardization, and physician resistance to change; additional discussion about these barriers is provided later in this chapter.

While usage rates for specific IT applications remain low, data does suggest that American physicians are increasingly reliant on computer-based resources within their offices. According to a recent American Medical Association survey, 99 percent of private practices and 96 percent of physicians use computers in their offices; 84 percent have a computer network in place; and 75 percent have Internet access. At the same time, however, the interconnectedness of these resources with other points in the health care system, such as the emergency department, has been found to be lagging, with only 35 percent of physicians reporting a connection with a hospital or laboratory (Chin, 2002). The apparent isolation of this emerging IT usage raises significant concerns about the continuity of care, particularly for ED patients for whom immediate access to medical records can mean the difference between life-saving intervention and life-threatening medical errors.

Data also suggest a growing recognition among providers about the potential of IT to significantly improve the quality of health care in the U.S. For example, a majority of respondents to a 2005 survey conducted by the Healthcare Information Management and Systems Society (HIMSS) cited "reducing medical errors and improving patient safety" as their top IT priority. Of these, nearly two-thirds indicated their next IT development would be the adoption of an EHR system. Other applications identified by respondents included CPOEs and clinical decision support systems (CDSSs). HIMSS survey respondents included hospitals, physicians' offices, mental/behavioral, health facilities, long-term care facilities, and home health agencies with annual gross revenues ranging from $50 million or less to $1 billion or more (Healthcare Information and Management Systems Society, 2005).

Given that more providers recognize and are turning to IT as a tool to improve the safety and quality of care, one might expect to find significant IT investment occurring in the health care field. After all, the U.S. invests approximately $1.7 trillion, or 16 percent of its gross domestic product (GDP), annually on health care. Data reveal, however, that the expected level of investment simply has not occurred. In 2004, between $17–$42 billon, or 10–25 percent, of all U.S. health care investments was applied to health IT. Less than one-third of this amount, or approximately $7 billion was invested in hospital clinical systems such as EHRs, CPOEs, or CDSSs (Goldsmith et al., 2003; Bower, 2005; The Lewin Group, 2005).

The health care field has also failed to keep pace with IT investments as a percentage of industry revenue. While spending on health care IT as a percentage of revenue has increased

slightly in recent years, rising from 1 to 2 percent in 1998 to 2 to 3 percent today, these figures are far less than the IT and financial services industries which invested 10 percent and 7 percent, respectively (The Lewin Group, 2005). This disparity becomes even more striking when one examines IT investment rates on a per worker basis; while most U.S. industry invested approximately $8,000 per worker for IT in 2004, the health care industry invested only about $1,000 (U.S. DHHS ONCHIT, 2005).

The paucity of investment in health care IT has ramifications far beyond the financial. Lacking adequate resources for the coordinated development or implementation of proven IT systems, efforts to enhance safety, optimize workflows, and foster communication among and across health care settings have largely stalled. Further, where improvements have been made, they have occurred in relative isolation, resulting in "islands" of innovation rather than systemic repairs to a failing system.

The National Health Information Infrastructure

Although the value of such integration and coordination has long been recognized (NHTSA, 1996), progress toward a highly integrated emergency care system has been slow. Instead, multiple systems of varied quality have developed independently of one another. The resulting fragmentation undermines the quality, safety, and timeliness of emergency care, limits the application of proven health care IT, and prevents the aggregation of data for public health surveillance and research (Halamka et al., 2005).

The federal government has recently assumed a leadership role through funding and other support to develop a uniform national health information infrastructure capable of supporting integrated health IT (Taylor, 2004; Cunningham, 2005; Hillestad et al., 2005; Shortliffe, 2005). This initiative can lead to significant improvements in emergency care, as well as other areas. Federal leadership is needed because of failures in the health IT marketplace, including asymmetrical risks and rewards for technological innovation and the inability to offer aggregated data comparisons (Taylor, 2004; Middleton, 2005). Moreover, such leadership is needed today in order to assure that IT advances are made in a coordinated way that facilitates necessary interoperability and communication.

The federal government has shown the ability to initiate necessary industry innovation when market forces have failed to do so. The Hill-Burton Act, for example, is largely responsible for the nation's hospital infrastructure (Halvorson, 2005). Adopted in 1946, Hill-Burton provided federal grants to states for the construction of hospitals, requiring states to adopt plans that assured constructed facilities met a variety of minimum requirements. Over the course of the next 30 years, Hill-Burton subsidized the construction of 40 percent of all U.S. hospital beds. Other examples of federal leadership filling a market void include the Rural Electrification Act of 1936 and the Federal Aid Highway Act of 1956 (Halvorson, 2005).

A number of other industrial nations have already embraced the need for national leadership and funding of health IT innovation. Among these, Britain's National Health Service (NHS) recently embarked on the world's largest civilian IT project, planning to spend approximately $11 billion on a national system that will replace the existing hodgepodge of local systems and paper medical records (The Lewin Group, 2005). IT tools to be featured in this effort include, but are not limited to lifelong EHRs coordinated at the national level, integrated information sharing among all health care settings, and online communications and data access for patients and providers (Detmer, 2000).

Using a Regional Health Information Organizations (RHIOs) model that provides common elements across the full continuum of health care settings, the U.S. government has the potential to significantly improve the quality, safety and timeliness of emergency care. While the direct costs associated with this effort are estimated at $276 billion over ten years, a national health information infrastructure would generate direct savings in the amount of $613 billion over the same years and $94 billion annual thereafter. This is in addition to the many ancillary savings associated with such benefits as improved management of chronic disease (Kleinke, 2005).

INFORMATION TECHNOLOGY IN THE EMERGENCY DEPARTMENT

The ED is a unique setting in modern medicine—a complex and chaotic environment that presents an increasing number of challenges. ED clinicians are frequently called upon to make crucial decisions under pressure with limited data while maintaining continual readiness for new arrivals, stressing available resources. Because ED providers must often make critical decisions without patient records or histories, it has been said that EDs operate on "information fumes." Emergency departments are subject to increasing patient volumes and more complex conditions, yet over the last decade they have experienced a diminished capacity caused by decreasing resources. One solution to the serious challenges facing today's EDs may be found in IT, which can both facilitate analysis of the problems and support solutions.

All of the common medical tasks performed by doctors involve information processing: taking a history, examining a patient, ordering and interpreting test results, considering diagnoses, devising a treatment plan, and communicating with other providers about the need for admission or discharge. All of these are data-management tasks. Information is generated when procedures are performed, and simply by the presence and flow of patients. Emergency providers are eager consumers of available past clinical data, and are creators of information to be used during follow-up. The quality of information management determines how well providers manage the care of their patients.

Today, there is an especially urgent need to apply IT to the delivery of emergency care. Among other factors, this urgency stems from the life-and-death nature of emergency care, the myriad threats to care posed by ED crowding, and the increasingly common role of the ED as the public's portal of choice for medical services.

There are five key areas of emergency care that could immediately benefit from an infusion of IT, including:

- **Management of Patient Flow**—Technologies such as electronic dashboards, radio-frequency tracking, and wireless communication systems can help ED staff manage patients and maintain control over department workflow.
- **Linking the ED to Clinicians in the Wider Community**—Enhanced communications between providers within a community can greatly enhance the availability of useful clinical information the emergency care, can improve coordination of care, and can improve allocation of community health care resources. Computerized messaging between patients and doctors, as well as can ensure that all providers fully coordinate their care. Telemedicine enables advanced medical knowledge to improve the care of patients in remote areas.
- **Clinical Decision Support**—As stand alone units or part of a broader system, clinical decision-support programs can help guide clinicians in choosing the optimal and economical therapy, and can enhance the safety and efficiency of triage. Clinical alerts and reminders can warn providers if a proposed treatment plan carries unrecognized risks.

- **Clinical Documentation**—Electronic documentation of emergency services can facilitate the timely, accurate collection and storage of information regarding the course of patient care, serving as proof of services rendered for reimbursement and supporting public health and research functions, among other services.
- **Training and Knowledge Enhancement**—Computerized educational and training resources can make the most up-to-date medical knowledge rapidly available to clinicians, and provide the experience they need to deliver quality care.
- **Population Health Monitoring**—Emerging IT applications can provide real-time population health monitoring, including syndromic surveillance and outbreak detection, necessary for many public health and homeland security priorities.

In each of these areas, IT has the potential to significantly enhance the timeliness, safety, and quality of emergency care, improving patient flow and reducing health costs in the process. The challenge in the future is to effectively integrate these technologies so that hospitals can invest in applications that address goals and objectives in all five categories. For example, systems should be able to support clinical decisions as well as operations management. Additionally, future development and advancement of IT applications must be designed to accommodate the special needs of pediatric patients.

Management and Coordination of Hospital Patient Care

The case of Mr. Conway illustrates the need for seamless communication among prehospital IT systems, hospital departmental systems such as laboratory and radiology, and hospital patient-tracking systems. To meet the complex data needs of an ED clinician, data must be easily and securely shared between clinical and financial systems, using widely accepted standards and protocols. Among the IT tools currently available to assist with the management and coordination of emergency care are the following:

Electronic Dashboards

The pre-IT solution for managing ED flow was for staff to track patients on a centrally visible whiteboard. Commonly arranged in the form of a grid, this whiteboard contained a list of patients and their locations, current providers, status of the visit, and orders to be completed. The information was updated manually when the staff noticed a change and had the time to update the board among their responsibilities.

Such a system provides a useful central source of individual data points. However, many management decisions are based on aggregate information that needs to be assembled in real time. Since information on whiteboards is only updated when someone notices the change and has time to update the board, the manual process breaks down during the ED's busiest times, when accuracy and timeliness of information is most critical. This problem tends to self-propagate: Outdated data causes inefficiencies, further taxing a harried staff that then does not have time to update further changes.

Computer technology transforms the manual whiteboard into an electronic "dashboard" that continuously displays updated information and integrates multiple data sources, such as laboratory, radiology, and admitting databases. Using a combination of colors or symbols to represent ongoing tasks and processes, many dashboards can present information in a tabular, grid-like format (similar to the manual whiteboard), while others arrange the screen as a graphical representation of the ED. Sometimes, the dashboard tracking function is used as a

central point of an ED Information System, providing links to other features listed in this report. Other times, the system is a standalone tool that can be modified to interface with other components of the hospital information system.

However they are configured, electronic dashboards allow providers to see the most recent information, without the need for manual input. Computerized systems provide an excellent overview of the department and allow both clinicians in the ED and administrators in their offices to get a "birds-eye" view of the flow. Bottlenecks become readily apparent, staff members are able to see developing problems, and action can be taken before operations are affected.

In addition, long-term storage of the data tracked by a dashboard system, similar to several other systems discussed in this chapter, is another useful tool that can aid in resource planning and error identification, analysis, and prevention. Given accurate models of patient flow and information on past bottlenecks, it is possible to anticipate future demands on staff and maximize the efficient deployment of resources (Cone et al., 2002). The complexity of the ED makes error identification a difficult process, and sole reliance on clinician reporting will likely be inadequate to effect change (Handler et al., 2000). Readily accessible data on all ED visits makes it easier to analyze standard quality assurance measures, such as unplanned revisits, as well as devise new metrics for quality care. In the case of an adverse event, analysis of stored dashboard parameters could allow reconstruction of events similar to what an airplane's "black box" provides after a plane crash.

Further, allowing clinicians (especially trainees) to access stored tracking data to follow up on their patients encourages self-monitoring for errors and helps mitigate a key deficiency of the feedback system of the ED: that an unknown result of treatment has the same reinforcing effect as a positive outcome (Croskerry, 2000). Often, errors and near misses are caught during follow-up care, but not reported back to the original treating clinician. Storing visit data permits ED providers to easily review a list of patients they have seen in the past. That list could integrate data from the ED course with other information from the hospital system, allowing providers to follow up on whether their diagnoses were correct and their treatments appropriate.

While there have been only a few effectiveness studies concerning comprehensive ED dashboard systems, preliminary findings appear to support their use. Among these, hospitals with ED dashboards have reported reductions in length of stay, fewer patients leaving prior to treatment, and less time spent on diversion (Jensen, 2004). Providing emergency physicians with an updated display of laboratory test status has been shown to improve perceptions of efficiency and communication with patients (Marinakis and Zwemer, 2003). And, the ability to better communicate estimated wait times to patients using dashboard technology has been found to improve patient satisfaction with emergency care (Thompson et al., 1996).

Radio Frequency Identification (RFID) Tracking

Effective workflow in the ED requires knowledge of the location of patients, caregivers, and equipment. New tracking technologies, such as Radio Frequency Identification (RFID), can show the exact locations of people and resources, enabling caregivers to optimize workflow and empowering administrators to understand how people move through the department.

Such tracking systems are available in two basic forms: (1) passive systems that require the use of RFID scanners to read unpowered RFID tags and (2) active systems that utilize existing hospital wireless networks to track battery operated RFID transmitters. Using hardware and

software, active RFID systems then track the position of these transmitters with enough accuracy to identify the room in which they are located.

Several pilots of RFID tracking in the ED offer insight regarding the potential of RFID to improve the quality, timeliness and efficiency of emergency care. At Beth Israel Deaconess Medical Center in Boston, for example, RFID is being used to track equipment and key staff members. At Summa Health System in Akron, Ohio, RFID is being used to optimize patient flow and track patient location. Finally, in Memphis, an ED is using RFID as a means to reduce patient waiting times by providing real-time notification of bed availability.

Digital Voice Communication

While the ED dashboard provides complete integration of all hospital data in a single location, there is still a need for real-time discussion of patient care issues among caregivers. Cellular technologies seem like an obvious answer to this real-time need, given the ubiquity of such devices, but cellular technology poses a number of challenges for hospitals, include electronic interference, varied reception, and germ transfer (Tri et al., 2001; Shaw et al., 2004). One means to overcome these issues is hands-free voiceover IP (VoIP) devices for voice communication over existing hospital wireless data networks. Newer VoIP devices provide dual capability—automatic use of the hospital network when indoors and automatic use of the standard cellular network when outdoors. Of note, users of such technology must take care with their surroundings to ensure that conversations protect patient confidentiality, and that the ambient noise doesn't degrade voice recognition.

Wireless Registration

In a typical ED, several components of emergency care occur simultaneously. A patient having a heart attack, for example, may have a physician performing an exam, a nurse inserting an intravenous tube, and a medical technician performing an electrocardiogram (EKG). At the same time, the laboratory will be processing blood tests while radiology is developing an x-ray and the catheterization laboratory is being instructed to prepare for a new arrival. In most EDs, however, there is a critical point of failure in the simultaneous nature of this response: the ED registration clerk.

As it currently stands at most facilities, ED registration serves as a significant bottleneck in what should be a serial process. For patients who have been triaged with a high severity of illness, one strategy for improvement is to move the formal registration process to the bedside via a wireless network. Such an approach would allow the registration process to become more agile as it removes the need to tie the registration process to a single physical space (Smith and Feied, 1998).

Mobile Computing (MC)

MC technology, such as specialized wireless laptop carts equipped with 24-hour batteries or specialized tablet PCs, are increasingly well received by ED physicians and their patients (Bullard et al., 2004). Among their other applications, MC technology can provide ED staff with bedside access to patient Electronic health Records and Clinical Decision Support Systems. Tablets can also be used to allow MDs and nurses to document their findings and care in real time, rather than dictating later, and provide the clinician about feedback to insure proper documentation for coding and billing. They also help clinicians remember the relevant questions to ask, findings to check and checklists to review before administering hazardous treatments, like

thrombolytic therapy. MC technology also can enhance ED capacity to deploy a fully functional system to any location on a moment's notice, as might be required during severe crowding or a mass casualty event

Handheld Wireless Devices

Handheld computers and multifunction wireless devices such as Blackberries are increasingly popular with physicians who use them in their clinical practice (American College of Physicians and American Society of Internal Medicine, 2005), there are numerous published reports that describe their utility for medical education (Bertling et al., 2003), dissemination of new medical practice guidelines (Strok et al., 2003), and documentation of patient care and procedures in the emergency department (Bird et al., 2001). When integrated with wireless communication, handheld computers can be used to view patient data (Duncan and Shabot, 2000), record, and transmit real-time patient vital signs during intrahospital transport (Lin et al., 2004), and serve as a triage and screening tool for medical support of mass-gatherings (Chang et al., 2004). These devices also can used to enhance patient safety by alerting physicians of abnormal test results (Bates and Gawande, 2003).

Digital Radiography and Picture Archiving and Communications Systems (PACS)

In recent years, many hospitals have migrated from film- to digital-capture and display of x-rays, MRI, CT, angiography and ultrasound images. These images are then stored in what is known as picture archiving and communications systems (PACS). Both digital radiography and the use of PACS have been shown to provide interpretations that are as reliable as traditional film-based methods (Kundel et al., 2001). With respect to emergency are, there are a number of benefits associated with digital radiography and PACS. For example, digital radiography technologies have been shown to reduce the time needed to capture images (Redfern et al., 2002). PACS offer instantaneous sharing of images with multiple clinicians, reduces the threat of films being irrevocably lost or misplaced, and eliminates all delays associated with retrieving films from archives and record rooms. And, both technologies facilitate remote interpretation of films, a service especially important in rural or community emergency department settings, which may not have access to 24-hour radiologist coverage. In addition, PACS enables on-call specialists to view films from home, office, or another hospital, thereby expediting care.

Electronic Health Records (EHRs)

Whether implemented as stand-alone features or part of a more comprehensive IT array, each of the coordination and management tools discussed here have the potential to significantly improve patient flow and enhance the quality, timeliness, and safety of care in the ED. This is particularly true when these tools are complemented by an integrated system of electronic health records.

The ED operates in a relative data vacuum with respect to patient and condition information. Typically, there is no medical record for ED patients, who may be uncommunicative or unconscious upon arrival. Moreover, extreme urgency of treatment is paramount as life-threatening illnesses or injuries have occurred. Under such circumstances, accurate diagnosis is made more difficult, drug allergies can be missed, and important co-morbidities can go undetected. Fortunately, EHRs offer a solution to this information void.

The potential of EHRs to improve patient care in all health care settings has been well-recognized for more than a decade, with the Institute of Medicine (IOM) having called for the

complete elimination of paper-based medical records as early as 1991 (IOM, 1991). As currently defined by the IOM, an EHR system consists of four key elements: (1) longitudinal collection of electronic health information—defined to include information pertaining to the health of an individual or health care provided to an individual—for and about patients; (2) immediate electronic access to patient- and population-based information to those with designated authority; (3) provision of knowledge and decision-support to enhance the quality, safety, and efficiency of patient care; and (4) support for efficient processes for health care delivery (IOM, 2003).

Over the last fifteen years, numerous studies have documented the advantages of EHR systems over traditional paper-based medical records. Among these advantages, EHRs improve reliability in chart access, allow multiple individuals to access the record simultaneously, and facilitate electronic communication between health care providers. They enhance the quality and completeness medical data and facilitate the integration of clinical decision support for providers. They also provide efficient access to medical references and assist with the collection of population health measurements (Holbrook et al., 2003). Studies examining the use of EHR systems in EDs have reached similar findings, concluding that the systems can improve documentation, patient care, and patient satisfaction without detracting from direct patient care or resident education or supervision (Buller-Close et al., 2003).

Linking the ED to the Wider Community

A number of IT tools are available to improve provider-to-provider and provider-to-patient communications during the course of ED care and beyond.

Prehospital Communications

The potential for IT to improve patient flow and enhance the quality, timeliness and safety of emergency care begins even before the patient reaches the hospital doors. Often, it is prehospital EMS units that are the first caregivers to acquire medical information about patients en route to the ED. The ability of these units to accurately capture and transmit vital signs, patient history, and early treatment information to receiving hospitals can be enhanced by several IT applications. For example, prehospital 12-lead electrocardiography has been shown to be safe, improve times to reperfusion therapy, and decrease patient morbidity and mortality (Urban et al., 2002). Also, the rapid diffusion of messaging and data transmission through commercial cell telephones suggests a significant potential for the development of cell-based prehospital-hospital communications.

It is critically important that the design and implementation of these systems support full interoperability, i.e., allow EMS personnel to “talk” to each other, to the police, to emergency management, fire, and EDs.

Emergency Management

A number of cities have begun to eliminate communications barriers by purchasing equipment that enables officials from public safety and public health to communicate in real-time (GAO, 2004). Some cities have also begun to address disaster preparedness communications issues with the help of the Health Alert Network. This is a nationwide communication network is designed to facilitate communications through high-speed internet connectivity, broadcast capabilities, and training.

In addition, the real-time capturing and transmission of EMS dispatch data can improve the coordination of prehospital and emergency care for critical patients (Teich et al., 2002). Such

data exchange allows EMS teams to quickly determine the best location at which to deliver patients. This not only minimizes delays caused by routine ambulance diversions, it significantly strengthens a community's ability to respond to mass casualty events. Retrospective analysis of EMS dispatch data also suggests that the monitoring of EMS data is a viable approach to public health monitoring and surveillance (Mostashari et al., 2003).

Regional Health Information Organizations

Development of RHIOs shows significant promise for connecting EMS, EDs, and other providers within regions (Koval, 2005). Regional health systems can link providers who serve the safety net to coordinate emergency and other community care. Many communities already have primary care networks that integrate hospital EDs into their planning and coordination efforts. A rapidly growing number of communities, such as San Francisco and Boston, have developed RHIOs, which coordinate the development of information systems to facilitate patient referrals, tracking, and sharing of medical information between providers to optimize the patient's care across settings. The San Francisco Community Clinic Consortium brings together primary care, specialty care, and emergency departments in a planning and communications network that closely coordinates the care of safety net patients throughout the city.

The development of these networks is a centerpiece of the federal government's strategic plan for health care information technology (Thompson and Brailer, 2004). The Agency for Healthcare Research and Quality (AHRQ) has provided seed money through grants to a number of RHIO start-ups.

Telemedicine

Telemedicine has a number of important applications in improving the delivery of emergency and trauma services in remote locations, including emergency patient care, education, research, and patient follow-up. A recent IOM study, *Quality through Collaboration: The Future of Rural Health*, highlighted to growing application of telemedicine to emergency and trauma care (IOM, 2004b). The use of two-way video conferencing, available since the 1960s, has begun to increase as the development of the telecommunications infrastructure accelerated in the last decade, with the introduction of digital communications and the improving capabilities and cost value of computer hardware and applications. Video conferencing has facilitated specialty consultation in a number of critical areas, including trauma, radiology, cardiology, and orthopedics.

Cost and outcome studies for the role of telemedicine in rural medicine are limited and warrant further attention. Studies have shown telemedicine to be effective in the delivery of acute care to victims of trauma in remote locations (Marcin et al., 2004). Teleradiology has been shown to have a significant impact on the diagnosis and treatment decisions (Lee et al., 1998). Studies have also indicated high levels of patient and provider satisfaction with these technologies (Boulanger et al., 2001).

Automated Discharge Systems

For many patients who enter the health care system through the ED, treatment concludes with discharge instructions for self-care and instructions on when to return for follow-up care. Unfortunately, patient recall of these instructions is often quite poor, a factor compounded by the frequent appearance of medical jargon and difficult-to-read handwriting (Vukmir et al., 1993). Further, patient non-compliance with instructions for follow-up services often hampers recovery, thereby contributing to return ED visits. For non-English speaking patients, these problems are

compounded. Good communication between patient and clinician is essential to quality care and good outcomes. The IOM report, *Health Literacy: A Prescription to End Confusion*, documents the poor state of health literacy, even among English-speaking patients, and serious consequences it can have on health (IOM, 2004a). For non-English-speaking patients, the problem is even more critical. As the number of non-English proficient residents increases, the need for IT solutions will becoming ever more critical.

Today, there are number of IT tools that can assist with the discharge process. These include automated discharge programs that produce clear, concise, legibly-written instructions proven to enhance patients' understanding of their condition and their compliance with treatment plans (Vukmir et al., 1993; Jolly et al., 1995). It also includes discharge communication programs that allow ED physicians to establish a primary care appointment for follow-up care, a service that has been shown to markedly improve patient show rates at follow-up appointments and allow for additional opportunity to provide important preventive services (O'Brien et al., 1999).

Automated Referral Systems

A common frustration facing emergency department staff today is how best to receive information on patients who are referred to the ED by their primary care doctor. In an effort to streamline care, referring doctors often want to share insight and suggestions about the patient they are referring. However, in large emergency departments it is often impractical and interruptive to have a busy ED physician stop patient care in order to field a call when a referring doctor sends in a patient. To solve this problem, some departments make fax or phone transcription options available to callers. Yet, at the busiest times, a large number of patient referrals can pile up by the triage desk, and getting them accurately matched up as patients arrive becomes a challenging and time-consuming task.

In an effort to alleviate these challenges, many hospitals are adopting automated referral systems as a means to facilitate information transfer. Among the systems being deployed, Beth Israel Deaconess Medical Center (Boston, MA) developed a system which allows doctors to access a secure Web page and input or import the patient's information. Once the information is submitted, the system prints out a summary report and attaches an electronic copy of the same report to the patient's EHR. This way, even if the triage staff is unable to match up the paper referral with the appropriate patient's chart, clinical staff can still see and act on the information via the dashboard display. Prior to this system's implementation, ED administration at Beth Israel Deaconess Medical Center received several complaints per week related to this problem; now, complaints are almost nonexistent.

ePrescribing

ePrescribing, or the electronic transfer of prescription data from clinicians to pharmacies, is an increasingly common method of assuring providers, pharmacists, and patients have timely access to accurate prescriptions and medication information. ED clinicians can use ePrescribing technology to automatically send discharge medication prescriptions to a pharmacy that is convenient for their patients. This improves the timeliness and accuracy of prescriptions and eliminates risks due to poor handwriting or inaccurate transcription (Bizovi et al., 2002). It also improves enforcement of formularies and enhances communication among providers. ePrescribing technology can be implemented alone or integrated into other discharge programs, such as those as described above.

E-Communications

The complexity of modern medicine has made the sharing of information a critical function in healthcare. Failures of communication between healthcare providers are one of the most common contributing factors to adverse events (Bates and Gawande, 2003). Health care IT can help facilitate communication between physicians, as well as between patients and their providers. It can also help make the dissemination of information more efficient by ensuring it is received and handled with appropriate priority.

There are currently two common approaches to secure e-communications. The first is called S/MIME gateways. In this approach, organizations obtain digital certificates, which are used to encrypt e-mail as it travels over the Internet. Thus, the organization-to-organization transmission of e-mail is protected. Once the electronic message arrives at the destination organization, it is treated as secure internal e-mail.

The second approach relies on a secure messaging website that stores all messages in a secure database accessible only via a password-protected encrypted website. Doctors and patients communicate via the Web, but reminders are sent to their regular e-mail accounts informing them they have new messages pending. In this way, no patient-identified information is sent via regular, unsecured e-mail technologies. This secure website approach enables discharge summaries, admission notification, and other clinical correspondence to be sent electronically between doctors. Additionally, patients and doctors can exchange clinical results and clinical messages using the same system.

In both cases, efforts must be taken to facilitate use in ways that make both providers and patients more comfortable with the technology. Today, while 45 percent of online consumers would like to communicate with their physicians using e-mail, only 6 percent have done so (Manhattan Research, 2002). The adoption of privacy standards and other protections is needed to encourage use at both ends of the care spectrum. An example of a system linking patients and providers is described in Box 5-1.

BOX 5-1 The PatientSite Project

CareGroup HealthCare Systems is an integrated health care delivery system based in Boston, MA, consisting of five hospitals, including its flagship facility, the Beth Israel Deaconess Medical Center. It employs approximately 1,700 medical staff who provide care to more than 1 million patients at CareGroup centers and through numerous affiliated practices. CareGroup implemented the world's first clinical computer system and online medical record program.

In 1999, CareGroup and Beth Israel staff began discussing how best to involve patients in their care and meet the demands of online patients. Using a variety of information servers and databases, including some developed by project authors, the team established an independent clinical platform that could display patient information on a secure website accessible through a number of Web browsers. Known as PatientSite, this system features secure messaging between patients, providers and staff; it allows patients to perform routine tasks, such as requesting appointments, obtaining prescription refills, or requesting primary care referrals online; and it supports patient "homepages" that can be customized with a range of health education links, as well as messages from identified providers.

Patients registered with PatientSite have access a comprehensive medical file, including medical records, established at their time of registration. They also can maintain personal medical records, recording such information as medication problems, allergies and other pertinent notes. Numerous security measures are in place to ensure that patients have access only to their own files. Physicians registered with PatientSite, by contrast, have access to information on all of their patients.

In early 2003, PatientSite claimed more than 120 participating providers representing 40 CareGroup centers and practices. It had more than 11,000 active patients, defined as those who had logged on at least once following their registration. Participation rates for both providers and patients have steadily increased since the programs inception in 2000. Additional information about PatientSite, including a demonstrate page, is available at https://www.patientsite.org.

SOURCE: Sands and Halamka, 2004.

Clinical Decision Support

Adverse events can often be prevented if additional information is known at the time that critical decisions are made. Sometimes the pivotal facts are available, but, due to "information overload", they are not readily apparent amongst a large volume of less important data. Computers can be programmed to use guidelines to alert physicians about unexpected results or remind them of important information at the time choices are being made. Numerous studies have been published showing that alerts and reminders are an effective method of changing physician behavior and improving the quality of care (McDonald, 1976; Kuperman et al., 1999; Kilpatrick and Holding, 2001). Specific examples of clinical decision support tools currently available to improve emergency care include:

Automated Triage Systems

Automated triage systems are commonly used to refer patients to the appropriate levels of medical care. For example, nurse call centers routinely use protocols and guidelines to triage patients to self-care, primary care, or emergency care. Initial attempts at the development and implementation of such systems for use in the ED have achieved variable levels of success (Brillman et al., 1996; Haukoos et al., 2002; Dale et al., 2003). While additional research on the potential of triage systems to enhance ED patient flow and improve quality of emergency care is needed, there is at least one tool available to assist with ED triage efforts—the Emergency Severity Index (ESI).

Consisting of a 5-level triage system, the ESI has been shown to reliably correlate with resource utilization, the need for hospitalization, and length of stay (Wuerz et al., 2000). It has excellent integrator reliability and a high correlation with the need for ICU admission (Tanabe et al., 2004). The ESI also has been validated in pediatric populations (Baumann and Strout, 2005). Integrating ESI into automated triage systems in the ED could assist in the accurate and rapid assignment of severity scores, and immediate capture of the results can help expedite care and provide real-time data on the departmental workload. Further, when combined with metrics of throughput and capacity, ESI data can be used to plan staffing and bed requirements, helping to avoid the need for ED diversion and minimizing the impact of ED overcrowding.

The University of Alberta's eTRIAGE system was developed in conjunction with the Alberta provincial government and uses the 5-level Canadian Triage Acuity Scale (CTAS). It has been prospectively validated and found to have a high level of inter-rater reliability (Dong et al., 2005). Existing computer triage systems can also be modified to support syndromic surveillance. Even more promising is the notion of modifying eTRIAGE and similar systems to automatically alert the triage nurse whenever a patient presents with a history, symptoms, or clinical signs that suggest exposure to a bio-terror agent or another public health threat.

Electronic and even manual triage systems can be designed to facilitate advance ordering of diagnostic tests (i.e., urinalysis, pregnancy test, ankle x-rays) based on evidence-based clinical algorithms, which enables testing to begin before the patient is even seen.

Computerized Provider Order Entry (CPOE)

Recent efforts to decrease adverse drug events have focused on providing clinical alerts at the time of ordering. Requiring providers to prescribe medications via CPOE systems ensures that the program has the opportunity to force entry of key information and to provide suggestions for changes or additional orders as appropriate. Many CPOE systems prevent errors by checking that safe and effective doses have been prescribed, while others add checks for allergies or interactions with other prescribed medications. Adverse reactions to medications still occur, even when prescribers follow dosing recommendations and safety checks are performed. A detailed audit from CPOE systems and automated dispensing machines (discussed below) can assist with the identification of these rare events.

Over the last decade, CPOE systems have been shown to save time (Tierney et al., 1993), improve resource utilization (Tierney et al., 1988; Bates et al., 1999), improve compliance with clinical guidelines (Overhage et al., 1997; Teich et al., 2000), and decrease medication errors (Bates et al., 1998, 1999). They also have been found to enhance patient safety by providing extra safeguards for high-risk situations (Kuperman et al., 2001) These advantages have only been shown for custom-written CPOE software, however, and may not be replicable with commercial purchased systems (Kaushal and Bates, 2001).

Further, although efforts to implement CPOE in the ED are just beginning—currently, only 18 percent of emergency medicine residency-affiliated EDs report having medication order entry systems, and only 7 percent report having systems that could check for errors (Pallin et al., 2003)—preliminary studies suggest that these systems have the potential to introduce inefficiencies (Shu et al., 2001; Field, 2004). A process change in a busy ED that slows care is not only frustrating, but could cause more harm than a CPOE system prevents. As a result, it is especially important that CPOE systems for the ED be specifically designed for use there, and the impact on quality, timeliness, and safety of emergency care be carefully monitored (Handler et al., 2004).

Automated Dispensing Machines (ADMs)

Automated dispensing machines (ADMs) are another patient-safety technology that have been gaining acceptance among health care providers. These devices are cabinets that contain multiple drawers filled with medications. They process medication orders and restrict the user's access to just those medicines that have been prescribed, helping to ensure the correct drug is chosen. An audit trail is kept by the ADM that records which provider had access to each medication, facilitating investigations of adverse events. The machines are usually networked to a central pharmacy that keeps track of inventory and proactively replenishes stocks when they are running low.

While ADMs appear to have the potential to promote safety and improve patient flow, further study is needed to determine if the benefits outweigh the downsides (Murray, 2001; Oren et al., 2003). For example, if an inadequate number of machines are installed, there is the potential for a decrease in efficiency as staff waits in line instead of caring for patients. Further, certain classes of medications (i.e., those used in case of cardiac arrest) need to be accessed immediately, and therefore are not appropriate for storage in ADMs in the ED.

Computer Decision Support Systems (CDSS)

Clinical decision support systems (CDSSs) integrate information on the characteristics of individual patients with a computerized knowledge based for the purpose of generating patient-specific assessments or recommendations designed to aid clinicians and/or patients in making clinical decisions. In this way, CDSSs assist clinicians and patients with three types of clinical decisions: preventive and monitoring tasks, prescribing of drugs, and diagnosis and management (IOM, 2001).

Use of CDSSs has been found to improve clinician compliance with a number of prevention and monitoring guidelines, including vaccinations, breast cancer screening, colorectal cancer screening, and cardiovascular risk reduction (Shea et al., 1996; Balas et al., 2000). Studies examining CDSS usage for drug selection, screening for interactions, and monitoring and documenting of adverse side effects similarly suggest some positive effect (Classen et al., 1992; Evans et al., 1998; Hunt et al., 1998). By contrast, however, serious questions have emerged regarding the systems' ability to have a meaningful role in diagnosis or to improve patient outcome (Wexler et al., 1975; Chase et al., 1983; Pozen et al., 1984; Wellwood et al., 1992; Hunt et al., 1998; Gallagher, 2002). If the time needed to consult a CDSS inadvertently slows the delivery of emergency care, for example, its implementation would result in far more negative consequences than its usage could offer benefits. Additional research concerning the effectiveness and safety of CDSSs for diagnosis and management, particularly in the ED, is therefore warranted.

Clinical Documentation

All emergency encounters require documentation of the salient details of the visit. This information is kept to fulfill a number of important goals. It serves as a record to assist in the care of the patient; it serves as proof of services rendered for reimbursement;, it memorializes the provider's thoughts in defense against a negligence claim; and it supports public health and research functions. Creating documentation that is legible and meets these goals is a time-consuming task. Physicians overwhelmingly prefer to spend their time with patients rather than

documenting the visit. This has led to a number of programs aimed at making the documentation process as efficient as possible.

Among the available technology, some clinical documentation programs require the entering of information in a structured manner, forcing the user to choose from provided options by selecting findings from rows of checkboxes, traversing a nested hierarchical tree of options, or clicking symbols on a diagram of a human body. Others permit unstructured input, allowing the user to type free text or dictate with minimal or no restrictions on what they can enter. A third technology is computer-assisted dictation, where a computer voice-recognition program takes a first pass at understanding the words, and then a human "correctionist" verifies the accuracy.

Free text and unstructured entry options permit rapid input. However, due to limitations in computer understanding of human language, they do not allow much more than computer-assisted storage and transmission. The structured approaches usually have a more cumbersome and time-consuming data entry process, but they store information in a way that programs can easily understand, allowing them to serve as the basis for many other computer-assisted functions. Often, the increased time spent entering the data is made up by increases in efficiency elsewhere. Human factors will play a key role here—the ways that clinicians actually use and interact with different systems will ultimately determine the best approaches. A well-designed tablet may turn out to be more efficient than dictation.

For example, fully computerized ED charts can support automated error surveillance, (Schenkel, 2000) and help monitor the quality of ED care. Computer algorithms that search for the presence or absence of certain physical exam findings can lead to increases in the sensitivity of biosurveillance algorithms (Teich et al., 2002). Computerized decision-support systems use programmed rules to promote safer healthcare; with a structured computerized chart, these rules could be written to handle a much wider range of less common clinical scenarios without the inefficiency or annoyance of asking the user too many questions.

The user-interface and data-entry modules of clinical documentation systems should be rigorously crafted to promote high quality data entry and efficiency. Although there are many potential benefits to electronic clinical documentation, carelessly designed interfaces will slow the charting task and leave clinicians with two bad choices: allow the system to delay care in the ED, or batch the charting for completion at a later time (Davidson et al., 2004). These systems often have to negotiate a trade-off between obtaining more accurate and detailed information on the patients and increases in the amounts of time required for the inputs.

Training and Knowledge Enhancement

In addition, IT can provide ED and related staff with a number of informational and educational tools. Examples of these communication and education technologies include:

Integrated Information Resources

With the increasing complexity of medical care, emergency providers may care for patients who have conditions that were unheard of during their training or that are being treated with medications that were recently approved. It is not possible for anyone with patient care responsibilities to memorize current information on every possible pathology, medication, or therapy that he or she could potentially encounter. Given the rapidly expanding volume of medical information and the wide variety of conditions that present to an emergency department, easy access to electronic references is a key to improving patient safety (Bates et al., 1999).

Through new IT tools, the medical reference industry is now able to bring medical knowledge to the point of care in the ED and beyond. For example, textbook websites offer online versions of key medical texts and publications, a format which facilitates remote viewing, subject searches, and routine errata and addendums. Likewise, medication websites provide ED physicians and other staff with quick access to monographs on all prescription, nonprescription, and herbal preparations, as well as information on drug interactions and prescription costs. Many of these services are moving to provide an increased level of integration into the clinical information system, so that, for example, a provider who encountered an unfamiliar diagnosis in a patient record could read a summary simply by clicking on its name.

In addition, IT translation and visual communication tools can help providers deal with the dozens of languages that are heard in the emergency department. Important applications include gathering information for triage and diagnosis, communication regarding treatment decisions and care in the hospital, and providing written information to patients for subsequent compliance and follow-up.

Training and Simulation

The nature of emergency medicine practice requires clinicians to rapidly assess a situation and execute an intervention plan, often with incomplete information. Extensive training can help prepare future emergency medicine staff for these types of challenging situations they will face. Just as with the training of commercial airline pilots, computer-driven simulators can provide valuable educational experiences for both the development and evaluation of emergency practitioner knowledge (Gordon et al., 2004). Simulation also can be especially useful for training Emergency Medicine residents in invasive procedures (Vozenilek et al., 2004). The potential of IT based training and simulation recently led the Society of Academic Emergency Medicine to issue the following recommendation:

> EM residency programs should consider the use of high-fidelity patient simulators to enhance the teaching and evaluation of core competencies among trainees….The impact of patient simulation on emergency medicine resident training is believed to be so significant that, were it not mindful of administrative and cost burdens for individual programs, the consensus panel would have advised that all emergency residency programs obtain access to a simulator (Vozenilek et al., 2004, p. 1153).

Population Health Monitoring

Real-time population health monitoring is an emerging technology in emergency and public health informatics. The initial efforts have largely focused on regional monitoring of disease among the ED populations. Interest and funding in this area were propelled in 2000 and 2001 by concerns about bioterrorism.

Public health agencies have long used “surveillance”—the systematic monitoring of health conditions of importance within populations—to measure the incidence of disease, identify outbreaks, and evaluate the impact of prevention programs (CDC, other sources). Active surveillance using traditional methods such as post cards, telephone lines, faxed forms and even email are erratic because clinicians may forget to report a case when they see one, or assume someone else is doing it. This can be true whether the condition involves an infectious disease like tuberculosis or a high impact injury, such as a gunshot wound (Kellermann et al., 2001).

Electronic monitoring of key triage complaints and/or discharge diagnoses would greatly facilitate ED compliance with this traditional public health obligation.

A relatively recent development in population health monitoring is the notion of "syndromic surveillance" (Mandl et al., 2004). This refers to methods relying on detection of individual and population health indicators that are discernible before confirmed diagnoses are made. Before there is laboratory confirmation of an infectious disease, ill persons may behave according to identifiable patterns, or have symptoms, signs, or laboratory findings that can be tracked through mining of data sources including emergency department chief complaints (Fleischauer et al., 2004), ICD9 codes (Espino and Wagner, 2001), laboratory data, and pharmaceutical data (Tsui et al., 2003).

The goal of outbreak detection is to generate an alert whenever observed data depart sufficiently from an expected baseline. To accomplish this, the system must be able to detect a signal (i.e., disease outbreak) against background noise (i.e., normally varying baseline disease in the region). There are number of syndromic surveillance systems currently being developed regionally as well as nationally. These include Automated Epidemiologic Geotemporal Integrated Surveillance System (AEGIS) in Massachusetts (Mandl et al., 2004; Children's Hospital Informatics Program, 2005), the Real Time Outbreak Disease Surveillance System (RODS) in Pittsburgh (Tsui et al., 2003), the Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE) system in the National Capital Area (Lombardo et al., 2003), and the national BioSense system being developed by the Centers for Disease Control and Prevention (Loonsk and CDC, 2004).

As these systems become more advance, the need for standard protocols for alerting appropriate personnel of abnormal conditions becomes more pressing. One model may be found in the AEGIS system, which fully automates population health monitoring from end to end, interfaces with a state-wide health alert network. This network is a comprehensive communication and alert messaging switch that provides message content and routing, and is an example of a communications technology that helps to unite clinical and public health entities.

CLINICAL TECHNOLOGY

New clinical technologies can be expected to alter the way care is delivered in the ED, but in ways that are difficult to predict. In general, however, we can expect a wide range of technologies that provide faster and more mobile diagnostic capabilities. We can expect such technologies to gradually push out from the hospital to the prehospital environment. For example, strategically locating advanced imaging equipment in the ED will shorten patient wait times and improve throughput by accelerating diagnosis. Among the technologies that are positioned to do just that are digital radiography (DR) systems, 16-slice or higher CT scanners and high-field MR systems, and handheld ultrasound systems. As with all medical technologies, well designed, controlled studies should be used to assess their efficacy and cost-effectiveness in general and in ED applications.

Digital Radiography and Picture Archiving and Communications Systems (PACS)

In recent years, many hospitals have migrated from film- to digital- capture and display of x-rays, MRI, CT, angiography and ultrasound images. These images are then stored in what is known as picture archiving and communications systems (PACS). Both digital radiography and the use of PACS have been shown to provide interpretations that are as reliable as traditional

film-based methods (Kundel et al., 2001). With respect to emergency care, there are a number of benefits associated with digital radiography and PACS. For example, digital radiography technologies have been shown to reduce the time needed to capture images (Redfern et al., 2002). PACS offer instantaneous sharing of images with multiple clinicians, reduces the threat of films are being irrevocably lost or misplaced, and eliminates all delays associated with retrieving films from archives and record rooms. And, both technologies facilitate remote interpretation of films, a service especially important in rural or community emergency department settings, which may not have access to 24-hour radiologist coverage.

Multislice CT Scanners and High-Field MR Systems

The improved temporal resolution and ever increasing thin-slice imaging ability of these systems will have a significant impact on ED imaging. The 16-slice CT performance is the proven standard for general whole-body clinical utility in the ED. However, 64-slice scanners offer a full complement of applications for both radiology and cardiology. In between, there are the 32- and 40-slice systems that are less costly than 64-slice systems and are upgradeable.

Manufacturers are redefining "open" MR by improving their performance with stronger magnets or redefining the term to include wider-bore, short-cylinder systems with traditional high-field image quality. For some of these systems, such as the Siemens Magnetom Espree, in many instances the patient's head remains outside the gantry. The combination of a patient table with lateral movements and wide offset capability make it well suited for orthopedic studies.

Although the 1.5-Tesla MR imaging systems continue to offer the broadest range of applications and clinical utility, the newer very-high-field (3.0T) MR systems offer improved performance, particularly for neurologic, orthopedic, and spinal studies. Body imaging techniques continue to improve with new surface coils and software to reduce motion artifacts. The 3.0T MR imaging systems show promise for cardiac imaging with cardiac sequences that are near real-time and do not require patient breath-holding. Adoption of very-high-field MR is currently limited but will expand as more sequence development work is done using these systems.

A promising new imaging system developed in South Africa is currently being evaluated at a handful of medical centers around the country. It allows the trauma team to obtain a quick, low dose, "total body X-ray" to evaluate the entire patient in under 30 seconds.

CT Angiography

Over the next decade, cardiac CT angiography (CTA) will become part of routine clinical use in the ED where its high negative predictive value for coronary artery disease will provide efficient triage of patients with chest pain. In cases where the diagnosis of chest pain is not clear after more basic tests have been completed, CTA offers a rapid evaluation of three possible causes of chest pain—abdominal aortic aneurysm, pulmonary embolism and coronary artery obstruction. Although a 16-slice scanner is the minimum performance level for cardiac imaging, the newer 64-slice scanners have better image quality, particularly for very small vessels. Scanners with dedicated cardiac application packages provide CTA for the heart, great vessels and peripherals, as well as calcium scoring and other functional cardiology tools.

Portable Ultrasound

Ultrasound systems have become increasingly compact and mobile. The size of a laptop computer, these portable units come equipped with linear probes for vascular and small-parts imaging for use in echocardiography. These ultrasound systems will become a mainstay in the ED as they allow for the emergency physician to perform focused echocardiography and vascular studies, resulting in earlier diagnosis and treatment. Several manufacturers offer portable systems that can be used at the bedside. An example is Zonare's US system, which features the ability to remove the handheld data processing unit and probe from the cart, complete an exam, then return it to the cart to review. ED ultrasound is for focused identification of time critical events, such as FAST (Focused Abdominal Sonography for Trauma) scans, or RUQ ultrasounds to look for gallstones, or a scan to identify the internal jugular vein for placement of a central line. They are not intended to replace the precision of comprehensive ultrasound exams by radiologists at a later time. If you don't add this qualifier, the radiologists will howl.

Rapid Diagnostics

Current methods for rapid disease diagnosis in the ED are limited. As an example, 90% of aseptic meningitis cases are caused by enteroviruses that result in benign disease. Only 10% of patients need to be admitted and given intravenous (IV) antibiotics, but many are unnecessarily hospitalized because of the difficulty in distinguishing aseptic meningitis from more severe bacterial meningitis. Currently, when a patient suspected of having meningitis presents to the ED, he or she would be admitted and prescribed prophylactic antibiotics while awaiting results from the laboratory culture, a process that takes 3 to 10 days.

Given that infections of various types and fevers of unknown origin are among the top 20 diagnoses sending patients to the ED, technologies that can speed diagnosis will have an important benefit in improving ED workflow.

By contrast, the use of real-time polymerase chain reaction (PCR) tests designed to identify enterovirus infection can diagnose EV-positive patients within 5 hours. The patient remains in the ED and is admitted only after the results identify the cause as bacterial or of unknown origin.

Rapid diagnostic tests are available for an increasing number of conditions seen in the emergency setting, including *Streptococcus pneumoniae* infection, meningitis, bloody diarrhea, and septicemia. Emerging real-time PCR tests will replace lab evaluations for occult bacteremia and with their rapid, accurate test results, may sharply decrease the use of antibiotics. Early targeted disease detection not only expedites diagnosis and improves accuracy of clinical decision making; it will also speed recovery by identifying causative organisms and allowing for optimal antibiotic selection.

At least initially, most molecular tests that will impact the ED will be offered through centralized molecular diagnostics labs. However, as the technology advances over the next 2 to 5 years, real-time PCR will allow decentralization into rapid-response labs with even faster test turnaround times.

An added benefit is that rapid diagnostics can also be used to determine if a patient is a carrier of a disease that could potentially harm other patients and health care workers. For example, rapid bedside testing could also help EDs identify hard to reach patients who are at risk for HIV infection and refer them for treatment. A substantial subgroup of patients come to the ED for care, but are unlikely to ever seek HIV testing at a health department. Provision of rapid

bedside screening with an oral swab rather than a blood draw might allow ED personnel to detect HIV infected patients, advise them to modify high risk activity, and refer them for treatment. Evaluations are needed to validate the social and clinical feasibility of this strategy. Recent advancements to real-time PCR improve its speed. The traditional PCR requires three steps, the real-time PCR requires two steps, and the next generation of real-time PCRs will require one step. That translates into samples that can be extracted, amplified and detected in less than 25 minutes, significantly reducing patient wait time and expediting diagnosis.

Laboratory Automation

The automation of lab services will have a significant impact on care provided in the ED. As lab testing devices become smaller and easier to use, lab tests can be performed more frequently at the point of care (POC). Lab information systems (LISs) allow for the rapid transfer of lab results to the ED and, in some circumstances, can even provide real-time information, as in the case of PCR-based tests.

In the ED, POC testing will improve patient throughput. To reduce lengthy ED stays, Massachusetts General Hospital established a POC-satellite testing lab in the ED to perform urinalysis, glucose tests, rapid strep tests, pregnancy tests, cardiac markers and influenza tests. As a result, test turnaround times were reduced 87%, ED length of stay (LOS) declined 41 minutes per patient and ED diversions decreased. Also, emergency physicians' satisfaction with the lab's turnaround time increased 50% (Lee-Lewandrowski et al., 2003).

Lab automation can also eliminate ED bottlenecks by providing test results in a timely manner. Northwestern Memorial Hospital in Chicago improved its ED performance through the use of an automated centralized lab. Northwestern identified that 18% of the average 4.5-hour ED visit was attributed to waiting for lab results (Personal communication, K. Clarke, 2004). The hospital developed a system to better connect its lab services to the ED, using an early draw process to reduce wait times. Now, when a patient presents to the ED, the nurse screens the patient and, whenever possible, orders lab tests based on standing physician orders. After the nurse draws the blood, an ED lab tech orders the tests on the LIS and labels tubes with bar codes. The tubes are pneumatically transported to the automated lab. The results are back by the time the physician performs the initial patient exam. If additional tests are necessary, the results are available within 5 to 20 minutes. As a result of using automation in the centralized lab, patient throughput and room utilization increased 20%, patient wait times were reduced by 40% and Press-Ganey patient satisfaction survey scores jumped to the 80th percentile.

A number of hospital IT tools have been demonstrated to be effective in improving patient flow and efficiency, and to have a direct and substantial impact of emergency care crowding and quality. Given the sporadic adoption of these IT tools to date, the committee believes that hospitals should increase their efforts to enhance their IT capabilities that impact to emergency and trauma care. It therefore recommends that **hospitals adopt robust information and communications systems to improve the safety and quality of emergency care and enhance hospital efficiency**.

BARRIERS TO INFORMATION TECHNOLOGY ADOPTION

Given the array of IT tools available to improve patient flow and enhance the quality, safety and timeliness of emergency care, the argument for their widespread adoption seems clear. From prehospital care to ED and ancillary services to recovery and rehabilitation, IT has the potential to resolve many of the challenges currently facing the U.S. emergency care system. Despite this, however, health care IT has not been widely implemented in the ED or other health care settings and significant challenges to applying IT to health care remain. It would be difficult to exaggerate the daunting challenges that hospital face in implementing state of the art IT systems. The limitations on resources, including financial, physical, and intellectual, often stand in the way of even modest goals. The challenges of winning the acceptance of older physicians and dealing with the existence of (often inadequate) hardware and software already in place compound the problems. The investment needed to achieve the goals described here is substantial, and must be addressed through public policy if it is to move forward rapidly. Five specific barriers to the adoption of health care IT in the ED include:

Financial Requirements

For most health care facilities, the lack of financial support continues to be the most significant barrier to IT implementation (Healthcare Information and Management Systems Society, 2005). Not only is capital needed to purchase and install new technology, a process that is often associated with sizeable short-term transition costs, specialized training and education costs also must be incurred to help physicians and other staff adapt to the new "high-tech" environment. Adding to these challenges is the fact that access to capital may be particularly limited for certain types of health care organizations, including the non-profit hospitals which provide much of nation's safety-net emergency care. Further, while large for-profit hospitals and health plan may have ready capital to invest, they may lack the leverage and incentives needed to implement various IT tools (IOM, 2001).

While there are few published estimates of the costs of widespread implementation of health care IT, there are a number of estimates regarding specific IT applications. Among these, the RAND Corporation recently projected that the cumulative cost for 90 percent of hospitals to adopt EHR systems would be $98 billion, assuming 20 percent of these hospitals currently have EHR systems in place. Average yearly costs for hospitals across a 15 year adoption period would be $6.5 billion. For physicians, the cumulative costs for 90 percent adoption would be $172 billion, with average year costs of approximately $1.1 billion (Hillestad et al., 2005).

Efforts to quantify the return-on-investment of these costs suggest that short- and long-term returns far exceed initial outlays. At 90 percent adoption of EHRs, for example, the RAND study projects average annual savings of more than $77 billion, with $42 billion saved each year on average during the15 year adoption period. Related improvements in prevention and chronic disease management could result in an additional $147 billion of saving annually, while transaction improvements could yield up to $10 billion of savings per year (Hillestad et al., 2005). Estimated net potential savings associated with electronic medical records are shown in Figure 5-1.

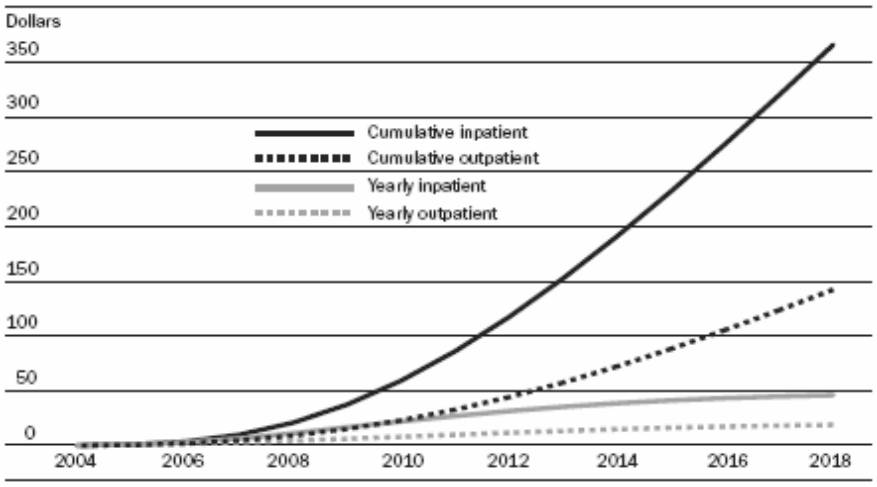

FIGURE 5-1 Net potential savings (efficiency benefits over adoption costs) for hospital and physician electronic medical record (EMR) systems adoption during a fifteen-year adoption period (2004–20018). SOURCE: Hillestad et al., 2005. HEALTH AFFAIRS BY/INGLEHART, JOHN K. Copyright 2005 by PROJECT HOPE. Reproduced with permission of PROJECT HOPE in the format Other Book via Copyright Clearance Center.

Beyond EHRs, Kaiser Permanente of Northern California estimates that it will break even on its systems-wide $1.2 billion IT investment in 6.5 years, with a 200 percent benefit payment on investment to be achieved in 10 years (Detmer, 2000). Similarly, with IT-related improved quality and efficiency and reductions in medical errors, it is estimated that Medicare could save up to 30 percent of its annual spending (The Lewin Group, 2005).

All totaled, and at a national level, the federal government estimates that the nation would save $140 billion annually, or 20 percent of costs, from improved IT use in health care (U.S. DHHS ONCHIT, 2005). Improved interoperability and shared diffusion is likely to result in even more substantial savings.

Investment in New Clinical Technologies

Clinical technologies are somewhat different in that their adoption is linked more directly to reimbursement than to cost-savings as in the case of other information technologies. There is a robust market for the development of new medical technologies. These and other changes will occur whether or not there is an active policy towards their development and utilization, or government support for their diffusion.

Interoperability Standards

A key factor inhibiting the rate of adoption of a new technology is the development, or lack thereof, of shared health care IT standards (Goldsmith et al., 2003). Data communication standards are sets of rules that allow disparate computer systems to exchange information without requiring custom programming for each new connection. Without such standards in place, there a number of factors that discourage the effective integration of multiple data sources into one useful whole. For example, data may be sorted in isolated locations; it may be collected and stored using different internal systems, structures or coding; and it may be generated in ways that do not match the expectations of clinical providers, researchers, or health care managers

(McDonald et al., 2001). Widespread adoption of shared standards is needed to overcome the factors, and permit the creation of clinical data-sharing networks that build bridges between the various "islands" of information.

> We have people showing up at emergency rooms all the time and their data is not there. We've never stopped to ask, What are the standards that we need to get someone's data to the emergency room.
>
> —David Brailer, National Health Information Technology Coordinator (Cunningham, 2005)

The health care industry is just starting to realize the improvements in efficiency, safety and quality that shared data systems can provide. Providers participating in the Massachusetts Healthcare Data Consortium, for example, have access to pharmacy prescription databases for treatment purposes. Such information is critical in emergency care as many patients arriving in the ED are unable to tell staff exactly which medicines they take, whether due to alterations in mental status, forgetfulness, or the sheer number of different pills. Data communization standards also facilitate the sharing of clinical information, such as past medical histories, allergies, and electrocardiograms. With standards in place, data sharing has already been proven effective within and among various health care system (Halamka et al., 1997; Overhage et al., 2002).

In an article in the New England Journal of Medicine, Senate Majority Leader William H. Frist (R-TN) recently described his vision for how using interoperability standards to share clinical data could be used to save the life of a patient having a heart attack (Frist, 2005). Senator Frist, along with Senator Hillary Rodham Clinton (D-NY) and Representatives Nancy L. Johnson (R-CT) and Patrick J. Kennedy (D-RI), is currently leading congressional efforts to urge the development and implementation of health care IT interoperability standards. At the same time, President George W. Bush has called for federal action, establishing the Office of the National Coordinator for Health Information Technology (ONC) in order to provide "leadership for the development and nationwide implementation of an interoperable health information technology infrastructure to improve the quality and efficiency of health care and the ability of consumers to manage their care and safety" (Department of Health and Human Services Office of the Secretary, 2005). ONC has recently established the Healthcare Information Technology Standards Panel (HITSP) to harmonize healthcare data standards for the country.

Limited IT Knowledge

With new technology comes the need for new expertise. Just as the purchase of health care IT tools requires significant investment of financial capital, human capital (e.g., professional time and knowledge) is needed if the tools are to be successfully implemented and maintained. While many larger hospitals and health care systems may have dedicated IT staff able to oversee the adoption of new technologies, smaller organizations often lack such resources. Moreover, while IT staff is an essential part of the equation, failed attempts to launch new IT tools suggest that clinical staff must also be comfortable and conversation with the technology if its potential is to be realized.

Resource sharing, such as that offered by Beth Israel Deaconess Medical Center and the Veterans Health Administration, is one way to help ensure that all health care settings have access to the knowledge and expertise need to adopt proven IT solutions. The VA's VistA

program is described in Box 5-2. Comprehensive IT training modules, such as those supported by the Agency for Healthcare Research and Quality, is another.

BOX 5-2 Veterans Health Information Systems and Technology Architecture (VistA)

The Veterans Health Administration (VHA) is the nation's largest integrated health care system. With a staff of nearly 200,000, VHA provides care to more than 5.1 million veterans and other enrollees annually. It operates over 1,300 facilities nationwide, including 157 medical centers, with one in every state, Puerto Rico and Washington DC. It also oversees the nation's largest medical education and health professions training program, turning out approximately 83,000 health professionals each year.

A critical component of VHA operations is the Veterans Health Information Systems and Technology Architecture (VistA). Key aspects of VistA include the Computerized Patient Record System (CPRS), which offers providers a single interface through which they can review and update patients' medical records, as well as place orders for medications, laboratory tests and other services. In its next generation system, "HealtheVet", VistA also implements standard functions for health data repository systems, registration systems, provider systems, management and financial systems, and information and educational systems.

VHA has shared both its health information and health IT resources—including software and staff expertise—with other federal agencies through the Health Information Technology Sharing (HITS) Program since the late 1990s. The HITS Program was expanded to include some non-governmental and international organizations in 2001. And, through the recent HealthyPeople Initiative, VistA software and expertise is now available at minimal or no cost to public- and private-sector organizations that serve the poor and near-poor.

SOURCE: Department of Veterans Affairs, 2005.

Human Factors

Some of the most challenging barriers to the adoption of IT in health care are human factors barriers. Currently, there are over 780,000 physicians and more than 2.2 million nurses, as well as many other health care providers, involved in the delivery of patient care in the U.S. (HRSA, 2003). These individuals possess highly varied levels of IT-related knowledge and experience. Further, clinicians tend to be conservative and reluctant to adopt new automated workflows, especially if previous attempts at IT solutions failed to prove useful in solving diagnostic, therapeutic, or workflow problems (Kassirer, 2000; IOM, 2001).

An important potential hurdle for institutions planning major IT enhancements is the 6-12 month learning curve faced by physicians. Implementation of such systems must be carefully executed and supported, and products must be tailored to each institution through use and modification over time. No system is fully applicable directly off the shelf. Unless the system brings demonstrable value to the users, the potential for physician dissatisfaction and indirect patient dissatisfaction is substantial.

Human factors research deals with human-computer interaction and has developed methods to test and improve the usability of software. Used by the aviation industry for more than a decade, human factors research is largely credited with minimizing pilot error and improving the safety of air travel (Vincente, 2004). Many of the actual and perceived problems with health care IT in the ED could be overcome by employing human factors techniques (Helmreich, 2000; Wears and Perry, 2002).

For example, the "usability" of software is based on its perceived usefulness as well as its perceived ease of use. A useful program enhances the performance of the user. It makes him or

her more efficient, or improves the quality of his or her work. A program's ease of use is judged by the amount of effort that is required to accomplish tasks. Some studied barriers to program use include: accessibility (are there enough computers for all users), availability (does the system crash when people wish to use it), start-stop hassle (does it take too long to begin/resume a task or save work to be continued later), system dynamics (is the response time too slow), training barriers (does it take too many hours to learn to use the program effectively), and lack of consistency (do various components of a system work together in the same way).

Several examples can be found to demonstrate the inefficiencies and reductions in patient safety that accompany poor implementation of health care IT (Ash et al., 2004). Among these, Cedars-Sinai Medical Center uninstalled its CPOE after less than six months following significant resistance by doctors and nurses who claimed the system was difficult to use. Such resistance may be less pronounced among emergency clinicians as IT adoption typically occurs faster in ED than other settings (Healthcare Information and Management Systems Society, 2005).

While the barriers to IT adoption are significant, research demonstrates that they are hardly insurmountable. In fact, as was so clearly stated in *Crossing the Quality Chasm: A New Health System for the 21st Century*, "solutions to these barriers can and must be found given the critical importance of the judicious application of IT to addressing the nation's health care quality concerns" (IOM, 2001). An essential step to realizing the potential of health care IT to improve patient flow and enhance the quality, safety and timeliness of patient care is the creation of a National Health Information Infrastructure. Additional discussion about this infrastructure is provided below.

Confidentiality

One of the biggest challenges in the development of electronic systems for tracking patients, documenting care, and communicating among clinicians is protecting the confidentiality of patient information. As quickly as systems become develop protections against security breaches, new methods of attack are devised. While there are technical solutions, there must also be tradeoffs made between the capabilities of systems and the requirements for confidentiality.

PRIORITIZING INVESTMENT IN EMERGENCY CARE INFORMATION TECHNOLOGY

The specific costs and benefits of many of these approaches to individual hospitals are largely unknown, and they can be expected to vary according to the individual circumstances and technology infrastructure and "readiness" of each institution. For example, adopting advanced systems in a hospital that has a limited existing IT platform would probably not be cost effective; in a hospital with a sophisticated platform, it could be highly cost effective as the marginal costs associated with its addition would be very small. Consequently, it would be difficult to prioritize the many techniques in a way that could be generalized to all hospitals. However, the committee identified five key areas that would have a substantial impact on emergency care, and that are feasible to adopt within 3 to five years for many institutions.

- Approaches that facilitate patient flow management. Electronic dashboards and tracking systems

- Approaches that improve the continuity of care across the continuum, in particular EMS-hospital systems linkages, and RHIOs that enhance the information available to clinicians across settings
- Decision support tools that facilitate optimal use of resources, such as automated triage.
- Systems that reduce the likelihood of errors in the ED and, such as CPOE
- Systems that facilitate public health surveillance

Some specific strategies for cost-effective adoption of technologies are described in Box 5-3. The committee also believes that the ED should be a priority site for early development of enterprise-wide IT systems. For example, the development of EHR is important throughout the hospital and across the health care delivery system. The ED needs it more than anywhere else, and it has advantages, with 43 percent of inpatients admitted to the hospital through the ED (Merrill and Elixhauser, 2005).

BOX 5-3 Roadmap for Health IT Implementation

In an ideal world, where all hospitals and health care systems were equally flush with capital and similarly motivated to invest in new health care information technology, the IT tools known to improve the quality, safety and timeliness of emergency care would be immediately adopted and embraced by staff and patients alike. In the real world, however, financial and other limitations temper the pace at which IT improvements can be implemented. This is particularly true among the nation's small, rural, and "safety-net" hospitals, which typically have less revenue and more limited IT systems at their disposal.

Given these real world constraints, it is important that IT investments in the ED be made strategically, with close attention paid to such issues as total costs, staff education and training requirements, and the time needed to complete workplace transitions. To this end, automated discharge systems represent a relatively inexpensive, easy-to-use program that many hospitals could turn to as a first step in modernizing their care delivery. While significantly more expensive that automated discharge systems, electronic dashboards – because they have the potential to improve so many aspects of patient care management – are seen as having the "biggest bang for the buck." Dashboards also can serve as a launching pad for future IT investments, such as clinical decision support systems (CDSSs) and computerized provider order entry (CPOE).

Clinical documentation programs are the next logical choice for many hospitals and health care systems seeking to improve patient flow and enhance quality and safety. Wireless registration, radio frequency identification (RFID) tracking, digital hands-free voiceover IP (VoIP) communications can facilitate more seamless care with fewer interruptions and more time for direct patient care. These programs also can capitalize on existing hospital wireless networks or dashboard programs, further reducing costs and encouraging coordination.

Finally, hospitals may look to computerized provider order entry (CPOE) systems to reduce errors, improve safety and save time in the ED. Efforts should be made to ensure that applied CPOE systems are customized for use in the ED, a task that will require additional outlays. Further, the impact of such systems on the quality, timeliness and safety of emergency care should be carefully monitored.

Several organizations are moving to make their IT tools more widely available through resource sharing and discounted pricing. For example, the Veteran Health Administration routinely shares its health information and health IT resources - including software and staff expertise - through the Health Information Technology Sharing (HITS) Program at no or minimal costs. Further, through its Center for Healthcare Information Technology, the American Academy of Family Physicians is making low-cost, standards-based IT more available to family physicians nationwide. In many rural hospitals, it is family physicians that comprise the bulk of ED staff.

RECOMMENDATION

5.1: Hospitals should adopt robust information and communications systems to improve the safety and quality of emergency care and enhance hospital efficiency.

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6
The Emergency Care Workforce

Emergency care is delivered in an inherently challenging environment, often requiring providers to make quick life and death decisions based on minimal information. Many who go into emergency care profession enjoy the challenging work and the high-pressure environment, and take satisfaction in providing care to patients in urgent need. But providers on the front lines of emergency care increasingly express frustration with the deteriorating state of emergency care and the health care safety net. They experience the imbalance between demand and capacity described in earlier chapters on a daily basis, and find themselves spending an increasing proportion of their time in tasks such as getting patients admitted to crowded inpatient units; finding specialists willing to come in during the middle of the night; and finding psychiatric centers, skilled nursing facilities, or specialists who are willing to accept referrals. They also face a rigid regulatory environment that can make it difficult to address patients' needs in the most efficient, effective, and patient-centered manner.

This chapter describes the professionals working in the ED, and discusses the unique challenges hospital face in staffing EDs. There is a wide range of professionals who deliver care in the ED, including physicians from multiple specialties, nurses, physician assistants, EMTs, social workers, pharmacists and technicians. In this introductory section, we present an overview of the roles and responsibilities, training, and demographic characteristics of these workers. The rest of the chapter addresses the committee's concerns with regard to the size, competency, effectiveness, and safety of the ED workforce.

PHYSICIANS

Several different types of physicians who work in the ED extensively. With the exception of many rural hospitals, most hospitals have full time coverage by emergency physicians, the training and background of those physicians can vary considerably. Larger hospitals, particularly those designated as trauma centers, have a host of other types of physicians on staff who can respond in the event that a patient needs specialized medical care beyond the care that emergency physicians are trained to provide.

Emergency Physicians

Emergency physicians evaluate the presenting problems of patients, make diagnoses, and initiate treatment. They must be prepared for a wide variety of medical emergencies, and for this reason must be well-versed in the emergency care aspects of such diverse subjects as anesthesia, cardiology, critical care, environmental illness, neurosciences, obstetrics/gynecology, ophthalmology, pediatrics, psychiatry, resuscitation, toxicology, trauma, disaster management, and wound management. In addition, because they often represent the only source of primary care to patients whose only access to care is through EDs, they must be expert at delivering care for minor illnesses and injuries, providing care for chronic conditions, delivering primary and preventive care. Emergency physicians also perform specialized duties beyond their scheduled clinical time. A survey by Moorhead et al. found that physicians spend several hours per week

performing unscheduled clinical duties, administrative work such as ED quality improvement, medical direction of EMS, supervision of mid-level providers such as physician assistants (PAs) and nurse practitioners (NPs), teaching, and/or research. Many emergency department physicians also must serve on-call for the ED (Moorhead et al., 2002).

Emergency physician staffing models are quite different than those seen in most other specialties. The Physician Socioeconomic Statistics survey (AMA, 2003) reports that 32 percent of emergency medicine physicians are self-employed; 19.8 percent are independent contractors; and 48.2 percent are employees. Of the employees, 29.6 percent are employed by free-standing centers or group practices, while 66.8 percent by hospitals, medical schools or state and local governments. These figures suggest that approximately 14 percent (29.6 percent of 48.2 percent) of emergency physicians are employed by contract management groups (CMGs), although there is conflicting data on this. One survey of board-certified emergency physicians estimated only 18 percent to be part of a multihospital contract company (Plantz et al., 1998). However, this study did not survey physicians who staffed the ED but were not board certified, and was limited by its relatively small size (465 responses out of 1,050 surveyed). The American Academy of Emergency Medicine estimates that approximately half of all EDs are staffed by large, national CMGs with majority ownership by non-physicians (Scaletta, 2003). Many of these are small, rural EDs that are unable to attract board certified emergency physicians. Penetration of CMGs is generally lower among large and urban hospitals.

A specialty in emergency medicine exists for physicians wishing to practice in the ED. Emergency medicine residency training involves 3–4 years of specialized training after medical school. (See Box 6-1.) Approximately 62 percent of physicians who identify their primary site of practice as a hospital emergency department are board certified in emergency medicine. Academic medical centers and large private hospitals in urban areas are much more likely to have residency trained and board certified emergency medicine physicians than other types of hospitals (Moorhead et al., 2002).

BOX 6-1 The Specialty of Emergency Medicine

The specialty of emergency medicine began to organize in the mid-1960s in response to the growing demand by hospitals for full time emergency room physicians. The American College of Emergency Physicians (ACEP) which was founded in 1968 (Danzl and Munger, 2000). In 1970, leaders in emergency medicine established an educational curriculum for residency training, and the first emergency medicine residency program began at the University of Cincinnati. By 1975 there were 23 approved residency programs in the US. In 1976, a Section on Emergency Medicine formed at the American Medical Association, and pressure grew for the American Board of Medical Specialties (ABMS) to recognize the specialty. In 1976, the American Board on Emergency Medicine (AB) was established, but the ABMS didn't formally recognize it. The development of the specialty was initially resisted by physicians who believed that training in another discipline, such as internal medicine or family practice, was sufficient to practice emergency medicine (Rosen, 1995). Second, emergency medicine represented competition to "adjacent" specialties such as trauma surgery, cardiology, and primary care. After three years of negotiations, however, the ABEM was accepted as a modified-conjoint board, making emergency medicine the 23rd medical specialty (Rosen, 1995). The ABMS finally granted primary board status to the ABEM in 1989.

In 1980, 600 emergency physicians sat for the first certification exam. Emergency Medicine developed a critical mass of specialists by allowing experienced practitioners to sit for the certifying exam until 1988, when the "practice track" to board certification was phased out (Marx, 2005). Approximately 20 percent of emergency physicians are board certified as emergency medicine physicians but not residency trained in emergency medicine (Moorhead et al., 2002). Since this "grandfather" track is no longer open, the number of physicians certified through this pathway will progressively decrease over time and eventually disappear. Board certification has also been granted by the American Osteopathic Board of Emergency Medicine (AOBEM) since 1980, and now includes additional certifications in toxicology and sports medicine. In addition to the ACEP, another small, but growing, emergency medicine specialty practice group is the American Academy of Emergency Medicine (AAEM). The AAEM was formed in 1993 as an organization limited to those emergency physicians with ABEM/ABOEM certification or eligibility for such certification. The AAEM has a particular focus on issues related to fair business practices (e.g., open books, physician practice ownership, contract negotiations) with respect to contract management companies.

Residency training requirements were established by the Accreditation Council for Graduate Medical Education, and since then, residencies have been growing at a fast rate—from 1 residency in 1970 to 43 in 1980, 81 in 1990, and 132 in 2005. Today there are 3909 new emergency medicine physicians being trained in accredited residency programs (ACEP Research Committee, 2005). In 2003, board certified emergency physicians and pediatric emergency physicians were available at 63.5 percent and 18.1 percent of EDs, respectively in 2003 (McCaig and Burt, 2005). Emergency medicine has demonstrated a regular increase in the percentage of U.S. medical students entering the specialty, growing from 2 percent in 1987 to 4 percent in 2002). There are now three subspecialties within emergency medicine: pediatric emergency medicine, medical toxicology, and sports medicine, and undersea and hyperbaric medicine. There are also a number of non-accredited fellowships that are not funded by Medicare GME dollars that emergency medicine physicians may pursue. These include disaster medicine, medical direction of emergency medical services, ultrasound, health services research, and international emergency medicine.

A small group of emergency physicians hold Board Certification in Emergency Medicine (BCEM) from the American Board of Physician Specialties. This certification, which requires completion of a residency in some field plus 5 years of clinical practice in emergency medicine, is only recognized in Florida (ABPS, 2005).

While residency programs have grown at a rapid pace, academic departments in emergency medicine have progressed more gradually. Society of Academic Emergency Medicine (SAEM) formed in 1989, through the merger of the University Association for Emergency Medicine (UAEM) and the Society of Teachers of Emergency Medicine (STEM), to promote research and foster the development of academic emergency medicine. Today there are 64 autonomous departments of emergency medicine at U.S. medical schools and 135 emergency medicine residency programs.

Physicians Not Board Certified in Emergency Medicine

Approximately 38 percent of practicing emergency department physicians are neither board certified nor residency-trained in emergency medicine. EDs in suburban and rural locations are more likely to be staffed by emergency physicians that are not residency trained or board certified in emergency medicine than academic medical centers and large urban hospitals (Moorhead et al., 2002). The majority (84 percent) of these physicians have completed a residency in another specialty, most commonly family practice or internal medicine (Moorhead et al., 2002).

The supply of board certified emergency physicians is not sufficient to staff all emergency department physician positions, and in the absence of a large scale expansion of training positions, will not be sufficient for several decades (Holliman et al., 1997). As such, physicians from other disciplines (internal medicine, family practice, pediatrics, etc.) are currently filling positions in EDs. Although they lack board certification, these physicians represent an essential component of ED workforce at many hospitals, especially smaller facilities in suburban and rural settings. Many acquire a high level of competency in emergency care through a combination of post-residency education, directed skills training and on-the-job experience.

Demographics

It is difficult to determine precisely how many ED physicians practice in the U.S. A 2002 study of the emergency physician workforce in 1999 estimates that there were approximately 32,000 physicians working in EDs in 1999, which includes both board certified emergency medicine physicians and non-board certified emergency medicine physicians (Moorhead et al., 2002). But in a 2004 AMA physician survey, 25,500 physicians self-identified themselves as having an emergency medicine specialty (AMA, 2004); this number likely includes some physicians not board-certified in emergency medicine, but practicing in an ED on a full time basis.

The AMA survey also provides some basic demographic information on those physicians. The composition of practicing self-identified emergency medicine physicians is less diverse than the general physician population overall. Eighty-three percent of self-identified emergency physicians are non-Hispanic white compared to 75 percent of physicians overall. The primary difference, however, seems to be in the lower number of Asians in emergency medicine. While 13 percent of all physicians in 2002 were Asian, only 7 percent of emergency medicine physicians were Asian. Additionally, only 20 percent of emergency medicine physicians are women compared to 25 percent of all physicians. Emergency medicine physicians also tend to be younger than other physicians. Nearly one-quarter were under the age of 35 in 2002, and fully half were under the age of 45. In the overall physician population, 59 percent of physicians were age 45 and older (AMA, 2004).

The number of self-identified emergency physicians in the U.S. has increased substantially since 1979, when emergency medicine was first recognized as a specialty (Figure 6-1). Growth in emergency medicine has been much stronger than growth in medicine overall. Since 1990, the number of self-identified emergency physicians in the U.S. increased from 14,000 to more than 25,500, an increase of 79 percent compared to 39 percent growth in the number of all physicians. One of the key reasons for the rapid growth in emergency medicine residency programs is that academic medical centers find these programs quite useful to staff their own EDs. The “fill rate” of emergency medicine residency positions is quite high, reflecting the fact that emergency medicine is a popular career choice for U.S. medical students.

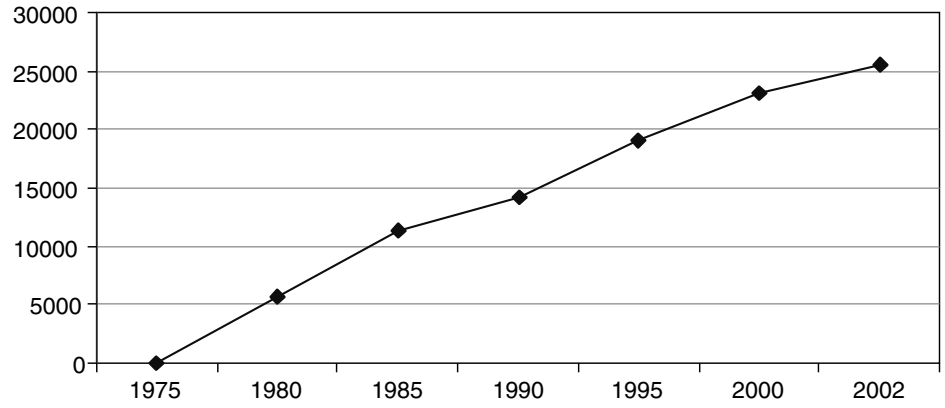

FIGURE 6-1 Number of nonfederal emergency medicine physicians, U.S., 1975 to 2002.
SOURCE: AMA, 2004.

Physician Payment

ED physicians are often not hospital employees and are reimbursed separately from the hospital. Medicare physician payment is based on a resource based relative value scale (RBRVS). The provider reports to the payor the service's CPT E/M code, which describes the intensity of the physician service given. Over eighty percent of ED care falls under the five emergency care CPT evaluation/management codes (ACEP, 2004). This code is converted by the CMS into relative value units (RVUs) and modified by area factors. There are three RVU categories: physician work, practice expense, and professional liability. Each of these RVUs is multiplied by a corresponding geographical practice cost index (GPCI). Medicare then pays the physician 80 percent of the charge, and the patient is responsible for the other 20 percent. An anomaly of reimbursement for emergency physicians is that they are sometimes not credited for some of the tasks they perform—in many cases, the emergency physician is the first to read a patient's EKG or x-ray and use it to make the relevant clinical decisions. Hospital radiologists and cardiologists sometimes read these results and dictate interpretations hours or even days after treatment has been rendered, and bill for the service. CMS will only reimburse one physician for each interpretation, payment often goes to whomever rereads the study at a later time, rather than the emergency physician who applies their own interpretation to real-time patient care decisions.

Medicaid programs use similar systems that have different rates and details (Kaiser Commission on Medicaid and the Uninsured, 2003). In fact, over 70 percent of all ED physician payments, for both public and private care, are derived from a RBRVS (ACEP, 2004).

Uncompensated Care

The American College of Emergency Physicians has been active in an effort to increase the practice expense RVU, including efforts to count uncompensated care mandated by the1986 Emergency Medical Treatment and Labor Act (EMTALA) toward the practice expense RVU. A survey by the American Medical Association of Physicians in 2000 estimated that emergency physicians incurred an annual average of $138,000 in bad debt by providing care mandated by EMTALA (Kane, 2003). Actual foregone income is probably substantially less than this on

average, since the $138,000 is based on charges, and not actual payments. Nonetheless, a reimbursement rate of 50 percent suggests significant foregone income that has not been corrected through changes in the CMS practice expense RVU. It should be noted that other specialties that perform emergency care also deliver substantial amounts of uncompensated care and face similar economic problems. Reimbursement of on-call physicians is discussed later in the chapter.

Contract Management Groups

Contract Management Groups (CMGs) provide hospitals with ED physicians who work on a contract basis, allowing hospitals to staff their EDs around the clock, and often include contract management services including coding and billing services (McNamara, 2006). About 16 percent of emergency physicians are employed by a CMG company. However, if independent contractors are included, the number rises to close to 40 percent of emergency physicians (AMA, 2004).

Contracting with a physician management group is an attractive option for some rural hospitals because it guarantees full-time physician coverage of the ED (Williams et al., 2001). The availability of an ED staff also helps attract physicians from other specialties, who are relieved of the need to staff the ED on a rotating basis. CMGs may be attractive option for physicians as well. They handle many of the business details of practice, such as billing, an provide health and other benefits.

These advantages may come at a price. In some areas of the country, CMG companies represent such a large share of the emergency physician practices that it may be difficult for a physician to practice emergency medicine unless employed by a CMG, may require physicians to sign non-compete agreements.

Moonlighting

The pressing need for ED physicians leads hospitals to frequently augment their staffs with emergency medicine residents, known as “moonlighters,” often to cover evening and weekend shifts. These are typically emergency medicine residents, but may also include non-emergency physicians and residents training in other specialties. These physicians typically have no specific training or qualifications in emergency medicine (Kellermann, 1995). More than half of all emergency residents reported moonlighting in a recent survey, though not all in emergency departments (Li et al., 2000), for a variety of reasons, including supplementing their income and enhancing their educational experience. The practice is discouraged by the emergency medicine specialty organizations because it may place both the resident and the patient at risk, especially when there is no experienced backup in the ED (Keim and Chisholm, 2000). In addition to moonlighters, some physicians working in EDs are provided by “locum tenens” firms that supply physicians to hospital EDs to fill staffing gaps on an as needed basis.

Trauma Surgeons

The other specialty of particular relevance to emergency care is the surgical subspecialty of trauma/critical care surgery. Trauma is defined as any bodily injury severe enough to pose a threat to life and limb. It requires an organized emergency response that guarantees immediate intervention including, if needed, the immediate commencement of surgery. Trauma is a major national health problem and remains the leading cause of death for all Americans under the age of 44. In addition it has huge economic tolls on our society as it accounts for the greatest loss of

productive life in our country. Trauma care requires a systemic approach that mandates coordination of all prehospital and hospital based services to optimize care and outcomes. Trauma often occurs during "off hours" and therefore trauma centers are busier during night time and weekends and holidays. This requires a 24 hour a day operational status that is costly in both facility and human resources.

Most severe trauma care is directed by trauma surgeons who are general surgeons with special commitment to the care, management and organization of trauma care within their hospital and region. The term trauma surgeon usually refers to person trained in general surgery who has an additional one to two years training in trauma surgery and critical care. These surgeons focus their practice and expertise on trauma surgery and care management, surgical critical care and recently all emergency general and vascular surgery. Trauma surgeons generally complete a minimum of 7 years of residency training—a complete 5 year general surgery residency, followed by a 2 years of fellowship training in Trauma Surgery and Surgical Critical Care. The American College of Surgeons estimates that there are about 3,000 trauma surgeons practicing in the United States today (Personal communication, C. Williams, February 17, 2006). Trauma surgeons tend to focus their practice in specially designated units known as trauma centers. Indeed, a key component of the trauma center designation process is documentation of continuous coverage by trauma surgeons. For level I designation, a trauma surgeon must be available 24 hours a day, 7 days a week. Most level I centers and some level II trauma centers have in house 24/7 trauma surgeons who are responsible for all aspects of care of the trauma patient. Trauma care is also provided by emergency physicians especially in some level II , III, and IV trauma centers. Subspecialists in anesthesia, emergency medicine, orthopedics, neurosurgery, radiology and, in some states, rehabilitation medicine are required for all level I and II trauma center accreditation.

In the last thirty years the development of trauma centers and trauma systems have been recognized as a key factor in improving outcomes from injuries, especially those involving vehicular crashes. In addition, trauma centers are a critical component of the safety net system, and play a critical role in preparing for potential disasters, including natural disaster, man-made, and terrorism. Trauma that is cared for at trauma centers and within an established system have the best outcomes with significantly lower mortality rates than non-trauma center hospitals (MacKenzie et al., 2006). The development of trauma systems and trauma surgery practice has been largely developed and codified through a series of reports by the American College of Surgeons and its Committee on Trauma, including most recently, the so called "Gold Book," *The Optimal Care of the Injured Patient* (Committee on Trauma, ACS, 1998).

Currently, hospitals face a decline in the numbers of trauma surgeons due to the large amounts of uncompensated care, high levels of medical malpractice risk, and the burden that trauma practice places on family life. A key factor is the low number of general surgeon trainees electing go into trauma surgery. Currently most of the fellowships in trauma and surgical critical care are not filled. A national shortage of these specialists will become critical as trauma surgeons now in their late 50s and 60s retire. Furthermore, the trauma capacity in certain cities and regions has declined as trauma centers have closed due to high costs and high levels of uncompensated care.

Specialists Who Provide On-Call Emergency and Trauma Care Services

Hospitals that offer specialist services, such as neurosurgery and vascular surgery, to inpatients must also have the same services available to patients who present at the ED (Glabman, 2005). ED physicians rely on and consult these specialists for a range of services—clinical consultation, surgical follow-up, inpatient care, and post-discharge care (Macasaet and Zun, 2005). The limited availability of certain specialists, however, is a well-documented problem that is concerning for both consumers and emergency providers. Over the past several years, hospitals have found it increasingly difficult to secure specialists for their ED patients. According to a 2004 survey by ACEP, two-thirds of ED medical directors report shortages of on-call specialists at their hospitals (ACEP, 2004). An update to this survey found that the situation is growing worse. In 2005, 73 percent of EDs reported problems with on-call coverage, in contrast to 67 percent the year before (ACEP, 2006). Numerous other studies and surveys have investigated the shortage of on-call specialists finding that the problem extends across many different specialties and all regions of the country, and the problem appears to be worsening (Green et al., 2005; O'Malley et al., 2005).

Consider the experience of a patient in San Antonio in his 20s who came to the ED with a vascular injury to his leg artery, the result of a gunshot wound. The vascular circulation needed to be repaired within 6 hours or the patient would risk losing his leg. When the patient arrived at the hospital, ED staff attempted to contact the specialist on call, but he was in surgery and could not respond. Another on call surgeon was also unavailable because he was performing surgery. The ED staff ultimately decided to transfer the patient hundreds of miles away to a hospital with the expertise to treat the patient. However, by the time the patient arrived, too much time had passed to save the patient's leg (Glabman, 2005). EMTALA currently requires hospitals to have contingency plans for such situations, but unfortunately many do not.

The experience of the patient in San Antonio is not uncommon, yet it is remarkable. One would expect that the city would have enough specialty resources to care for the patient with this injury. Another reason why the shortage of on-call specialists is remarkable is because it affects all patients regardless of income or insurance status—insured patients are at the same "risk" of not having a specialist available when needed as uninsured patients.

Factors Contributing to the Decreased Availability of Emergency and Trauma Specialists

Surveys of hospital administrators, ED staff, and specialists indicate that there are at least five underlying factors affecting the availability of emergency and trauma specialists: (1) the supply of specialists; (2) compensation for providing emergency services: (3) quality of life issues; (4) liability concerns; and (5) relaxed EMTALA requirements for on-call panels (Yoo et al., 2001; California Healthcare Association, 2003; Taheri and Butz, 2004; Green et al., 2005; Salsberg, 2005).

(1) Supply of Specialists

Hospital by-laws often require physicians to take ED call for a certain number of years (e.g., 15 years) in exchange for admitting privileges. Historically, this arrangement worked well; it allowed hospitals to fill their on-call panel and gave young specialists an opportunity to build up their practices. But with the movement of specialists to large, multi-specialty groups, younger physicians no longer need to rely on ED call to supply patients. Hospitals have less leverage to

tie admitting privileges to ED call and many groups discourage their members from taking call in the ED (Taheri and Butz, 2004).

But the availability of on-call specialists is also dependent upon the local supply of specialists. If there are many specialists in market, then specialists may be more likely to serve on emergency call panels in order to draw new patients into their practices, assuming that some of these patients are insured. If there are shortages of certain specialists in a market, then the specialists will likely be able to fill their practice without taking call. Indeed in many areas of the country, there is a shortage of certain specialists that would be needed to cover the ED (GAO, 2003a). One reason is that medical school enrollment has not kept pace with the growing population. Neurosurgery is a good example of this. Despite substantial increases in the U.S. population and in the number of trauma visits, the number of practicing neurosurgeons in 2002 (3,050) was less than the number practicing 12 years earlier. There are far fewer neurosurgeons in the US than the number of EDs (4,900) (Couldwell et al., 2003). The specialty largely attributes this decline to medical liability problems.

The shortage of available on-call specialists is a serious and complex dilemma, which appears to defy simple resolution. It reflects long term trends in professional practice and physician supply that would take years to address even if the solution were clear. There are two approaches, however, that the committee believes warrant special consideration: regionalization of specialty services, and development of an emergency surgery subspecialty.

Regionalization of Specialty Services

Much like the regionalization of trauma services, regionalization of certain specialty services will direct patients to the hospitals that have access to the needed specialists and that have demonstrated superior outcomes. The intent of regionalizing specialists is to rationalize the limited supply of specialists by facilitating agreements that would ensure coverage at the key tertiary and secondary locations based on actual need. This would replace the current haphazard approach that is based on many factors other than patient need. Without such regional arrangements, some hospitals may have on overabundance of certain specialists, while others face a constant shortage. These patterns may be based on physician practice preferences, academic affiliations, reimbursement issues, contractual arrangements, or myriad other issues. They may also be due to simple ignorance of the community-wide needs. Regionalization would provide a framework for recognizing and addressing these needs and imbalances through the collection of information on specialist demand and supply, and the use of that information to reallocate specialists services through various arrangements, including payment incentives.

While there is limited direct evidence regarding regionalization of on-call specialty services, regionalization has been proven to be effective in other contexts, and it is consistent with the broader vision of a regionalized emergency care system. There are few examples of regionalization with specific reference to emergency and trauma specialty on-call services. Palm Beach County is an example of a nascent attempt to regionalize the services of certain on-call specialties through a community-wide cooperative that will collectively contract for their services. This was described more fully in Chapter 3. But despite the current lack of direct evidence, the committee believes that it holds promise and should be encouraged and evaluated. Therefore the committee recommends that **hospitals, physician organizations, and public health agencies collaborate to regionalize critical specialty care on-call services**.

Emergency Surgery Subspecialization

In order to expand the pool of surgeons available to emergency and trauma patients, a new specialty designation of emergency surgeon has been proposed. The emergency surgeon would receive broad training in elective and emergency general surgery, trauma surgery, and surgical critical care. In addition to performing what is conventionally considered "general trauma" (neck, thoracic and abdominal injuries), the new trauma surgeon specialist could also perform selected and limited neurosurgical and orthopedic procedures, with support from fellow surgical specialists (The Committee to Develop the Reorganized Specialty of Trauma, Surgical Critical Care and Emergency Surgery, 2005). The intent is not that this new specialty perform major neurosurgical or orthopedic procedures, but rather that it perform only those procedures that that can be safely performed without the direct intervention of these specialists, and thus enable them to concentrate their efforts on more difficult cases.

In the traditional surgical practice model, surgeons may end up working all night operating or covering the ICU, and then spend the following day seeing their own admitted patients, a physically stressful approach. Under the new model, the service would be shared by the emergency surgery group. Each surgeon would work 8-12 hours at a stretch, and then be off until the next shift, with another member of the group assuming responsibility for the group.

There has been some controversy about the inclusion of emergent neurological and orthopedic surgical procedures in this new training curriculum. However, the need for the Acute Care Surgeon to perform these procedures would only be called into play when these specialists are not available in emergent situations. This may occur in urban facilities where the specialists are on staff, but are not willing to provide the coverage, and/or rural areas where the acute care surgeon may be the only surgeon available to provide this life and limb saving care.

(2) Compensation

Another reason that specialists may be unwilling to take emergency call is that they often receive little or no compensation for these services because of the large number of uninsured and underinsured patients that they are required to care for. Yoo and colleagues (2001) reported the results of a 2000 California Medical Association survey on reimbursement for on-call emergency services in which nearly 80 percent of the respondents reported difficulty obtaining payments for services, regardless of insurance type. Fifty-four percent responded that they received no payment for on-call services, though the frequency of non-payment is unclear. Another 42 percent reported underpayment and payment delay. Forty percent of the physicians with voluntary call stated that lack of payment has forced them to reduce call, while 20 percent responded that they would be unable to continue voluntary call under the present circumstances.

Perhaps the most common strategy has been for hospitals to provide a stipend or extra payment for physicians to take call. According to a 2004 AHA survey, approximately 40 percent of hospitals pay some specialists for ED call, with a median stipend of $1,000 per night. (Glabman, 2005). Stipends have helped individual hospitals secure the availability of certain specialists, but the long-term viability of this strategy is questionable, as the size of stipends are quite large for some specialists and not all hospitals have funding to support stipends. However, the practice of paying physicians to be on-call is controversial. With many hospitals operating at a deficit, the American Hospital Association claims that hospitals cannot make these stipends a permanent feature of emergency call (Maguire, 2001). Additionally, the question of which specialists should receive payment may initiate controversy across specialties. Further the size of the stipends for on-call coverage is large in many cases, to the point that payments may not be a

realistic option for many communities. For example, one hospital in Miami is reportedly spending $13 million annually to compensate physicians for taking call in the ED (Mays et al., 2005). A Phoenix-area hospital reports paying each of its neurosurgical groups $10,000 per week in exchange for taking call (Hurley et al., 2005). These payments are in addition to any patient revenue that the specialists may collect.

An alternative model which may have advantages over paying stipends has been implemented at Scripps Health in San Diego. This model uses an exclusive contract to secure neurosurgery coverage for the trauma center. It involves combining all emergency neurosurgery and trauma cases, and putting out an RFP for exclusive rights to providing care for these patients. Substantial competition for the contract resulted in a qualified and committed group of neurosurgeons providing services for emergent and trauma care. The contract requires: prompt response, participation in all process improvement and educational programs, leadership in neurosurgical quality improvement. The program is more successful in areas where stipends for on-call staff are used and are rising quickly (Scheck, 2004). While this approach will depend on the market dynamics and characteristics of the hospital, it has been at least initially successful.

(3) Quality of Life

A third factor limiting the availability of specialists is that the new generation of specialists appear to be less inclined to take call than their older colleagues due to quality of life considerations. There is no question that the demands of on-call coverage are substantial. When on-call, specialists may be summoned in the middle of the night and required to perform complex surgeries, diagnoses, or other services. It is not unusual for a surgeon on call to work through the night and then see a full day's worth of patients in the office. For specialists taking daytime call, they may be interrupted in the middle of a busy day of seeing patients in the office, forcing patients to reschedule. Furthermore, as the availability of specialists taking emergency call declines, the burden on those specialists who continue to take call grows. In 2003, the Accreditation Council for Graduate Medical Education (ACGME), following the earlier lead of the New York State Bell Commission, placed strict limits on resident work hours, including the number of consecutive hours doctors in training can be required to work on call without a period of intervening sleep. The same limits do not apply to practicing physicians, and are routinely exceeded by surgical specialists and others who take overnight emergency call.

Younger physicians are placing greater importance on the balance between work, marriage and family time, and are therefore demanding greater control over their work schedules, fewer absolute work hours, and more time devoted to their private practice (Salsberg, 2005). Further, many do not view ED call as a professional obligation to the degree that previous generations of specialists did, particularly when market factors enable them to build a successful practice without the addition of emergency patients (Taheri and Butz, 2004).

(4) Professional Liability

The high risk of being sued and the high costs of professional liability insurance premiums further discourage specialists from providing on-call services. Procedures performed on emergency patients are inherently risky and expose specialists to an increased likelihood of litigation. There are several reasons for this: emergency and trauma patients are often sicker, and may have serious comorbidities; and the on-call physician usually has no preexisting relationship with the patient or his/her family.

Patients with serious or complicated medical problems are often referred by their primary care provider to hospital EDs in order to shield the primary care physician from liability during diagnostic work ups (Berenson et al., 2003). Safety net hospitals are especially affected by the liability problem. As panels diminish at community hospitals, they increasingly transfer patients to the large safety net hospitals, which have no choice but to accept them, resulting in even higher concentrations of uninsured, high risk patients. Several reports have documented trauma center closings, at least temporarily, or downgrading their status due to staffing shortages associated with liability concerns (Whaley, 2002). In the current high liability risk environment, safety net hospitals are at risk of becoming the "dumping ground" for the liability crisis.

A 2004 nationwide survey of neurosurgeons conducted by the American Academy of Neurological Surgeon found that 35.8 percent of respondents had been sued by patients seen through the hospital ED (Perception Solutions, Inc., 2004). For this reason, specialists who regularly take ED call pay more for liability coverage than those that do not. An analysis of premiums paid by specialists in Palm Beach County, FL revealed that orthopedists who take regular ED call pay 75 percent more for malpractice insurance than orthopedists that do not take call (Taheri and Butz, 2004). One neurosurgeon reported being told by his insurance company that he must limit coverage of the ED to 10 nights per month or his premiums would be increased to prohibitive levels (Byrne and Bagan, 2004).

Liability premiums for specialists in general have been rising at an increasing rate. Data from the Medical Liability Monitor show that premiums for general surgeons grew approximately 1 percent in 1998 and 1999, but grew 7 percent in 2000, 12 percent in 2001 and 21 percent in 2002 (Thorpe, 2004). The result is burdensome premiums for specialists in many areas of the country. For example, the largest underwriter of professional liability insurance in Illinois reported that the average premium in 2005 for neurosurgeons in the Chicago area is $235,000 per year for only $1 million in coverage. While $1 million may seem like adequate coverage, nearly half of settlements in the Chicago area exceeded $1 million in 2003. More than 10 settlements exceeded $10 million (Byrne and Bagan, 2004). Growth in physician liability premiums has not been offset by growth in revenues. In fact, patient revenues, which are often set to the Medicare payment schedule, have actually been declining, making the burden of increased premium payments even greater (Valadka, 2004).

The specific effects of liability premiums on emergency and trauma specialists was addressed in a 2003 report by the U.S. General Accounting Office (GAO, 2003b). The report was based on a study that compared experiences in five states with reported medical malpractice problems (crisis states) to experiences in four states without reported problems. The GAO found that in the crisis states, access to emergency care was reduced, particularly for trauma and obstetrical services; transfers of patients increased; and the availability of on-call specialists to EDs was reduced—especially for critical specialties such as orthopedic and neurological surgery. The study further documented that reduced on-call coverage resulted in frequent delays in care, and transfers of patients up to alternative facilities 100 miles to receive specialist care. A section of West Virginia lost all neurosurgical coverage for 2 years, requiring all emergency patients requiring neurosurgical consults to be transferred more than 60 miles away. The report noted, however, that confirmed problems in access frequently involved hospitals, often rural, with longstanding problems in maintaining the availability of services.

Trauma services were affected in every state in the study, including temporary trauma center closings due to loss of on-call specialist services for trauma care in West Virginia, Pennsylvania,

and Nevada. In each of these cases, the state had to resolve the crisis by either providing liability coverage or making the specialists state employees, thus limiting their exposure.

Strategies for Addressing Medical Liability

The effect of caps on malpractice awards at the state level to ameliorate access problems has been the subject of numerous research efforts over the past few years. The growing consensus is that state liability reforms have helped reduce physician liability premiums somewhat (Thorpe, 2004) and have led to some small increases in physician supply (Hellinger and Encinosa, 2005), particularly in rural areas (Encinosa and Hellinger, 2005; Matsa, 2005). However, the direct impact of these reforms on the delivery of emergency services has not been adequately examined.

There are a number of additional approaches that could be used to protect emergency care specialists without compromising patient safety. One is to provide "conditional immunity" for emergency physicians and specialists while seeing patients on-call. Another promising approach is a public no-fault system modeled after the National Vaccine Injury Compensation System. In such a system, malpractice in emergency care would be compensated through a fund that is supported by hospitals and physicians. Such an approach would provide much more rapid and certain compensation than the current tort system, while encouraging hospitals and individual providers to address patient safety issues in a transparent and energetic manner. Alternatively, non-economic damage award caps, which have been effective in some states, could be placed on emergency services (Thorpe, 2004).

Whatever liability reform strategies are used to ease the crisis in availability of emergency providers, they must be balanced with protections for patient safety. One proposed mechanism would be the establishment of a national emergency care patient safety initiative. This would include: reporting systems for sentinel events, with penalties for failure to report incidents; a national data base of patient safety events; development of standards of care; monitoring and reporting of performance standards; and corrective measures to be taken in instances of repeated problems. An additional feature that might be considered is tying protections from liability exposure to demonstrated performance on quality-of-care indicators.

Many states have enacted some form of liability reform, though the types of reforms undertaken have varied. These reforms have led to a "natural experiment" for researchers to investigate the impact. Congressional policymakers, with advice from health services researchers, should monitor the impact at the state level and consider federal liability reform.

Because of the critical nature of the on-call specialty crisis, and the substantial role that liability appears to play in creating and sustaining this crisis, the committee believe that it is of crucial importance to the nation to more clearly understand the true impact of liability on specialty services, the range of public policy and private initiatives that can make a significant difference, and to take urgent actions based on these findings. Therefore the committee recommends that **Congress appoint a commission to examine the factors responsible for the declining availability of providers in high-risk emergency and trauma care specialties, including the role played by medical malpractice liability in specific, and to recommend targeted state and federal actions to mitigate the adverse impact of the responsible factors and ensure quality of care.**

The committee recognizes that medical malpractice is a national issue that affects all areas of medicine, not just emergency medicine. But it also recognizes also that it represents a unique and urgent challenge in emergency care that cannot wait for long term national or state solutions. It

warrants special consideration not only because of the crisis facing emergency care, but because of its unique public good characteristics. Medical emergencies are unpredictable events, and the emergency care system must maintain a state of readiness to handle emergencies as they arise. Because individuals don't know when they will need emergency services, they will under-consume the readiness aspect of emergency care. Government intervention is warranted in order to maintain an efficient level of readiness. Liability protections for emergency providers could be a stop-gap until broad, national legislation addressing medical malpractice reform is enacted.

(5) EMTALA Requirements

The responsibility of hospitals to ensure the availability of on-call staff was revisited by the Centers for Medicare and Medicaid Services (CMS) in guidance published in September 2003. Prior to the 2003 amendment, there was considerable confusion surrounding hospitals' on-call list responsibilities. Afraid of violating EMTALA, many hospitals adopted a "rule of three" policy, which states that if a hospital has more than three physicians within a specialty, it must provide continuous emergency department coverage for that specialty. Struggling to maintain their on-call lists, some hospitals required specialists to be on-call 24 hours a day, seven days a week (Russell, 2004). Complaints by on-call physicians and hospitals led to a clarification of the policy in 2003. CMS clarified that EMTALA does not require that hospitals follow "rule of three" and changed its statutory language to state "Each hospital must maintain an on-call list of physicians on its medical staff in a manner that best meets the needs of the hospital's patients who are receiving services required under this section in accordance with the resources available to the hospital, including the availability of on-call physicians" (42 CFR §489.24). CMS also clarified that physicians could be on-call at more than one hospital simultaneously (hospitals must have procedures in place for when a physician is on call at another hospital and is unable to respond) and that surgeons could perform elective surgery while on call (Russell, 2004).

The impact of the EMTALA amendment on the supply of and access to on-call specialists is not clear. Many believe that access to on-call specialists has worsened as a result. In the example above of the patient from San Antonio, the local on-call surgeons would not have been allowed to perform elective surgeries while on-call prior to the 2003 EMTALA guidance. Though it is unclear in the example above whether the on-call specialists were performing elective or emergency surgery, it is easy to see how the change to EMTALA potentially makes access to on-call specialists more difficult. But others argue that the amendment change was beneficial. Had CMS not loosed on-call requirements, they argue, more specialists may have refused to take call in the ED altogether.

In an alternative approach, some have put forward the idea of a more direct approach in which CMS would hold specialists accountable for providing on-call services rather than hospitals. One approach would be to require specialists to take call as a condition of Medicare participation. While the directness of the approach has some appeal, it fails to address the underlying problems, such as the declining numbers of specialists, and is, indeed, likely to contribute to that decline.

Hospitalists and Critical Care Specialists

Hospitalists

In 2003, more than 8,000 hospitalists—physicians who exclusively focus on managing hospital inpatients—were practicing in U.S. hospitals, according to the Society of Hospital Medicine (Society of Hospital Medicine, 2006).

That number is expected to reach 30,000 in the next decade. The use of hospitalists will increase as hospitals seek to reduce costs, streamline patient flow, and improve patient safety (Pham et al., 2005).

Hospitals have traditionally been used to care for inpatients and their service has shown to decrease length of stay and reduce morbidity. Adding hospitalists to a hospital's medical staff is an attractive option because they are generally more willing to accept emergency admissions after hours or at night—sparing the need to involve the patient's office based physician. Faster acceptance by the admitting physician can help an ED maintain patient flow, and reduce the risks of crowding and ambulance diversion. In some hospitals, the hospitalists may provide back-up when the ED is particularly busy by assisting with disposition of patients that clearly need to be admitted. Hospitalists can also staff observation units in EDs (Dresnick, 1997).

On the other hand, hospitalists sometimes utilize emergency department resources (e.g., space and staff) in conducting workups of patients they are admitting, placing a drain on crowded EDs. This is alleviated in some hospitals by admissions units that are separate from the ED. Because hospitalists focus on inpatient care rather than traveling back and forth from their office, they are often more efficient than office-based practitioners. One hospital found that by using hospitalists to coordinate care immediately following the admission decision, the hospital cut the average length of stay for patients admitted through the ED by two days, increasing bed availability (Brewster and Felland, 2004). Many hospitalists are being asked to become more involved in emergency department triage decisions. The theory is that hospitalists may have more time than emergency physicians to fully evaluate patients, and may also be more familiar with home care or skilled nursing facilities (Wachter, 2004). However, this strategy is also not without drawbacks. Hospitalists may refuse to be the physician of record for unassigned patients in communities with heavy uninsured populations and many hospitals to not have the funding to hire hospitalists (Maguire, 2001).

Hospitalists may also help alleviate some problems with the availability of on-call staff. Hospitalists in the ED can assess the status of unassigned patients, and make a determination about whether a specialist is needed. According to a survey for the California Healthcare Foundation, emergency physicians appreciate the availability of hospitalists as timesavers and specialists value fewer calls and fewer late night trips to the ED. In fact, more survey respondents said that the use of hospitalists was a successful approach to the on-call problem than mandating on-call coverage or contracting with a third party for call coverage. However, hospitalists are best used for medical patients and are unlikely to help alleviate problems with on-call subspecialists and surgeons (Green et al., 2005).

Critical Care/Intensivists

Critical care specialists are essential component of emergency and trauma care in addressing the needs of severely ill and injured patients. The use of intensivists has been associated with a 30 percent reduction in hospital mortality and a 40 percent reduction in ICU mortality (Pronovost

et al., 2002). Greater use of intensivists has also led to significantly reduced hospital and ICU LOS (Pronovost et al., 1999).The Leapfrog Group promoting the use of a full-time intensivist model to meet its ICU Physician Staffing standard. Currently only 10 percent of ICUs actually meet this standard (The Leapfrog Group, 2004).

Because inpatient units are becoming increasingly crowded, critically ill patients are boarding in the ED for longer periods of time. This is a challenge for EDs because critically ill patients require an intensive amount of resources including medical attention, monitoring equipment, and medications (Church, 2003). This has led some hospitals to use intensivists in the ED. The committee recognizes the importance of providing critical care services quickly to admitted patients but does not endorse the practice of using intensivists as a way to accommodate the practice of boarding. Instead, the committee encourages hospitals to address the root causes of boarding so that critically ill patients are quickly moved to intensive care beds.

Currently, residency trained board certified emergency physicians and other acute and primary care specialists are blocked from sitting for the subspecialty exam in critical care, despite the fact that there is a severe national shortage of critical care physicians. Critical care societies have petitioned Congress to increase the number of foreign medical graduates (FMGs) with critical care training allowed to immigrate to the US. Nevertheless, the ABMS does not allow US born, critical care fellowship-trained emergency physicians from obtaining subspecialty certification in critical care. Combined emergency medicine/critical care physicians could help address the shortage, provide a margin of safety for ED boarders, and provide extra capability in community hospitals that can't afford to keep both types of providers on staff every night (Osborn and Scalea, 2002). In order to increase pool of well trained intensivists in the adult and pediatric world, the committee recommends that **the American Board of Medical Specialties and its constituent Boards extend eligibility for certification in critical care medicine to all acute care and primary care physicians who complete an accredited critical care fellowship program.**

NURSES AND OTHER CRITICAL PROVIDERS

There are approximately 90,000 nurses working in emergency departments (NHT, 2006). According to the Emergency Nurses Association (ENA), emergency RNs perform the following tasks: assessment, analysis, nursing diagnosis, planning, implementation of interventions, outcome identification, evaluation of responses, triage and prioritization, emergency operations preparedness, stabilization and resuscitation, and crisis intervention for unique patient populations (e.g., sexual assault survivors) (ENA, 1999). In a 2000 national survey of nurses commissioned by DHHS, nurses working in EDs overwhelmingly (83 percent) reported that their dominant function was direct patient care. Smaller numbers of ED nurses reported working in supervision (3.5 percent) or administration (2.5 percent).

To become a nurse, an individual can either pursue an Associate Degree in Nursing (ASN) or a Bachelor of Science in Nursing (BSN). The ADN course is typically a two year degree program, and is focused on the practical applications of nursing. The BSN is a four year course of study that expands into the theoretical realms of patient care. A third course of study is the diploma, which was common prior to the 1970s. The diploma program is a two to three year course of study that is located in a hospital and prepares students for positions in hospitals. There are less than 100 diploma programs in existence today (All Nursing Schools, 2005). In recent years national nursing organizations have pushed to mandate the BSN be a minimum

requirement to be a professional nurse. After graduation from one of these programs, nurses must take the state board examination to become a registered nurse.

Emergency Nurses

The Emergency Department Nurses Association was formed in 1970. The name of the organization changed to the Emergency Nurses Association (ENA) in 1975 to reflect that emergency nurses may work in a variety of settings (ENA, 2005a). In the late 1970s, a committee convened to write a certification examination and the ENA helped establish a Board of Certification for Emergency Nursing. The first certification examination was administered in 1980 and 902 emergency nurses passed the exam. In the early 1990s, the Board also assisted with the development of the certification program for flight nurses (ENA, 2005b).

In 2004, 13,115 RNs nationwide were credentialed as Certified Emergency Nurses (CENs). There are also other advanced degree options for nurses including Masters and Doctoral degree programs with various areas of specialization and practice. Many nursing management positions require advanced degrees. Some ED nurses specialize in caring for children and may work in pediatric EDs, but there is no certification available in pediatric emergency nursing, and very little data available regarding these nurses. State boards of nursing may require Pediatric Advanced Life Support for nurses providing conscious sedation. Pediatric EDs are likely to require advanced pediatric courses, and may even require advanced training in neonatal resuscitation for nurses.

Demographics

According to the DHHS' National Center for Health Workforce Analysis, ED nurses are overwhelmingly non-Hispanic white (88.5 percent). All racial/ethnic groups were severely underrepresented in the ED nursing population relative to the U.S. population. ED nurses are predominantly female (86 percent) and are younger on average than nurses that work in other settings, with a median age of 40 compared to 43 for other nurses. But ED nurses were aging at approximately the same rate as other nurses, with the median age increasing by 3 years (from 37 to 40) between 1988 and 2000. ED nurses generally have less experience than nurses in other settings. Thirty percent reported graduating in the last five years compared to 20.6 percent of other nurses. Only 11.4 percent of ED nurses reported graduating 26 or more years ago compared to 22.6 percent of all nurses. ED nurses were more likely than other nurses to report an associate's degree as their highest level of education (45.6 percent versus 36.6 percent), and were less likely to have attained a master's degree (5.8 percent versus 10.6 percent) (U.S. DHHS, 2000).

Advanced Practice Nurses

Advanced practice nurses (APNs) are masters prepared registered nurses that provide significant medical care to patients, often with supervision by a physician dependent upon the APNs' role and scope of practice. APNs include nurse practitioners (NPs), clinical nurse specialists (CNSs), certified registered nurse anesthetists (CRNAs), and certified nurse midwives (CNMs). Advanced practice nurses are required to have a defined scope of practice statement for their role approved by the state board of nursing.

There is no national certification for APNs in emergency care, but NPs and other APNs may obtain training in emergency care skills through university-based programs, continuing education, and work experiences (Cole et al., 1999). APNs in emergency settings were most

likely to report a specialties in family NP (43 percent), acute care NP (13 percent), adult care NP (12 percent), critical care CNS (9 percent), or pediatric NP (7 percent) (ENA, 2003).

National data are not available on the demographic characteristics of APNs in emergency departments. However, data collected on licensed NPs in New York State in 2000 allow examination of some of these characteristics in this one state. NPs in EDs were slightly less likely to be female than other NPs. Despite being younger, ED NPs had spent slightly more years on average as an NP than other NPs (5.5 versus 5), and had also been in their current position for a longer period of time (3 years versus 2 for other NPs). In New York State, NPs in emergency departments were more likely to hold a Drug Enforcement Administration (DEA) certification, which is required in order to prescribe controlled substances, than other NPs (86.3 percent versus 66.3 percent), although they were less likely than other NPs to have hospital admission privileges (4.5 percent versus 7.3 percent) (Center for Health Workforce Studies, 2000).

Nursing Supply Issues

The nursing shortage in both hospital and non hospital settings has been the subject of press reports and research articles for years (U.S. DHHS, 2002). Although shortages of nurses persist and the average age of practicing nurses continues to grow, the pipeline of new nursing graduates has been very favorable for the last several years. Enrollments in undergraduate nursing programs increased 20.8 percent in 2005, and the number of graduates increased by 26.1 percent (National League for Nursing, 2005). In fact, 147 thousand qualified nursing school candidates were turned away in 2005, an 18 percent increase over the previous year. It appears that the limiting factor in the growth of the nursing workforce is the limited number of nursing programs and faculty.

Nevertheless, the shortages facing many hospitals today are acute, and extremely difficult to address on a day-to-day basis. These continuing shortages disrupt hospital operations, complicate attempts to deal with ED crowding, and are detrimental to patient safety and quality of care. Until the nursing school pipeline generates significant increases among the nursing workforce, the nursing shortage will continue to be a problem for hospitals and medical centers in all units, and the problem is expected to worsen before it gets better--the demand for nursing services as a result of the aging of the population, is expected to outpace number of new nurses for some time. A number of robust research studies have shown a direct link between nurse staffing levels and patient outcomes (Aiken et al., 2002; Needleman et al., 2002).

EDs are particularly vulnerable to the nursing shortage. Due to intensity of emergency care, EDs often have more vacant nursing positions than the hospital's average. Nationwide, it is estimated that 12 percent of RN positions for which hospitals are actively recruiting are in emergency departments. This makes the emergency department the third most common source of nursing position openings in hospitals (following general medical/surgical and critical care units). In a survey of hospitals in New York City, 83 percent reported that they are actively recruiting for nurses in their emergency department (Greater New York Hospital Association, 2004). In a 2002 survey of nurses in New York State, a majority of nurses responded that there was "definitely" no shortage of nursing jobs for nurses with their experience, training, and skills; however, there was "definitely" a shortage of qualified nurses with their experience, training, and skills. This trend was more pronounced among emergency department nurses than nurses working in other settings (New York State Education Department, 2003).

The impact of the nursing shortage and ED patient care has not been effectively evaluated; however, many speculate that the shortage has a negative impact on patient care for two reasons.

First, similar to other areas of the hospital, if the ED lacks appropriate nursing levels, patients will not receive the care or appropriate attention. For example, a triage nurse may be overwhelmed by the number of patients he or she has to evaluate and may miss an important sign of a severe illness or injury. Likewise, if a nurse in the ED must care for two many acutely ill and injured patients simultaneously, while assessing newly arriving patients and monitoring admissions who are a "boarding" in the ED, the potential for delayed care or medication errors is dramatically increased. Also, the nursing shortage adds to the problem of ED crowding by limiting the number of staffed inpatient beds available for emergency admissions.

Nurse Staffing Levels and Efforts to Address the Nursing Shortage in EDs

Traditionally, hospitals have determined levels of nurse staffing in the ED using a productivity measure called hours per patient visit (HPPV). Under this system, the total number of paid nursing staff hours is divided by the total number of ED visits to generate a number in hours per patient visit. Obviously, the shortcoming of this method is that patients with varying severity-of-illness levels receive the same consideration for nursing staff time (Robinson et al., 2004). More recently, labor unions, some nursing organizations, and the public have been promoting the use of mandatory nurse staffing ratios in an effort to promote patient safety and quality care (Hackenschmidt, 2004). In the ED, nurse staffing ratios tend to range from a 1:4 ratio for general ED patients to 1:1 for trauma patients (Robinson et al., 2004).

Hospitals have opposed mandatory nurse staffing ratios because of the difficulty meeting the ratios due to the nursing shortage, the potential increase in costs, and the increased risk of litigation if they are not in compliance with the ratios (Hackenschmidt, 2004). There are inherent difficulties associated with maintaining nurse staffing ratios on the ED. The patient census may change rapidly and the care requirements of patients change significantly during the course of their ED stay.

In 1999, California was the first state to introduced specific nurse-to-patient ratios in emergency departments, though the ratios were not implemented until 2004 (Hackenschmidt, 2004). The minimum staffing ratios used by the California Department of Health are one nurse to four general ED patients, one nurse to two critical care ED patients, and one nurse to one ED trauma patient. Triage nurses are not included in the ratios. For ED nurses, the reaction to staffing ratios in California is mixed. Some report feeling relief with improved staffing; others believe the law is too strict and does not allow for flexibility based on the unit and patient severity of illness. While individual patient care may improve from mandatory ratios, wait times in the ED may increase if ED nurses may care for only a limited number of patients at a time (Hackenschmidt, 2004).

The ENA has spoken out against the use of HPPV and legislated nurse-to-patient staffing ratios claiming that they are limited in scope and fail to consider the factors that effect the consumption of nursing resources. Indeed, there is a lack of scientific evidence to support the ratio numbers (Hackenschmidt, 2004). ENA has, in turn, developed their own staffing guidelines based on six factors: patient census, patient severity of illness, patient length of stay, nursing time for nursing interventions and activities by severity of illness, skill mix for providing patient care based on nursing interventions that can be delegated to a non-registered nurse, and an adjustment factor for the non-patient care time included in each FTE (Ray et al., 2003).

Despite the controversy over appropriate staffing levels, hospitals still struggle to fill vacant ED nursing positions. They have attempted several strategies to compensate for the shortage of ED nurses including recruiting nurses from foreign countries and the use of "float" or borrowed

nurses from other units of the hospital when the ED is particularly busy. While recruitment from other counties, particularly Canada has helped relieve shortages, the use of float nurses is more problematic because those individuals are not familiar with the complexity of the ED or emergency nursing practice (Schriver at al., 2003). Additionally, in many areas of the country, hospitals use mandatory overtime as a management tool to meet staffing requirements (Jacobsen et al., 2002). Mandatory overtime has been a controversial practice, one that has been opposed by all of the major nursing organizations. While almost 20 states have considered banning mandatory overtime for nurses, only a handful have done so (Rogers et al., 2004).

But even offering voluntary overtime to nurses is not without controversy. Nurses often work longer than their scheduled time and many shifts extend longer than 12 hours. Research has shown that the risk of medical errors increases significantly when nurses' shifts exceed 12 hours, when they work overtime, and when they work over 40 hours per week (Rogers et al., 2004). In *Keeping Patients Safe: Transforming the Work Environment of Nurses*, the IOM recommended that voluntary overtime for nurses be limited (IOM, 2004a).

Physician Assistants

The American Association of Physician Assistants (AAPA) reports that 1,775 physician assistants (PAs) (9.8 percent of all PAs) worked in emergency departments in 2003. PAs provide medical care to patients under the supervision of a licensed physician. They perform a number of functions including conducting physical exams, diagnosing and treating illnesses, ordering and interpreting tests, counseling on preventive health care and in most states, writing prescriptions (Allied Health Schools, 2005). PAs must be granted clinical privileges at the hospital in which they work.

Most PA programs can be completed through a two-year training program after college. The first year of training consists of coursework in the basic sciences while the second year allows students clinical experience in areas such as internal medicine, rural primary care, emergency medicine, surgery, pediatrics, neonatology, and occupational medicine. Some PAs pursue additional education in a specialty area such as emergency medicine (Allied Health Schools, 2005). There are three PA educational programs in the U.S. offering specializations in emergency medicine, although PAs do not need to graduate from such a program to practice in EDs.

Racial and ethnic diversity is also low among PAs practicing in EDs; 88 percent are non-Hispanic white. The majority of PAs practicing in EDs are men. PAs in EDs tend generally tend to be older than other PAs, in direct contrast to the patterns found among other emergency care personnel (AAPA, 2005).

Pharmacists

The ED is a high-risk area that is prone to medical errors, including medication errors (Goldberg et al., 1996; Selbst et al., 1999; Schenkel, 2000; Croskerry et al., 2004). In the 1970s, hospitals began integrating pharmacists into the emergency department staff. Their roles generally involved improving medication billing and inventory control. Since that time, the role of pharmacists in the emergency department has grown to include clinical consultation, education of ED staff, and research (Thomasset and Faris, 2003). Clinical pharmacy specialists (CPS) that work in emergency departments typically have doctor of pharmacy degree and have completed a one-year residency.

There is substantial evidence that including pharmacists in the care team can improve the quality and safety patient care in both inpatient and outpatient settings (Bates et al., 1995; Leape et al., 1999; Kaushal et al., 2001; Kaushal and Bates, 2001). There are several reasons for including a CPS in the emergency department care team. The first is to ensure that patient medication needs are appropriately met. With the increased number of drugs available and the increased complexity of drug selection, administration and monitoring, there is some justification for having a doctorally trained pharmacist participate on the care team. Participation of a pharmacist in the care team is in line with JCAHO guidelines to promote a multidisciplinary approach to patient care. Second, medication errors are a serious problem in emergency departments and pharmacists may be able to lead system changes to reduce or eliminate these errors. Finally, medication costs are rising and pharmacists are in a good position to evaluate which medications are most cost effective for patients and the hospitals to use.

Still, the prevalence of pharmacists, particularly full-time pharmacists, in EDs remains limited. A 2001 survey of directors of pharmacy in hospitals with at least one accredited pharmacy residency program was conducted in order to ascertain the prevalence and characteristics of pharmaceutical services in EDs nationwide (Thomasset and Faris, 2003). Only three percent of respondents reported having a dedicated pharmacist in an ED satellite pharmacy. Fourteen percent of respondents reported having a dedicated pharmacist that provides services to emergency department patients. But the demand for pharmacists or pharmacy assistance may grow over the next few years as a result of JCAHO's 2005 National Patient Safety Goals and Requirements, which call for complete and accurate medication reconciliation across the continuum of care (JCAHO, 2005).

EMS Professionals

Increasingly, EMS professionals are supplementing their prehospital EMS practice to work in hospital EDs. Because of their relevant training and experience they can serve as effective adjuncts to regular ED staff. According to a 2004 survey of EMS personnel conducted by the NREMTs, a considerable number of EMTs spend time working professionally in EDs— 32.9 percent of EMT-Bs[1], 34.9 percent of EMT-Is, and 29.8 percent of paramedics (NREMT, 2005). This represents a substantial increase over previous years. Anecdotal evidence suggests that this is a nationwide phenomenon that is prevalent in both rural and urban environments. There is substantial variation across states in how EMTs can be utilized in the ED, and some states (e.g., Kansas) have bridge courses that facilitate migration between EMT and RN credentials. This phenomenon may be explained in part by the substantial differential in pay and amenities between these two environments.

Psychologists, Social Workers, Patient Advocates

A variety of patient care professionals play a critical and generally undervalued role in assisting patients with issues associated with family, living arrangements, food and shelter, public and private insurance programs, mental health, and human dignity. The number of such

[1] Most states have three principal levels of EMS field providers. The First Responder provides basic first aid and conducts basic assessments, usually in advance of the arrival of a higher-level EMT. The EMT-B (Emergency medical technician-basic) is generally trained to provide basic, non-invasive prehospital care. The EMT-I (Intermediate) performs some invasive procedures, such as delivery of IV fluids. The EMT-P (Paramedic) is the most highly skilled EMS worker and is trained in advanced life support. In addition, many states have 2 additional levels—and EMT-Dispatch.

practitioners in the ED is not well known. As the diversity of patients seen in the emergency department has increased, so has the variety of their social and psychological needs. The importance of these providers has risen, by all accounts, much faster than their actual supply.

ENHANCING WORKFORCE SUPPLY

The ED workforce includes a broad cross section of the larger health care system—physicians from family medicine to neurosurgery, residents, nurses, pharmacists, and physicians assistants—as well as those who specialize in emergency care, including emergency medicine physicians, emergency nurses, trauma surgeons, and certain medical and surgical specialties. There are substantial concerns about the long term supply of emergency professionals in several categories.

Ensuring an adequate supply of highly trained professionals in every category is the goal of the committee. However, there are a number of challenges associated with enumerating the current ED workforce (e.g., how to count part-time workers, individuals who work in multiple EDs, different scopes of practice across states), and estimating of the size of the ED workforce needed for the future is an even more challenging step. Bioterrorism preparedness, the aging of the population, changing morbidity patterns, potential reforms to the health care system, and technological advances are just some of the factors that will impact the size of the ED workforce needed in the future.

While the national supply of physicians and other medical specialists is critical, so is the distribution of the workforce. The most highly trained and specialized clinicians tend to cluster in metropolitan areas, while rural and frontier areas lack even basic medical coverage. This is not, of course, a problem that is restricted to emergency care. But the lack of qualified emergency care personnel in rural areas has a disproportionate impact on health because of it urgency—people can schedule elective visits and procedures at distant locations. But in en emergency, that may not be an option. Addressing the rural distribution of the emergency care workforce will require concerted efforts along many fronts, including training, incentives, and enhancing the rural provider pipeline. For example, the frequently high debt burden of many emergency medicine residents and the limited opportunity to earn sufficient revenue to pay off educational debt in rural settings, presents a significant barrier to rural practice, even for those who may prefer it. Enhanced rural training options combined with loan forgiveness programs represent possible options for enhancing the rural workforce.

Developing effective strategies to ensure an adequate supply of trained ED professionals in the future requires an understanding of the needs of the nation in ten and twenty years**.** The committee therefore recommends that **the Department of Health and Human Services, the Department of Transportation, and the Department of Homeland Security jointly undertake a detailed assessment of emergency and trauma workforce capacity, trends, and future needs, and develop strategies to meet these needs in the future**. This assessment should be conducted in the context of regionalized systems, which will require a different mix of skills than might otherwise be anticipated. Further, the assessment should consider optimal combinations of professional skills—including emergency and family physicians, nurse practitioners, physicians assistants, pharmacists, hospitalists, trauma surgeons, on-call specialists, pediatric and geriatric specialists, social workers, psychologists, and EMS providers. Based on the findings of this assessment, targeted strategies should be considered to address long term projected shortages, including subsidizing graduate and continuing education programs to increase the number of providers trained in those fields.

This should also look at issues such as the impact of graduate medical education allocations at medical centers. These are usually capped, which makes it difficult for a newer specialty to increase the number of positions, which would require reducing positions in other established departments. Also, despite the fact that emergency physicians are broadly trained (i.e., they are more "generalist" in their practice than any specialty other than family medicine) they are excluded from the definition of "primary care" because they do not generally provide continuity of care. This excludes emergency physicians from certain federal and state programs designed to promote the training of primary care MDs, although in some rural counties, primary care is predominantly provided through the ED.

This discussion focuses only on emergency physicians, but concerns about the numbers of funded residency positions apply to virtually all specialties that provide emergency care. These concerns are especially important now that the physician workforce is projected to be inadequate for the future needs of this country.

BUILDING CORE COMPETENCIES

Core competencies are the critical skills, knowledge, abilities, and behaviors that a field or industry has agreed are essential to be achieved if a person is to be accepted as competent at a particular level. The specialty of emergency medicine pioneered the concept of a "core curriculum" for training emergency medicine residents, and now has "the model" a detailed roadmap of the training and competencies required for emergency medicine practice. The major professional organizations focused on emergency medicine (ACEP, SAEM, CORD, ABEM, EMRA, and RRC-EM) created and frequently update core content specific to the specialty. The core content eventually developed into the model of the clinical practice of emergency medicine, which has served as the foundation for medical school training and residency curricula, certification exam specifications, continuing education objectives, and residency program review requirements (Hockberger et al., 2001). The model was revised in 2004 to incorporate the six core competencies promoted by ACGME: patient care, medical knowledge, practice-based learning and improvement, interpersonal skills, professionalism, and system-based practice (Chapman et al., 2004).

A significant number of physicians practicing in emergency departments, however are not residency trained or board certified in emergency medicine (Moorhead et al., 2002). Their level of competency in emergency medicine is not well known. Only a small number of very limited studies have been conducted to compare the competencies of board certified or residency-trained emergency physicians versus other emergency physicians. Results from these studies suggest benefits to emergency medicine residency training in the performance of airway management and care of AMI patients (Friedman et al., 1999; Jones et al., 2002; Weaver et al., 2004). One study also indicates significantly fewer closed malpractice claims against emergency medicine residency-trained physicians versus non-emergency medicine residency trained ED physicians (Branney et al., 2000); however, there is a need for more robust research in this area.

Competencies in nursing are established and assessed in a similar manner. ENA developed the Emergency Nursing Core Curriculum for nurses wishing to take the CEN exam. Those nurses with the CEN credential possess the basic competencies deemed appropriate by the ENA. However, most nurses working in EDs are not CENs and their level of competency and training relevant to emergency care is not well known.

Furthermore, while specialties have established core competencies within their respective fields, there is no uniform standard of care for the multiple disciplines practicing within the ED.

Although most EDs treat cardiac patients, not all hospitals require physicians and nurses to take the Advanced Cardiac Life Support course. Similarly, not all hospitals require ED nurses to take the Emergency Nursing Pediatric Course and the Trauma Nursing Core Course and not all hospitals require ED physicians to take the Advanced Trauma Life Support course. Even so, while exposure to these courses may help improve the level of competency for some providers, particularly those with little formal training in emergency care, they do not ensure competency.

As a result of the variability in initial and continuing education that ED providers receive, there is also variability in what the public gets when it receives emergency care. The committee believes that the uncertainty about the quality and consistency of emergency care across the nation is unacceptable and that it is important to clearly define what qualifies as competent care and what does not. Therefore the committee recommends that **the Department of Health and Human Services, in partnership with professional organizations, develop national standards for core competencies applicable to physicians, nurses, and other key emergency and trauma professionals, using a national, evidence-based, multidisciplinary process.** The core competencies developed must not simply represent one minimum level of competency that all ED providers must attain. If that were the case, the competencies would be a challenge for only the most resource-strapped hospitals. Instead, the core competencies should be tiered and reflect the categorization of the ED. EDs categorized at the highest levels should be subject to the highest core competencies while providers working in categorically lower EDs should be subject to less rigorous core competencies. The competency standards should be developed in order to challenge hospitals, yet the standards must be obtainable. State regulatory agencies should monitor adherence to these competency standards.

These national standards should ensure that core competencies for all disciplines working tin the ED are assessed in accordance with the level of ED in which they practice, regardless of board certification or CEN status. Research must be conducted to track patient outcomes to monitor the benefits of universal core competencies. Additionally, the efficacy of core competencies should be periodically assessed and adjusted as necessary.

PROVIDER SAFETY

Working in an emergency department has the potential to be very rewarding, but the work is often very stressful and at times, dangerous. The work is complicated by limited access to patients' past medical history, the episodic nature of the care being provided, and the uncontrolled or unpredictable environments in which care must be provided (ENA, 1999). Physical threats to safety abound in the ED, ranging from a chance needle stick to the risk of assault, either physical or verbal, from patients that may be under psychological stress or the influence of intoxicants. Additionally, the psychological toll of working in a high pressured environment coupled with the exposure to the pain and suffering of illness and injury can result in tremendous stress on ED providers.

This section deals with the day-to-day dangers that affect emergency department workers. The next chapter addresses provider safety in the context of disasters, including chemical and biological exposure.

Mental Stress

Numerous studies both in the United States and abroad have identified stress as a major concern for emergency care providers. Emergency physicians in 2002 spent 55.7 hours per week

on average on professional activities. This figure is slightly less than the average number of hours spent on professional activities by all physicians (57.6); however, emergency physicians report more total patient visit hours (45.8 versus 43.0) and have more patient visits per week (118.4 versus 107.2) than other physicians on average (AMA, 2004). Furthermore, in contrast to most physicians, who follow an established panel of patients, the vast majority, if not all ED visits involve "new patient encounters" which are often more demanding, time consuming and complex. ED patients generally present with more acute conditions than seen in a typical office practice. ED physicians are prone to stress related to disruption of circadian rhythms because of the frequency and irregularity of night shifts. Stress also related to the intensity and high levels of severity of illness, the unscheduled nature of emergency visits, the high medico-legal risk of missed diagnoses and complications of care, the psychological drain of being second-guessed by consultants and admitting physicians. Emergency physicians must handle multiple patients at once and deal with a wide variety of social situations with little backup. As a result, emergency physicians who attempt to work similar total hours to office-based practitioners are prone to burnout.

Nurses also experience significant stress. Lambert and Lambert found that a lack of job control, work overload, exposure to death and dying, and poor work relationships are major sources of stress for nurses (Lambert and Lambert, 2001). A 2002 survey of registered nurses in New York State revealed that RNs that work in ED report feeling that they are under great stress significantly more often than RNs that work in other settings. Thirty-seven percent of ED RNs reported feeling under great stress "almost every day" (compared to 30 percent of other RNs), while only 10 percent said they felt great stress less than once a week (compared to 19 percent of other RNs), and none said that they "never" felt great stress (compared to 3 percent of other RNs) (New York State Education Department, 2003).

Violence

According to Bureau of Labor Statistics data for 1993, workers in the health care field experienced the highest incidence of assault injuries. One study found that 82 percent of nurses surveyed had been assaulted on the job, 56 had been assaulted in the year prior to the survey, and that many assaults go unreported (Erickson and Williams-Evans, 2000). Several characteristics of the emergency department, the community it serves, and specific patients make the ED and its employees especially prone to such violence. Few steps have been taken to explore the issue and provide ED workers and patients the security they require. With the support of hospital administrators and in cooperation with local officials, security measures and specialized training can be instituted in EDs to enhance provider safety.

The CDC's National Institute for Occupational Safety and Health (NIOSH) defines workplace violence as "violent acts (including physical assaults and threats of assaults) directed toward persons at work or on duty." In broader terms, workplace violence can encompass witnessing or being a victim of physical assaults, sexual assaults, nonverbal intimidation, and verbal threats (Flannery et al., 2000). Researchers have attempted to identify key risk factors associated with violence in the emergency department and the broader health care field in an effort to increase provider awareness and encourage the development of strong violence prevention programs. Those specific risk factors include staff shortages and long wait times, which can aggravate an already distraught patient or family member.

ED patients in poor mental health or those with substance abuse problems may instigate violence in the ED. This threat has grown with the move towards privatization and

deinstitutionalization; the emergency department has seen an increase in visits from psychiatric patients (Flannery et al., 2000). High crime rates in larger urban communities can also translate into violent incidents in the ED; gang-related incidents are becoming more common and weapons are increasing confiscated from patients and visitors upon entry into the ED (Ordog et al., 1995).

Safety measures to protect ED providers vary in cost and utilization. Many busy EDs are staffed with armed security personnel specially trained to handle disruptive or violent patients. Some EDs have metal detectors and controlled access to limit patients' ability to interfere with or threaten the care of others. Designated security phones or push buttons can provide direct links to local police departments. Additionally, assigning multiple staff members to violence-prone patients and assuring two points of entry into an exam room can also help protect providers.

Bloodborne and Airborne Pathogens

Health care delivery by nature poses unique threats to both patients and providers. Movement from one sick patient to another with the constant uncertainty of medical history or infectious disease makes the emergency department susceptible to a host of biological hazards, including bloodborne pathogens. Up to 800,000 injuries through the skin may occur annually in the U.S. and account for approximately 82 percent of exposures to blood or other body fluids in health care workers (National Institute for Occupational Safety and Health, 2004). Although exposure to these occupational hazards and prevalence of occupational injuries has increased for health care workers, the steady decline of infection speaks to the value of nationwide measures to protect the provider. Over a 17-year period, the adoption of recommended universal precautions and OSHA's Bloodborne Pathogens Standard helped decrease the number of hepatitis B viral infections among health care workers from nearly 11,000 in 1983 to fewer than 400 in 1999 (CDC National Center for Infectious Disease, 2002). Although there is growing concern about the risk of exposure to airborne pathogens including multi-drug resistant tuberculosis, SARS, and emerging strains of influenza, most emergency departments have few negative pressure rooms to effectively isolate staff and other patients from respiratory pathogens (Augustine et al., 2004).

The SARS outbreak in Toronto was triggered, in part, by a patient who sought care in a Toronto ED for fever and a cough. He spent the overnight in a crowded ED awaiting admission what was thought, at the time, to be community-acquired pneumonia.. Over the course of the night, he infected 2 nearby patients and several hospital staff members with SARS. Both this index case, and the two patients he infected, subsequently died from the disease, and a total of 31 patients and staff fell ill. Ironically, the same hospital where this incident occurred continues to board admitted patients in its ED (Cass, 2005).

Protection of emergency personnel from biological and chemical exposure is discussed further in Chapter 7, Disaster Preparedness.

Physical Stress

Nurses have the highest prevalence rate of back pain amongst health care workers and the highest incidence rate of workers' compensation claims for back injuries (Edlich et al., 2001). Estimates show that 12 percent of nurses leave the profession annually due to back injuries and more than 52 percent report chronic back pain (Robinson et al., 2004). General back pain is often considered an inevitable part of nursing practice. Nurses spend much of their time standing. Additionally, nurses often work in physically awkward positions since they must maneuver around patient equipment, work in space that is often limited, and/or handle patients with unique

sizes, shapes, or deformities. ED nurses also must lift heavy patients or equipment. NIOSH guidelines state that the average provider not lift more than 45 pounds; this translates into a need for over 3 providers to be present when lifting the average patient (Edlich et al., 2001). However, time pressures and lack of sufficient resources may force a provider to administer care without adequate support. Specialized patient lifting techniques and machines can help to prevent the common back injuries that many nurses face. Several emergency departments have added lifting machinery to protect providers from injury and/or instituted guidelines for providers to assist each other in executing physically demanding or straining tasks.

It is imperative that EDs be as safe of an environment as possible for the emergency providers to deliver the highest level of care to the patient. In fact, patient safety is positively impacted when a comfortable, supportive, and safe work setting is fostered.

INTERPROFESSIONAL COLLABORATION

The concept of interprofessional collaboration gained strength in the late 1990s as attention to medical errors grew. Health services researchers and others interested in improving patient safety were energized by successes in the aviation industry where teamwork training for the private and government aviation workforce led to reductions in errors and improved performance (Sprague, 1999). Research in the aviation industry indicated that effective teamwork does not arise spontaneously, but rather needed to be developed and practiced (Risser et al., 1999). The similarities between pilots and doctors—highly trained technically, accustomed to viewing themselves as bearers of ultimate authority and responsibility, independent yet increasingly dependent on others of varying skill level—suggests that teamwork training may be influential in reducing errors in the medical field (Sprague, 1999).

Several organizations including the IOM and the Institute for Healthcare Improvement (IHI) embraced the concept of teamwork training for health professionals. In 2000, the IOM report *To Err is Human* recommended that health care organizations establish team training programs for personnel in critical areas, including the emergency department (IOM, 2000). These recommendations are beginning to take hold. A November 2004 survey of ECRI's (formerly Emergency Care Research Institute) Healthcare Risk Control System members indicated that one-third of respondents provide teamwork training to employees, and nearly half that do not indicated that they plan to implement teamwork training in the next year (ECRI, 2005).

Teamwork training has considerable potential for improving quality in EDs for several reasons. First, the ED parallels the environment in the aviation industry in many ways; high-stress, time pressure and uncertainty abound in both (Small et al., 1999). Second, ED staff tend to have little or no formal training in teamwork skills yet the delivery of emergency care requires fast decision making and effective coordination of groups of caregivers often from multiple disciplines with vastly different training, professional missions, cultural identities and feelings of empowerment. This unique environment throws together in real-time interaction such diverse providers as nurses, pharmacists, social workers, neurosurgeons, psychologists, and patient's attending physicians from the community. Patient outcomes could be undermined if caregivers do not work well together and appropriately coordinate their services (Risser et al., 1999).

Third, teamwork failures in the ED are not uncommon. A review of closed malpractice claims from several EDs found that 43 percent of errors were due to problems with team coordination and 79 percent of those errors could have been mitigated or prevented if there were an effective team structure in the ED and ED personnel had team behavior training. The researchers also concluded that better teamwork would have saved $3.50 per ED patient visit in

legal costs (Risser et al., 1999; Shapiro et al., 2004). White and colleagues (2004) noted that communication issues were associated with 30 percent of the ED risk management files they studied, and appeared to contribute directly to adverse medical outcomes in 20 percent of those cases.

Research on the impact of teamwork training in the ED is thin but promising. MedTeams, a DoD project that introduced teamwork training in to healthcare, developed an Emergency Team Coordination Course (ETCC), an 8 hour didactic course taught for physicians, nurses, technicians and support personnel. An evaluation of the course revealed considerable success. EDs using the ETCC experienced a 67 percent increase in error averting behavior and a 58 percent reduction in observable errors (Risser et al., 1999; Shapiro et al., 2004). The research team also identified behaviors associated with teamwork failures including failure to identify an established protocol for patient care, and failure to cross-monitor the actions of other team members. They also found that in most of the adverse events studied, some team member had a piece of information, observed an action, possessed a skill, or had a doubt or suspicion that, if acted upon, could have prevented or mitigated the error (Wears and Simon, 2000).

Key to teamwork training for ED providers is the use of simulations and promotion of interprofessional collaboration. Simulation training involves giving ED providers practice performing tasks in lifelike circumstances using models or virtual reality and includes feedback from observers, other team members, and video cameras to assist improvement skills. Human simulators can give clinician experience in dealing with high-risk, low-frequency events. For example, a pregnant human patient simulator can be used to train clinicians for emergency cesarean-section procedures. These simulators allow for providers to learn from mistakes without harming a real patient (ECRI, 2005). The IOM report *To Err is Human* recommended use of simulation training as a strategy to prevent medical errors (IOM, 2000).

Again, evidence of the effectiveness of simulation-based training is thin, but initial research indicates benefits. In one study, groups of ED staff including nurses, physicians, emergency medicine residents, and technicians were randomly assigned to receive an 8 hour intensive experience with a simulator in which three scenarios of increasing difficulty were presented following a didactic training session. In comparison to a control group, that received only didactic training, the group that experienced simulation training displayed an improvement in the quality of team behavior whereas the control group did not. Those who underwent the simulation training believed it was a useful educational method (Shapiro et al., 2004).

The use of simulation training is becoming more common. An example is the Advanced Cardiac Life Support Course for third-year medical students at Brown University, which involves assigning students to multidisciplinary teams with nurses and technicians. The teams receive teamwork training while learning advanced cardiac life support (ACLS) using a high-fidelity simulation mannequin (Morchi, 2002). At Regions Hospital, emergency medicine residents spend 30 to 40 hours per year at a simulation center where, among other things, residents learn teamwork skills and develop their ED team leadership skills in realistically complex, challenging, and stressful emergency situations. The sessions are taped, and faculty and residents review and discuss performance (Patow, 2005).

Interprofessional collaboration is also a critical consideration for teamwork training, particularly in EDs where individuals from various medical disciplines must work together effectively. (See Box 6-2.) There are often differences in views that exist across health professionals that can act as barriers to team performance (IOM, 2004a). Interprofessional

collaboration in the ED may not develop naturally because of the high-pressure, high-stress environment coupled with strong personalities and egos of providers.

Interprofessional collaboration refers to an aggregation of attributes that include a shared understanding of goals and roles, effective communication, shared decision making, and conflict management. Evidence supports the effectiveness of interprofessional collaboration as a means of improving patient outcomes. There are several ways in which hospital leadership can nurture interprofessional collaboration through changes in organizational structure and processes. These strategies were endorsed by the IOM in the report *Keeping Patients Safe: Transforming the Work Environment of Nurses* (IOM, 2004a).

Most important is the need to enhance partnerships among the diverse professionals that function with the ED and hospital environments to mutually solve the problems of crowding, diversion, communication and coordination, in order to provide better patient care. For example, the operations management solutions to crowding discussed in Chapter 4 cannot work without buy in and collaboration among emergency physicians, admitting surgeons, and other critical specialists that make it possible to attempt changes in the status quo—in this case, changing long established admitting and OR blocking patterns. Likewise, unless emergency and trauma surgeons collaborate with on call specialties, it will be difficult to fashion solutions to the on-call problems that plague hospitals and contribute substantially to crowding and boarding of patients. This goes beyond transforming the patient care work environment, but must go in parallel with these changes.

Hospital leadership should model collaborative behaviors as a way to persuade other ED staff to adopt the same behaviors. Second, hospital leadership should support ongoing acquisition and maintenance of staff's clinical knowledge and skills. Research indicates that individual clinical competence is an essential precursor to collaborative practice. ED work and workspace should be designed to facilitate collaboration. The workspace should encourage physical proximity among ED personnel that work together and staffing patterns should ensure that personnel have time to participate in collaboration activities. Hospital leadership should encourage interprofessional practice mechanisms. Structured interprofessional forums, such as patient rounds or regularly scheduled interprofessional meetings, are effective in improving patient care. Patient record and document sharing also promote interprofessional information sharing.

Training in collaborative practice behaviors is needed. ED personnel tend to have little or no formal training in teamwork skills. The newly developed Emergency Team Coordination Course (ETCC), an 8 hour didactic course taught for physicians, nurses, technicians, and support personnel, has shown some success. An evaluation of the course revealed that EDs using the ETCC experienced a 67 percent increase in error averting behavior and a 58 percent reduction in observable errors (Risser et al., 1999; Shapiro et al., 2004). The use of high fidelity simulation models in these training exercises is important. The stress experienced by trainees when using a high fidelity patient simulation model reproduces realistic patient encounters and reflects the difficulty associated with performing under stress (Vozenilek et al., 2004).

Finally, human resource policies should be designed to support collaboration. Hostile behaviors, such as verbal abuse, should be identified and addressed. Managers should set practice expectations for staff, endorsing cooperation and communication with others while displaying regard for their dignity; shouting, foul language, and rudeness must be restricted. Performance evaluations could include measures of the extent to which staff are viewed as collaborators by staff from other disciplines.

BOX 6-2 Example of Effective Collaboration in the ED

It was an extremely busy shift in an ED, where the entire department had recently been trained in teamwork and collaboration. An emergency physician had just come from a resuscitation and was seeing a patient with an acute, but non-life-threatening condition. During the history and physical exam, the patient told the physician twice about his severe allergy to a particular medication. The physician noted the allergy, and as he left the patient's room, was pulled into another resuscitation. During a momentary break, the physician wrote orders on the patient's chart prescribing the medication he was allergic too. An experienced nurse caught the mistake and showed no hesitation bringing it to the physician's attention in a professional manner. Somewhat angry at himself for making the error, the physician was nonetheless very appreciative that the error had been caught and the nurse felt empowered to bring it to his attention.

RURAL ED PROVIDERS

The workforce in rural EDs has mirrored many of the challenges of recruitment and retention of healthcare providers in rural areas. A recent IOM study, *Quality through Collaboration: The Future of Rural Health*, described the special problems of rural health, and the unique challenges of providing high quality medical services in rural areas, particularly core health services such as emergency care. The report highlighted the critical shortages of medical personnel in rural areas, the critical need to address these shortages, and the complex challenges associated with strengthening the rural workforce (IOM, 2004b). Although twenty-one percent of Americans live in rural areas, only slightly more than twelve percent of emergency physicians, regardless of training or certification status, practice in this setting (Moorhead et al., 2002). Thus, a pattern of population based maldistribution exists and, in fact, has worsened since 1997. In 1997, fifteen percent of emergency physicians practiced in rural areas (Moorhead et al., 1998; Williams et al., 2001). This change may reflect the fast growth in urban areas with rising numbers of emergency medicine residency training programs rather than a sharp decline in rural communities. Nevertheless, a significant maldistribution exists.

The specialty of emergency medicine has focused on strategies for increasing the number of emergency medicine specialists in rural areas, but workforce issues in rural EDs may never be solved by this effort alone. The difficulties in recruitment and retention are due to a variety of reasons, but are generally assignable to one of two categories: work-related factors, or personal and community characteristics (Pan et al., 1996). There exists a strong correlation between where a physician is raised and the community in which he or she later chooses to practice (Williams et al., 2001). Additionally, the location of residency training is a major factor in choice of practice location for emergency medicine residency graduates regardless of previous geographical ties (Steele et al., 1998). Rural hospitals with residency training programs are more successful in recruiting and retaining physicians upon completion of residency (Connor et al., 1994; Cutchin, 1997). The fact that the majority of emergency medicine residency programs are located in urban areas suggests that residency graduates will likely continue to choose to practice in urban regions. These graduates are also faced with the reduced levels of compensation in rural areas (Bullock et al., 1999) and an increased workload; rural emergency medicine physicians spent thirty-five percent more time as on-call backup than the average for all emergency physicians (Moorhead et al., 2002). The high debt burden of many emergency medicine residents and the limited opportunity to earn sufficient revenue to pay off educational debt in rural settings, presents a significant barrier to rural practice. With fewer resources and consultants (Sklar et al.,

2002), the lack of emergency medicine trained physicians in rural areas is not surprising. Payment differences between urban and rural areas may also be an important factor.

One strategy to increase the emergency care workforce in rural areas would be to increase the number of emergency medicine residency programs in rural areas. However, ACGME program requirements enforced by the Residency Review Committee (RRC) make it virtually impossible to gain certification of a "rural" residency program unless it is situated in a large referral hospital. The RRC is equally reluctant to recognize "satellite" sites at rural hospitals if they are geographically remote from the program's "base" hospital, regardless of distance. Changes in such ACGME requirements might increase rural emergency medicine training during residency and ultimately benefit rural emergency medicine workforce and quality of care. Another approach would be to develop programs that cover the costs of medical education in return for future assignment to rural areas, based on the National Health Service Corps or the Public Health Service Commissioned Corps models, but targeted specifically toward emergency medicine.

In order to compensate for manpower shortages, rural EDs have resorted to alternative methods and providers in an effort to maintain minimum levels of staffing. This is evident in an examination of physician characteristics of rural EDs. One survey of random hospitals across the U.S. showed that rural EDs, comprising 25 percent of all EDs, reported an average of 4.74 physicians per institution, 40 percent fewer than the average for all locales (Moorhead et al., 2002). Full-time equivalents (FTEs), defined as 40 clinical hours per week, were also significantly lower in rural EDs; 3.42 FTEs/rural ED – 35 percent lower than average. Rural EDs were noted to have the highest percentage of osteopathic physicians (14 percent) and non-U.S. trained physicians (14 percent). Importantly, 67 percent of rural emergency medicine physicians are neither residency trained nor board certified in emergency medicine. Of the 33 percent of physicians with emergency medicine credentials, less than half are both emergency medicine residency trained and board certified. Only 12 percent of rural respondents in the survey reported requiring any emergency medicine credentials for ED hiring. In summary, rural EDs have lower levels of staffing, and when staffed by physicians, these physicians are much less likely emergency medicine specialists, but are more likely to be trained in family practice or other primary care specialties.

Although, ideally, all EDs would be staffed by residency trained board certified emergency physicians, this is highly unlikely to occur in the near to middle term, if ever. Therefore alternative staffing models must be developed. Clinicians other than physicians are often utilized in the staffing of rural EDs (Moorhead et al., 2002). These include, for example, physician assistants (PAs), nurse practitioners (NPs), certified nurse mid-wives and clinical nurse specialists. Rural EDs experience problems with recruitment and retention of all clinicians, not just physicians, and for similar reasons (Bullock et al., 1999). With national efforts to lower costs, and the demonstrated success of using non-physician clinicians in certain proscribed roles, their use in the staffing of rural EDs may increase (Blunt, 1998).

In the absence of any other standards for credentialing, rural ED providers exhibit wide variability in their skill levels and the competence with which they provide emergency care. Care often falls short of established guidelines. In a study of acute stroke care in non-urban EDs, patients were found to have been in ways discordant with AHA recommendations. Hypertension was often treated too aggressively and inappropriate medications were sometimes used. Additionally, it was suggested that non-motor symptoms of stroke were less likely to be recognized or were treated with less urgency than motor symptoms of stroke (Burgin et al., 2001). Although this data is far from conclusive, studies such as this may explain in part the

stigma of decreased levels of competence attributed to rural emergency physicians (Leap, 2000). Yet, the reality is that rural emergency physicians are often called upon to single-handedly care for critically ill and injured patients in a challenging setting typically lacking in manpower, equipment and access to consultants. The deficit of rural healthcare providers has complicated the roles that these providers must fill. It is typical that rural primary care physicians' practices entail management of patients in EDs, outpatient clinics, inpatient wards, intensive care units, as well as additional duties related to healthcare administration. Additionally, the low patient census in a rural ED may contribute to the difficulty physicians and mid-level providers have in maintaining a high level of emergency medicine proficiency.

Furthermore, the shortages of certain specialists who provide on–call emergency and trauma services are even scarcer in rural areas. Substantial near term increases in the capacity to provide advanced emergency and trauma care in rural settings are unlikely. This makes effective regional solutions to the transport of patients to definitive and trauma care essential. But effective transport requires effective stabilization, critical care management, and in some cases surgical intervention. The proposed subspecialty in emergency surgery, described in an earlier section, has particular applicability to rural settings where there are unlikely to be other specialists with the skills to adequately address certain serious emergencies

But all patients, regardless of setting, deserve prompt access to high quality emergency care. Initiatives to enhance emergency care quality in rural regions have recognized the need to develop strategies to enhance knowledge and training, as well as options to expand the emergency care workforce. Given current emergency care workforce shortages and health system economic conditions, it is unlikely that rural EDs will have resources and ability to have residency trained and board certified emergency physicians on a 24/7 basis. In order to address this, several have recommended increased collaboration between emergency medicine and primary care specialties (such as family practice who provide emergency medicine in rural areas), and increased links between academic medical centers and rural hospitals (Williams et al., 2001). Minnesota emergency physicians and family practitioners have developed a course for training teams of healthcare providers in comprehensive advanced life support that serves as a model for collaborative training in rural emergency medicine (Carter et al., 2001).

The committee supports these efforts. The committee recommends that **states link rural hospitals with academic health centers to enhance opportunities for professional consultations, telemedicine, patient referrals and transport, and continuing professional education.**

RECOMMENDATIONS

6.1: Hospitals, physician organizations, and public health agencies should collaborate to regionalize critical specialty care on-call services.

6.2: Congress should appoint a commission to examine the factors responsible for the declining availability of providers in high-risk emergency and trauma care specialties, including the role played by medical malpractice liability in specific, and to recommend targeted state and federal actions to mitigate the adverse impact of the responsible factors and ensure quality of care.

6.3: The Department of Health and Human Services, the Department of Transportation, and the Department of Homeland Security should jointly undertake a detailed assessment

of emergency and trauma workforce capacity, trends, and future needs, and develop strategies to meet these needs in the future.

6.4: The Department of Health and Human Services, in partnership with professional organizations, should develop national standards for core competencies applicable to physicians, nurses, and other key emergency and trauma professionals, using a national, evidence-based, multidisciplinary process.

6.5: States should link rural hospitals with academic health centers to enhance opportunities for professional consultation, telemedicine, patient referral and transport, and continuing professional education.

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7
Disaster Preparedness

The day before 9/11, the cover story of U.S. News and World Report described an emergency care system in critical condition due to demand far in excess of its capacity (Shute and Marcus, 2001). (See Figure 7-1.) While the U.S. News article focused on the day-to-day problems of diversion and boarding, the events of the following day brought home the frightening realization to many—if we can't take care of our emergency patients on a normal day, how will we manage a large scale disaster. Federal, state and local government entities have since realized the importance of hospitals, particularly EDs, in planning for these events and significant progress has been made in integrating inpatient resources into planning for disasters (Schur, 2004). More than four years after 9/11, however, Hurricane Katrina revealed how far there is to go. While Katrina was unusual in its size and scope, the capacity of the emergency care system to effectively respond to smaller disasters is still in question (GAO, 2003a).

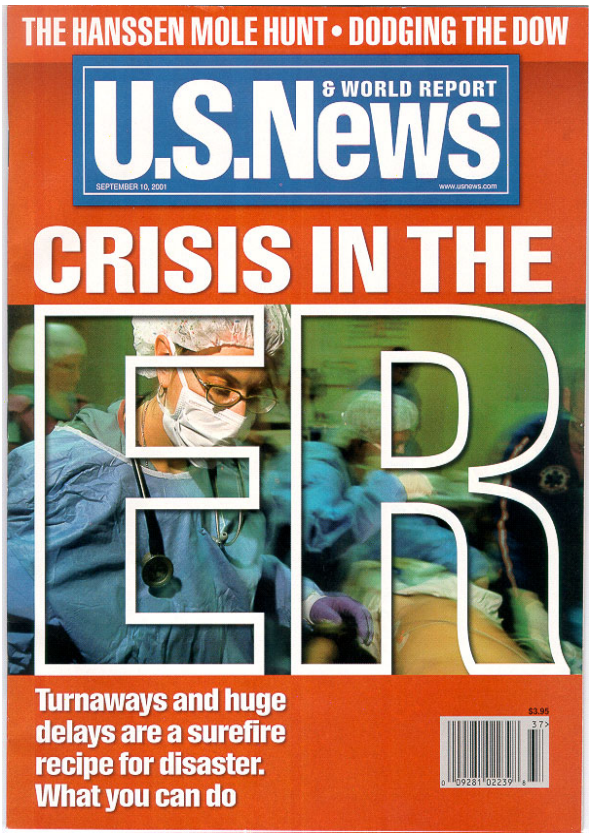

FIGURE 7-1 U.S. News and World Report, Cover Story on September 10, 2001.
SOURCE: **Copyright 2001** U.S. News & World Report, L.P. Reprinted with permission.

Disaster response involves many different community resources—from police and fire, to medical providers, structural and environmental engineers, and transportation and housing experts. The hospital plays a small but crucial role in this larger picture. It is the epicenter of medical care delivered to those who are injured. Running a hospital is an enormously complex task under the best of circumstances. Preparing a hospital for a disaster is infinitely more complicated. Planning for disasters involves a range of difficult questions—for what types of disaster events should hospitals prepare? Should every hospital prepare for disasters, or should medical response be regionalized? When does "busy" rise to the level of disaster, who decides that, and how does a large, complex organization shift from routine mode to disaster mode? How does a hospital protect itself and its staff from chemical or biological agents when the patients are contaminated?

This chapter examines these and other questions, and considers the current level of hospital preparedness. It also explores the special problems associated with rural hospitals, and describes the committee's recommendations to enhance hospital preparedness.

DEFINING DISASTER

The term "disaster" indicates a low probability but high impact event that causes a large number of individuals to become ill or injured. The International Federation of Red Cross and Red Crescent Societies defines a disaster as an event that causes more than ten deaths, affects more than 100 people, or leads to an appeal by those affected for assistance (Bravata et al., 2004b). This report expands the definition in the context of hospital-based emergency and trauma care to include any event that creates a significant, short-term spike in the demand for emergency care services which requires extraordinary measures to adequately address.

Disasters can range from large multiple vehicle crashes, to massive events such as the North Ridge Earthquake, Hurricane Katrina, and terrorist attacks such as 9/11. Disasters can be natural, such as earthquakes, floods, and disease outbreaks; or they can be manmade, such as transportation incidents, terrorist bombings, and biological or chemical attacks. The federal government has grouped potential terrorist threats into five categories: chemical, biological, radiological, nuclear and explosive (CBRNE), which are also useful for classifying general threats (see Box 7-1).

BOX 7-1 Classification of Terrorist Threats

The federal government combines terrorist threats into five categories--chemical, biological, radiological, nuclear, and explosive incidents--commonly referred to as CBRNE. Each type of threat has unique characteristics and medical impacts:

- **Chemical.** A chemical emergency occurs when a hazardous chemical has been released and the release has the potential for harming people's health. In the U.S. there are 60,000 chemical spills, leaks, and explosions with more than 300 deaths per year (Geiger, 2001; Kaji and Waeckerle, 2003). Many hazardous chemicals are used in industry (for example, chlorine, ammonia, and benzene). Chemical releases can be unintentional, as in the case of an industrial incident, or intentional, as in the case of a terrorist attack. Examples are nerve agents such as Sarin, mustard gas, and choking agents, such as phosgene. Others are found in nature (for example, poisonous plants).
- **Biological.** This includes bioterrorism agents, such as anthrax, smallpox, botulism, and plague. In the non-terrorism context, it can include outbreaks of infectious disease with a high risk of transmission and serious health effects, such as SARS and the avian flu.
- **Radiological.** Wide scale exposure to radiation could result from dirty bombs, in which radioactive material is dispersed through an explosive device, or by compromising the containment of nuclear power stations or nuclear storage facilities.
- **Nuclear.** Resulting from the detonation of a nuclear device, this can result in a wide range of injuries, including explosive, radiological, and burn injuries.
- **Explosive.** Explosive injuries can include blunt and shock wave induced trauma as well as burns, hearing loss, and injuries from shrapnel and the secondary collapse of structures.

Each type of threat presents different challenges to hospitals, and hospitals must able to respond to each in some capacity. However, given finite resources, hospitals must attempt to focus resources on the most likely and most potentially serious scenarios. Bombings are the most common form of terrorist attack (Frykberg, 2004). They often exhibit the worst forms of both blunt and penetrating trauma, in addition to burns, as recent experience has shown, e.g., the train and subway attacks in Madrid (Gutierrez de Ceballos et al., 2004) and London, the Oklahoma City bombing (Teague, 2004), the Atlanta Centennial Olympics bombing (Feliciano et al., 1998). Worldwide, there were more than 500 terrorist bombings between 2001 and 2003, resulting in 4,600 deaths (U.S. Department of State, 2005a,b,c). Over the past 25 years, few acts of global terrorism have involved the use of chemical or biological agents. In contrast, explosives and/or firearms have been used to commit countless acts of terrorism in Israel, Egypt, Kenya, Argentina, Colombia, Bali, Yemen, Russia, the United Kingdom, Germany, France, Italy, and many other countries

The possibility of bioterrorism or nuclear attack is also real, however, and the impact on public health would be catastrophic. To some degree, each region has to prioritize its response based on the likelihood of different types of events it may face. Thus, New York City should probably spend more resources on preparation for biological or nuclear attack than Topeka. Topeka, on the other hand, should focus more of its efforts on tornados.

The scope of different types of disasters is illustrated by selected recent events, which are summarized in Table 7-1.

Table 7-1. Recent Disaster Events (U.S. and Worldwide)

Type	Category	Location	Deaths
Natural	Hurricane (Katrina)	New Orleans/LA/MS/AL (2005)	1,326
	Avian flu	6 countries (2005-6)	118 (as of 10/20/05)
	Earthquake	Kashmir (2005)	73,000 (69,000 injured)
	Tsunami	12 countries (2004)	212,611
	SARS	25 countries (2002-3)	774
	Earthquake	Northridge, CA (1994)	57 (5000+ injured)
Man-made	Subway bombings	London (2005) Madrid (2004)	52 (700 injured) 191 (2000 injured)
	Nightclub fire	Rhode Island (2003)	100 (200+ injured)
	Nightclub bombing	Bali (2002)	202
	Anthrax	D.C. (2001)	5 (13 injured)
	September 11th	New York/D.C. (2001)	2,752
	Embassy bombings	Nairobi and Tanzania (1998)	224 (4000+)
	Sarin gas	Tokyo, Japan (1995)	12 (5000 injured)

Sources (in order): Associated Press, 2006a; BBC News, 2006b; Times Foundation, 2005; CNN.com, 2005a; IOM, 2004; Insurance Information Network of California, 2006; CNN.com, 2005b; Gutierrez de Ceballos et al, 2004; Associated Press, 2006b; BBC News, 2006a; CNN.com, 2002; Hirschkorn, 2003; Rand Corporation, 2004; Accountability Review Boards on the Embassy Bombings in Nairobi and Dar es Salaam, 1999; BBC News, 2005.

The federal government has promoted the idea of preparing for "all-hazards." But federal disaster planning has paid much more attention to biological and chemical threats, with little attention paid to explosive attacks by terrorists or, until Hurricane Katrina, on natural disasters (Arkin, 2005). Of the 15 National Planning Scenarios introduced by the Department of Homeland Security (DHS) to guide disaster preparation efforts, only two involve natural disasters and only one involves an attack using explosives (see Box 7-2).

BOX 7-2 The Department of Homeland Security's 15 National Planning Scenarios

1. Nuclear Detonation: 10-Kiloton Improvised Nuclear Device
2. Biological Attack: Aerosol Anthrax
3. Biological Disease Outbreak: Pandemic Influenza
4. Biological Attack: Plague
5. Chemical Attack: Blister Agent
6. Chemical Attack: Toxic Industrial Chemical
7. Chemical Attack: Nerve Agent
8. Chemical Attack: Chlorine Tank Explosion
9. Natural Disaster: Major Earthquake
10. Natural Disaster: Major Hurricane
11. Radiological Attack: Radiological Dispersal Device
12. Explosives Attack: Bombing Using Improvised Explosive Devices
13. Biological Attack: Food Contamination
14. Biological Attack: Foreign Animal Disease (Foot and Mouth Disease)
15. Cyber Attack

SOURCE: DHS, 2005b.

Following Hurricane Katrina, however, the Homeland Security Department altered the selection process for its Urban Area Security Initiatives grants to ensure that the program provided as much weight to cities under threat from natural disasters as those that are likely targets of terrorism (Jordan, 2006).

When Does an Event Become a Disaster?

Because of the unpredictability of demand for emergency services, hospitals face fluctuations in utilization on an hourly, daily, and weekly basis. With many hospitals already operating at or near full capacity already (as detailed in Chapter 2), temporary surges can exacerbate chronic emergency department crowding, boarding, and ambulance diversions While these surges in demand can severely stretch the resources of a hospital's staff and diminish the quality and safety of patient care, hospitals generally maintain the standard of care under which they normally operate through these surges. In a disaster situation, however, hospitals may need to shift to a sufficiency of care mode, in which the focus is on saving as many lives as possible, rather than ensuring that each patient receives the usual standard of care (AHRQ, 2005). In the most extreme cases, such as a full-blown influenza pandemic such as that experienced worldwide in 1918, this could mean, assigning the most severely ill or injured patients to "expectant care" a strategy that withholds treatment for those who have very little chance for survival in order to focus resources on saving the largest possible number of lives.

A hospital's decision to switch from routine to disaster mode has enormous implications. When to make that decision, and what actions to take as a result of it are complex. A number of initiatives are exploring these questions. For example, within DHHS, the CDC Center for Injury Prevention and Control, Division of Injury Response is developing a consensus report that describes the detailed actions to be taken by hospital and trauma center departments and personnel in the event of an explosive mass casualty event (CDC National Center for Injury Control and Prevention, 2006). The Agency for Healthcare Research and Quality (AHRQ) has sponsored research, convened expert panels, and published guidance for hospitals and communities to prepare for biological and other terrorist events. HRSA's Bioterrorism Hospital Preparedness Program is targeted specifically to hospital preparedness, with a focus on the development and implementation of regional plans to improve the capacity of hospitals to respond to bioterrorist attacks.

CRITICAL HOSPITAL ROLES IN DISASTERS

Evaluations of ED preparedness consistently reveal the same finding—EDs are better prepared than they used to be, but still fall short of where they should be (Schur et al., 2004). A survey conducted by CDC in 2003 gives a comprehensive picture of hospital preparedness in the years following 9/11 (Niska and Burt, 2005). Hospitals vary widely in the degree to which they have prepared for the range of possible threats. Almost all hospitals (97.3 percent) have plans for responding to natural disaster because it is a requirement of JCAHO accreditation to hold natural disaster drills. More than 80 percent of hospitals had plans for chemical (85.5 percent) and biological threats (85.5 percent), and more than 70 percent had plans for nuclear and radiological (77.6 percent) and explosive threats.

The remainder of this section reviews the current status of hospital preparedness and recommended actions to enhance preparedness across five critical hospital roles in disasters: maintaining surge capacity, planning and coordination with the wider health and public safety

communities, preparation in terms of training and disaster drills, protecting the hospital and its staff, and surveillance.

Surge Capacity

Hospitals in most large population centers are operating at or near full capacity. In many cities, the hospitals and trauma centers have problems dealing with a multiple car highway crash, much less a major mass casualty event. With many hospitals already operating at or near capacity, most hospitals do not have the capacity to handle the volume of patients likely to result from a large-scale disaster. In emergencies, there are a number of things that hospitals can do to free up capacity and extend their resources. But there are serious physical limits to such expansions. Surveys indicate that the number of available beds, ventilators, isolation rooms, and pharmaceuticals may be insufficient to care for victims of a large-scale disaster (Kaji and Lewis, 2004). The Rhode Island nightclub fire demonstrated that even medium-sized incidents can overwhelm local hospital capacities (Hick et al., 2004). Frequent ambulance diversion and ED boarding also signal limitations to hospital surge capacity.

The issue of capacity is an immediate problem because many hospitals and their EDs already maximize their existing capacity after years of capacity shedding in order to reduce cost. According to the American Hospital Association (AHA), 60 percent of hospitals were operating at or over capacity in 2001 (Lewin Group, 2002). Many hospitals have already opened additional beds in an effort to alleviate overcrowding but continue to face nursing shortages and staffing issues in supporting existing beds (Derlet and Richards, 2000; Asplin and Knopp, 2001).

The limiting factor in the ability to respond to a disaster will vary by hospital and by type of disaster. An important limiting factor is the availability of specialists that can treat the types of cases resulting from a disaster event. For an event involving a rare biological or chemical agent, there may be limited expertise in the community. For more common types of events, such as blast injuries, the limitation will likely be an inadequate supply of surgical specialists (including neurosurgeons, orthopedic surgeons and burn surgeons) to treat the volume of cases requiring their specialized services. While other staff, such as emergency physicians, critical care specialists, and nurses, are important, they are less likely to represent a hard constraint on the ability to treat additional patients. One way that hospitals can alleviate shortages of patient care staff is to utilize EMS personnel as physician extenders. In many disaster scenarios, the prehospital component is over in one to two hours, making a large number of EMS personnel available just as hospital activity is peaking.

Physical space is an important consideration, but probably not the most important factor. Hospitals can add to available capacity on short notice by halting elective admissions and discharging non-critical patients. In addition, hospitals can sometimes utilize ED hallways, inpatient hallways, and non-clinical areas to house victims in an emergency. According to the CDC survey, however, only 61 percent of hospitals had developed plans for the use of non-clinical space in such an instance (Niska and Burt, 2005). In some instances, particularly a more circumscribed disaster, hospitals can make room for patients by transferring existing inpatients to more distant facilities. But the CDC study revealed that only 46 percent of hospitals had agreements with other hospitals to accept patients in the case of a disaster (Niska and Burt, 2005).

ICU beds are much harder to empty on short notice than are other beds, and these are probably the key limiting factor in terms of physical capacity, as they often are in day to day crowding (GAO, 2003a). Another physical limitation is the number of negative pressure rooms

needed to prevent the spread of airborne pathogens. Limitations in available equipment, such as mechanical ventilators and decontamination showers are also important. The committee concludes that the lack of adequate hospital surge capacity is a serious and neglected element of current disaster preparedness efforts.

Planning and Coordination

When a disaster occurs, the normal operating assumptions about patients, response, and treatment often must be jettisoned. Depending on the type of event, some of the non-routine things that can happen include (Ackermann et al., 1998; Auf der Heide, 2006):

- The victims who are less injured and mobile (the so-called "walking wounded") will often self transport to the nearest hospitals, quickly overwhelming those facilities.
- Casualties are likely to bypass on-site triage, first aid, and decontamination stations.
- EMS responders will often self-dispatch. Providers from other jurisdictions may appear at the scene and transport patients, sometimes without coordination or communication with local officials.
- In some cases, local facilities are not aware of the event until or just before patients start arriving. Hospitals may receive no advance notice of the extent of the event or the numbers and types of patients they can expect.
- There may be little or no communication among regional hospitals, incident commanders, public safety, and EMS responders in order to coordinate the response region-wide.

Consider the regional response needed after the Rhode Island Nightclub Fire in February 2003. During a concert, a fire broke out on the stage in the small venue and quickly spread throughout the nightclub before many patrons could escape. The fire consumed the building in 3 minutes and 96 people were killed. One hundred and sixty firefighters from 15 communities were needed to put out the flames; sixty-five ambulances also responded (Gutman et al., 2003; Ginaitt, 2005).

The first patients began to arrive at local hospitals minutes after the fire broke out. Most hospitals received notification from EMS before patients began to arrive, but several others said that they received no notification or that there was limited or incorrect information regarding the number of patients to expect. A total of 273 victims sought care at hospitals. The closest hospital to the nightclub (3 miles away), Rhode Island's second largest, is a 359 bed acute care hospital that handles 58,000 ED visits per year. It received 82 patients of which 25 percent were admitted and 25 percent transferred to other hospitals. A level I trauma center located 12 miles away from the nightclub received 68 patients; approximately 63 percent were admitted (Gutman et al., 2003). A number of other Rhode Island hospitals as well as Mass General, University of Massachusetts Medical Center, and Shriners Hospital for Children also received patients. It was only the second time that Shriners opened their doors to adult patients (Ginaitt, 2005).

But there was limited communication between hospitals and no means for hospital coordination and prioritization of helicopter transfers of patients to burn centers. As a result, 10 transfers by helicopter occurred from four different hospitals within the first few hours. All air medical resources available in New England were used that evening (Gutman et al., 2003). The regional resources needed to respond to this event, which is considered to be a medium-sized emergency incident, is striking. It demonstrates the need for hospitals to coordinate planning

with each other as well as other responders, including prehospital providers and air medical personnel. This often means working and planning with groups across state lines, together deciding on and implementing the surge capacity, workforce training, protective equipment, and surveillance and communications systems appropriate for the region.

Coordination between Local, Regional, State, and Federal Entities

The underlying philosophy of disaster management is that every event is handled at the lowest possible geographic, organizational and jurisdictional level (DHS, 2004). When a disaster event becomes larger than can be handled adequately by local response, the state usually gets involved, enabling the allocation of statewide resources to the affected area. The state government has ultimate responsibility for the health and well-being of its citizens, and can allocate funding and statewide emergency resources, utilize National Guard troops, and draw on state supplies of drugs and vaccines. When an event becomes too big to be handled at the state and local levels, it may be declared an "incident of national significance". In this case, the command structure shifts to the federal response outlined by the National Incident Management System (NIMS) through the U.S. DHS, and opens the way for federal resources, including federal stockpiles, Disaster Management Assistance Teams (DMATs), and federal dollars to support operations.

Most agree that to be effective, incident control must be clear, communications good, and providers at the local level involved in to the process. In the event of a disaster, local emergency providers must respond as additional resources are mobilized at state or federal levels. The medical care component of most disasters is usually over after a few hours, so even if these additional resources can be assembled, they may arrive too late to be of much help (Waeckerle, 1991). Further, only regional and local planning can adequately anticipate and address local utilization patterns that will impact execution of disaster plans. Therefore, all hospitals must be prepared to receive patients suffering from any type of illness, injury, or exposure.

In order to respond effectively, hospitals must interface with incident command at multiple levels, and be prepared to deal with transitions between them, for example, when incident command shifts from local to state or federal levels. Each hospital should be familiar with the local office of emergency preparedness, and know how hospitals are represented at the emergency operations center during an event, whether through the hospital association, through the health department, through the EMS system, or some other mechanism. Using an existing program, such as the Hospital Emergency Incident Command System (HEICS), can aid hospitals in internal preparedness and coordination with the rest of the system. HEICS is a standardized approach to disaster management—essentially an internal hospital application of NIMS—that was developed and has been used nationwide for a decade.

Regionalization

Current federal preparedness funding has been geared toward preparing all hospitals to respond at some level to all hazards. Because the range of possible threats is so wide, the feasibility of meaningfully preparing all hospitals is unrealistic. Regionalization of certain aspects of preparedness may facilitate a more timely and effective response (Bravata et al., 2004a). The benefits of regionalizing disaster response include consolidation of inventories of drugs and vaccines, surveillance to identify outbreaks of disease, efficiency of concentrating certain types of medical response at fewer hospitals, and improved communications, command, and control associated with region-wide events (GAO, 2003a). Regionalization is also likely to

benefit triage, medical care, outbreak investigations, security management, emergency management, and training.

Regional trauma systems are critical to planning for the care of severely injured patients during a disaster. While 47 states have developed or are developing a statewide trauma system plan, and 38 states now designate trauma systems, there is wide variation across states in the level of development of these systems, and in the degree of coordination with disaster planning. In one example of a regional approach to disaster planning, Connecticut developed a statewide system for hospital preparedness for bioterrorism that was built on the trauma system (Jacobs et al., 2003). The Connecticut Department of Public Health contracted with two Level I trauma centers, which were designated as regional centers of excellence for bioterrorism preparedness. The existing trauma system and communications network provides the basic infrastructure for the system, which links to the Metropolitan Medical Response System centered in Hartford. The two centers of excellence serve to coordinate all aspects of medical disaster response activities within their regions, including surveillance, training, planning, facilities, equipment, and supplies. This model is based on the realization that resources are too scarce for a haphazard approach—disaster funding should be targeted to those regions and hospitals where it will do the most good for the community in the event of a disaster. Ideally, all assets required for a community or a state to mount an effective response should be developed within the regional context described in Chapter 3.

Federal funding for the development of such approaches is currently limited. The establishment of the Division of Trauma and EMS within DHHS in 1990 helped to jump start the development of trauma systems through state grants. But this program was eliminated in 1995, leaving a gap in federal leadership until the creation of the Trauma/EMS Systems Program within HRSA's Division of Healthcare Preparedness in 2001. This program was also recently defunded. While this program operated on a relative shoestring—approximately $3.5 million in fiscal years 2002 to 2005—it provided critical national leadership for planning, infrastructure development, standards development, and coordination with other federal agencies.

Communications

Good communications between the many community services involved in disaster response are essential to an effective response. Without them, officials cannot ensure that patients will be directed to the most appropriate facilities, that hospitals will not be overwhelmed with patients, that hospitals will be alerted sufficiently in advance for the arrival of patients so that they can mount the appropriate response, and that resources will be allocated effectively throughout the community. Unfortunately, communication is a significant weakness of the current system, reflecting the fragmentation in emergency care that currently exists. According to a 2003 CDC survey, surprisingly few hospitals had provisions in their bioterrorism response plans for contacting outside entities such as EMS (72 percent), fire departments (66 percent),or other hospitals (51 percent). Hospital collaboration in mass casualty drills with outside organizations followed a similar pattern—only 71 percent collaborated with EMS, 67 percent with fire, and 46 percent with other hospitals.

In addition to coordinated communications, there should be investment in enhanced communications equipment. Hospitals should have reliable and redundant digital and voice communications with the regional and state public safety, emergency management, and public health agencies. The loss of hospital communications capabilities during Katrina turned out to be

a major obstacle to coordinating evacuation and care of victims. Hospitals should have some satellite telecommunications capability in preparation for a catastrophic event.

Veterans Administration

With hospitals, nursing homes, ambulatory care clinics and counseling clinics in many communities across the country, the Veterans Health Administration (VHA) is well positioned to enhance regional response, particularly since its hospitals are required by law to maintain excess capacity. VHA currently deploys personnel to all presidentially declared disasters including Hurricane Andrew, the Northridge earthquake, and the 9/11 terrorist attacks. Staff also support events such as the Super Bowl, presidential inaugurations, and papal visits. It is also in the process of developing an Emergency Management Academy to train and equip VA staff with emergency management skills. It also procures, stores, and maintains pharmaceutical stockpiles for incidents involving WMD (Emergency Management Strategic Healthcare Group et al., 2005). The committee recognizes the importance of the VHA in emergency planning and response, and recommends that **the Department of Homeland Security, the Department of Health and Human Services, the Department of Transportation, and the states collaborate with the Veterans Health Administration to integrate the VHA into civilian disaster planning and management.**

Training

The unique aspects of disaster response require specialized training, in both the clinical management of disaster victims, and in institutional procedures that may be quite different than under normal operating conditions (HRSA, 2002; Treat et al., 2001; GAO, 2003a,b; Rivera and Char, 2004). There are strong indications that education and training is inadequate in both areas.

Hospital Training and Drills

The recent CDC bioterrorism survey indicates that progress has been made since 9/11 in training hospital staff to deal with emergencies, but deficiencies remain. Training in response to terrorism-related threats varied widely among staff—92 percent of hospitals trained their nursing staffs in at least one type of threat. Residents and interns received training at only 49 percent of hospitals (Niska and Burt, 2005) (see Figure 7-2). This nevertheless indicates an improvement over pre-9/11 training. Treat, for example, found that less than 25 percent of hospitals in and around Washington, DC, had staff trained in weapons of mass destruction pre-9/11 (Treat et al., 2001). In the recent CDC study, staff at most hospitals (89 percent) had received training since 9/11 in the diagnosis and treatment of biological agents—most frequently smallpox and anthrax. And three-quarters of hospitals had trained staff in implementing an incident command system.

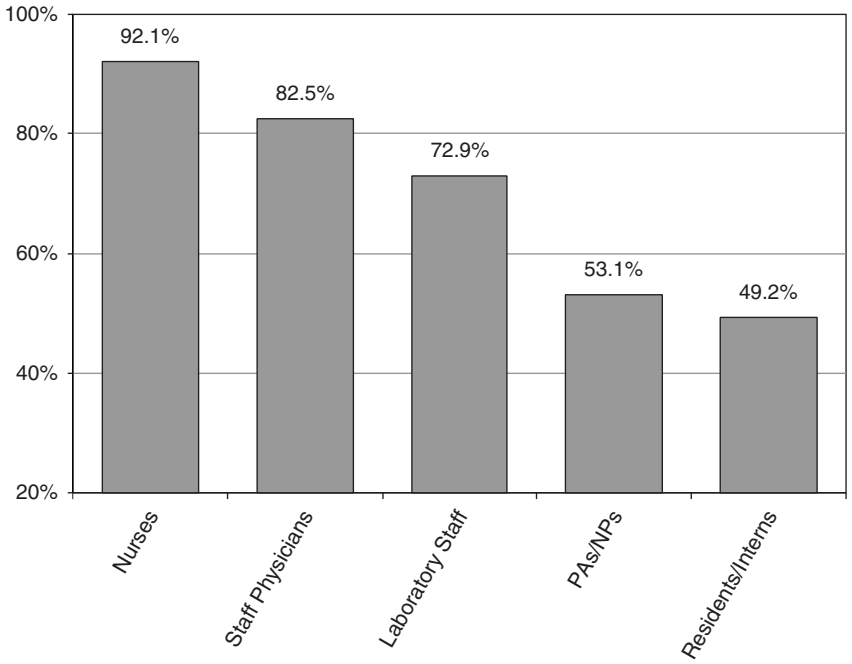

FIGURE 7-2 Percentage of hospitals with staff trained in disaster response.
SOURCE: Niska and Burt, 2005.

According to the CDC survey, almost 90 percent of hospitals (88.4 percent) have conducted a mass casualty drill. The most common scenario was a general disaster response, with far fewer hospitals addressing other types of threats—chemical (44.7 percent), biological (37.5 percent), explosive or incendiary (21.3 percent), nuclear or radiological (15.4 percent), and severe epidemics (7.1 percent).

JCAHO requires hospitals to have an emergency management plan and to evaluate the plan by conducting practice drills, but this effort focuses mostly on logistical aspects rather than personnel training. Some hospitals have developed their own curriculum or training guides for staff (Zavotsky, 2000; Phillips and Lavin, 2004). Researchers have aided these efforts by outlining key recommendations for training components (Waeckerle et al., 2001; Greenberg et al., 2003), developing ideas for future training approaches (Terndrup et al., 2005); and suggesting best practices based on provider feedback (Alexander et al., 2005). States can overcome the lack of standardized disaster training guidelines and other barriers by expanding and supporting continuing education and facility preparedness requirements.

But introducing on-the-job training for ED personnel is difficult for a number of reasons. Many hospitals report inadequate funding to cover attendance costs (e.g., time off, tuition, travel) of training (ACEP Nuclear Biological and Chemical Task Force, 2001). At the University of Pittsburgh Medical Center, a disaster drill in the ED costs $3,000 per hour in staff salaries alone (AHRQ, 2004). Also, the ED may experience personnel shortages during training unless coverage is provided for the staff that are being trained. Additionally, sometimes the failure of hospital administrators or ED personnel to recognize the importance of training results in a lack of support for training (ACEP Nuclear Biological and Chemical Task Force, 2001).

HRSA's National Bioterrorism Hospital Preparedness program (HRSA, 2006) (discussed in more detail below) provides grants to states to improve hospital preparedness. Guidance to grantees in the initial year of the program (HRSA, 2002) made education and training a secondary priority and in the following year it was made optional. However, all grantees noted that they were addressing education and training for bioterrorism and other public health emergencies. The most frequently addressed training was worker safety, followed by psychosocial issues for both patients and providers. Other topics addressed included responding to CBRNE events, incident command, risk communication, and treating special populations (AHRQ, 2004). The grantees used a variety of different methods for training, including face-to-face training, distance learning, field exercises and drills or distribution of written materials.

Professional Training Curricula

Training currently provided to physicians in medical school and continuing education programs does not uniformly incorporate training on the threat of disasters, types of WMD agents, and procedures for handling mass casualty incidents and events. WMD-related training is only a small component of emergency medicine residency programs, but, as mentioned earlier, approximately 38 percent of practicing emergency physicians are neither residency trained nor board certified in emergency medicine, and are therefore not exposed to that curriculum. Barriers to training include an already full medical school and residency curriculum and a lack of instructor expertise, equipment, and advocates to lobby for the inclusion of disaster preparedness training (Waeckerle et al., 2001; ACEP Nuclear Biological and Chemical Task Force, 2001). But opportunities for training on CBRNE agents exist at various levels; medical schools can incorporate instruction on these agents into current coursework (toxicology, epidemiology, etc.) and clerkships, residency programs can dedicate time to these agents in both the ED and in planned educational experiences, and states can require a certain amount of continuing education on these agents for re-licensure (Waeckerle et al., 2001).

Disaster training is also currently not a core component of the nursing curriculum. WMD topics and agents have been added to the ENA's *Emergency Nurses Core Curriculum*; however, only a small percent of ED nurses undertake this training. Additionally, disaster response is not included on the emergency nursing certification exam. Opportunities exist for integrating WMD agents and disaster response techniques into the nursing curriculum. Additional steps might include incorporating articles on disaster response and related topics in professional nursing journals and introducing related questions into the CEN board exam (Waeckerle et al., 2001).

The lack of standardized training for ED workers is recognized and there have been several efforts to improve competencies. For example, the AMA developed training courses for physicians and other health professionals regarding disaster preparedness; Basic Disaster Life support (BDLS) and Advanced Disaster Life Support (ADLS) have been developed (AMA, 2003). Additionally, the federal Office of Emergency Preparedness (formerly in DHHS, now in DHS) contracted with ACEP to identify the core content of a national training program for prehospital emergency personnel and emergency physicians and nurses to detect and respond to nuclear, biological, and chemical agents. Phase two of the contract, which has not yet been funded, would assist with the implementation of that curriculum (ACEP, 2005).

There are serious clinical and operational deficiencies, fragmentation, and lack of standardization across a broad spectrum of key professional personnel (nursing, physicians, ancillary care providers, administrators, and public health officials) in both individual training and coordination of a team response. It is the belief of the committee that a concerted effort to

integrate disaster preparedness and education into established professional curricula, continuing education, and certification programs appears to be the most reasonable solution at this point in time. Therefore, to address the need for competency in disaster medicine across disciplines, the committee recommends that **all institutions responsible for the training, continuing education, and credentialing and certification of professionals involved in emergency care (including medicine, nursing, EMS, allied health, public health, and hospital administration) incorporate disaster preparedness training into their curricula and competency criteria.**

Protecting the Hospital and Staff

Protecting the Hospital

The hospital represents a critical asset in the event of a disaster, but it is also a vulnerable one. Hospitals can fall victim to the disaster event itself, as occurred in the cases of Katrina and other recent hurricanes. Obviously, each hospital must have procedures in place to maintain essential services when necessary and transport patients to alternate facilities. In addition, when a hospital shuts down, its staff, vehicles, equipment, and supplies may still be useful. Regional disaster planning should include plans to distribute these assets as needed by the community.

Hospitals can be targeted by terrorism directly or indirectly, and there has been little preparation for, or even discussion, of that possibility. Hospitals should plan for direct attacks and establish plans for limiting access, securing perimeters, protecting water and power supplies, and sheltering staff. A particular vulnerability, because of the information intensity of the hospital environment, is the hospital's exposure to cyber attack. Such an attack could have a profound impact on clinical operations, communications, telemetry, records, and many other critical functions.

Hospitals are also vulnerable to an influx of disaster victims. Large numbers of victims descending on a hospital can overwhelm it and lessen its effectiveness in dealing with casualties. Patients suspected of exposure to chemical or biological agents can completely shut down a facility if they are not decontaminated properly before entering the facility (this goes for EMS vehicles as well). Every hospital must have adequate decontamination showers and procedures for dealing with contaminated patients, because experience has taught that many victims "self evacuate" from the scene of a disaster, bypassing scene triage and scene decontamination procedures (Auf der Heide, 2006). In extreme cases, the hospital must be prepared to lock down the facility to prevent the entry of contaminated patients that would otherwise disable the facility—an action that is antithetical to the open way in which hospitals typically operate.

Protecting Staff

The risk of chemical or biological exposure of hospital staff occurs when exposed patients are not properly decontaminated before arriving at the ED or as ED personnel are in the process of decontaminating victims. The risk of secondary contamination is present if the substance is toxic and likely to be carried on a victims' clothing, skin or hair in sufficient quantities to threaten rescuers or health care providers (Horton et al., 2005). There may also be a risk if victims of chemical contamination exhale the fumes that they have inhaled in the same breathing space as others.

The Sarin attacks in Tokyo and the SARS epidemic in Toronto are examples of exposure by emergency care providers. The SARS epidemic in Toronto (see Box 7-3) indicated the difficulties associated with containing even a small outbreak—particularly when health professionals themselves are inadequately protected and become both victims and spreaders of disease (Donovan, 2003; Augustine et al., 2004). One of the most important tools in such an event is the availability of negative pressure rooms that prevent the spread of airborne pathogens throughout the ED or inpatient ward. The potential for a major outbreak of avian flu further highlights the need for this capacity. Unfortunately, the number of such rooms is minimal and is often restricted to a handful of tertiary hospitals in major population centers. The committee believes that the lack of adequate negative pressure rooms is a critical vulnerability of the current system and that the existing capacity could be quickly overwhelmed by either a terrorist event or a major outbreak of avian flu or other airborne disease, posing an extreme danger to hospital workers and patients. Hopefully, future emergency department construction and hospital bed construction will include designs that allow any patient room to be converted to negative pressure rooms.

BOX 7-3 SARS: Brief History and Implications of the Disease Outbreak

The 2003 outbreak of SARS (Severe Acute Respiratory Syndrome) speaks volumes about the global health care community's deficiencies in recognizing, controlling, and communicating information about potential infectious diseases.

The rapid spread of SARS in early 2003 caught the world off-guard and challenged the global public health infrastructure. A clinical syndrome characterized by fever, lower respiratory symptoms, and radiographic evidence of pneumonia (CDC, 2005), SARS is caused by a coronavirus originally transmitted from an animal source. Case control studies suggest China's Guangdong Province as the first point of infection and transmission (IOM, 2004). Between November 16, 2002, and February 10, 2003, the respiratory disease quietly spread throughout provinces in China as well as neighboring countries before being officially recognized. Striking mostly adults aged 18-64, infected travelers and "superspreaders" rapidly spread the disease. Nosocomial transmission got out of hand, making health care providers, patients, and family members of both groups especially susceptible.

Deficiencies in both global and local public health infrastructures were apparent at every stage. The virus went unreported from China for three months, and later warnings and alerts were slow to be released. Most warnings about symptoms were unrecognized and guidelines for the use of isolation or personal protective equipment (PPE) ignored (Donovan, 2003). Furthermore, a comparison of properties and agents of bioterrorism and SARS indicates strong similarities and speaks to the need to treat the infection as a very serious one with the potential of reemerging in coming years (Augustine et al., 2004).

The SARS outbreak in Toronto was triggered, in part, by a patient who sought care in a Toronto ED for fever and a cough. He spent the night in a crowded ED awaiting admission for what was thought, at the time, to be community-acquired pneumonia. Over the course of the night, he infected 2 nearby patients and several hospital staff members with SARS. Both this index case, and the two patients he infected, subsequently died from the disease, and a total of 31 patients and staff fell ill. Ironically, the same hospital where this incident occurred continues to board admitted patients in its ED (Cass, 2005).

But health care workers clearly suffered the most. The aggressive respiratory care actually helped spread SARS, while insufficient availability of isolation rooms and PPE helped boost the case-fatality rate for the disease to 10-15% (Augustine et al., 2004). Based on data as of December 2003, there were 8094 total suspected SARS cases, 774 of which were deaths (WHO, 2005).

While an adequate number of negative pressure rooms is e essential for airborne infection control, this is only part of the solution. There must also be substantial training in disease recognition, and decontamination and containment procedures. In addition, it will be necessary

to learn from SARS and similar experiences, and develop techniques and approaches that add to our existing understanding of the management of outbreaks. One possible containment strategy is to use cohort staffing techniques similar to those used in neonatal intensive care. In this approach, groups of providers are linked with groups of patients for the episode of care to prevent spread to other patients and providers.

The failure of providers in that Tokyo hospital to wear protective equipment coupled with a decision to contain the still-clothed contaminated patients in a poorly ventilated hospital chapel contributed to hospital workers' secondary Sarin exposure (Hick et al., 2004). See Box 7-4. This incident raises an important issue with regard to disasters involving exposures: most ambulatory patients are unlikely to wait for hazardous materials teams to deploy and set up decontamination equipment; instead, victims self refer to the nearest emergency room (Hick et al., 2004; Horton et al., 2005).

BOX 7-4 The Tokyo Subway Attack

At approximately 7:45 AM on March 20th 1995, five men, all members of a religious cult, boarded five separate subway trains in Tokyo. Witnesses reported that one of the men boarded the train wearing a sanitary mask and after taking a seat, he opened his briefcase and removed a box wrapped in newspaper. The man put the box at his feet and leisurely read the newspaper until the next stop when he exited the train leaving the package behind.

This man and the four others each released one or more containers of Sarin, a lethal, colorless gas. Riders on the subway were immediately affected. Subway stations evacuated all passengers, many choking, vomiting and blinded by the chemical. Over 4,000 victims of the attack sought treatment at hospitals; most were self-transported. Lacking the initial knowledge of the Sarin attack and proper protective equipment, hospital workers became victims when they were exposed to the nerve agent on the clothing of patients. Twenty-three percent of the hospital house staff (100 health care workers) showed signs of Sarin poisoning (Pangi, 2002).

Personal Protective Equipment

The use of personal protective equipment by hospital workers is complicated by the fact that different types of PPE are needed for different types of exposures. Biological and chemical agents require different types of respiratory and dermal protection (Arnold and Lavonas, 2004). Proper selection of PPE is challenging when the identity of the contaminating agent is unknown. Additionally, PPE is often restrictive and cumbersome, making triage and patient care more difficult (Suner et al., 2004; Horton et al., 2005).

Until recently, there has been little guidance provided to hospitals regarding the specific PPE that should be available (Hick et al., 2004; OSHA, 2005). JCAHO requires each institution with an emergency department to have a plan for treating at least one contaminated patient (Arnold and Lavonas, 2004). In January 2005, the Occupational Safety and Health Administration (OSHA) compiled a document of best practices that specifies the PPE that hospitals could use to effectively protect first receivers assisting victims contaminated with unknown substances. Recommended PPE for first receivers includes a powered air purifying respirator (PAPR), a chemical-resistant protective garment, head covering if it is not already included in the respirator, double layer protective gloves, and chemical-protective boots. However, this recommendation assumes that hospitals will make a conscientious effort to limit the secondary

exposure of healthcare workers (e.g., hospitals have protocols in place to remove victims' clothing, properly decontaminate victims, etc.). Additionally, OSHA recommended that hospitals assess specific local hazards and augment the recommendations depending on those hazards identified (OSHA, 2005). The committee believes that protection of emergency care and other hospital personnel is a critical deficiency of the current system.

Surveillance

Emergency departments are well-positioned to collect and analyze, in collaboration with state and local health departments, data on injury incidence, disease trends, and potential bioterrorism threats in the community (Garrison et al., 1994). The role of EDs in surveillance has been demonstrated by the National Electronic Injury Surveillance System (NEISS), operated by the U.S. Consumer Product Safety Commission. The Commission uses data from the NEISS to monitor consumer product-related injuries in its regulatory jurisdiction and recommend changes in policy regarding those products. For example, NEISS helped the Commission identify an outbreak of injuries from all-terrain vehicles (ATVs), which ultimately led to direct intervention by the federal government to restrict access to ATVs (Garrison et al., 1994). ED surveillance data has played a crucial role in our current understanding of non-fatal injuries, leading to physical safety improvements (i.e., better-designed highways) and public safety legislation (i.e., changes to speed limits).

With the threat of bioterrorism and disease outbreaks, hospital emergency departments can recognize the diagnostic clues that might indicate an unusual infectious disease outbreak so that the public health authorities can respond quickly (GAO, 2003c). During the SARS outbreak in 2003, hospitals played an important role in identifying infected individuals. ED staff routinely used questionnaires to screen patients for fever, cough, and travel to a country with active SARS. But this action of screening patients for SARS symptoms was reactive – EDs were performing the screening because SARS had become a problem in Toronto and there was a real possibility of it spreading to cities in the United States. The greater challenge is preparing ED staff and their public health partners to identify an initial outbreak.

Surveillance systems vary considerably from region to region, and according to a recent GAO report, there are serious gaps in our ability to detect an outbreak. The most rudimentary of systems in existence today are manual systems, which rely heavily on ED personnel to communicate information to public health personnel. There are two types of manual systems: passive and active. Under active surveillance systems, hospital staff are responsible for reporting incidents and conveying data on illnesses to public health officials, for example through phone calls or faxes (GAO, 2003c; McHugh et al., 2004). An example of an active system is the one operating in Santa Clara County, CA. ED nurses make note of every patient who has a chief complaint compatible with one of six syndromes: flu-like symptoms, fever with mental status changes, fever with skin rash, diarrhea with dehydration, visual or swallowing difficulties/slurred speech or dry mouth, and acute respiratory distress syndrome. The information is then faxed to the local health department at the end of each nursing shift (Henning, 2003). Because of underreporting by hospitals and the time lag between the diagnosis and the health department's receipt of information, active systems are not effective in identifying a rapidly spreading outbreak at its earliest stage (GAO, 2003c).

Other regions use passive systems, in which information is automatically collected in the course of patient care, and either automatically reported or "mined" by public health workers to solicit information from hospitals (GAO, 2003c; Schur, 2004). Passive systems tend to provide

more complete reporting of surveillance data than a system that is fully dependent on voluntary reporting (GAO, 2003c). In an effort to further improve disease surveillance capabilities, some hospitals use electronic surveillance systems to passively collect surveillance data and automatically transfer it from the ED to health departments. Electronic systems are beneficial in that they allow more timely transmission of data, but electronic systems are inappropriate for local health departments that do not have the adequate resources to manage, analyze and interpret large inflows of data (Bravata et al., 2004b). The CDC funds three on-going electronic surveillance system networks that collect data from a sample of hospitals. One of those networks is EMERGency ID NET, which collects data from 11 academically affiliated EDs that cumulatively account for approximately 1 percent of all ED visits (Talan et al., 1998; Barthell et al., 2002). The data are collected during evaluation of patients with specific clinical syndromes, entered into the program's software within one day of the patient visit, and are electronically stored, transferred, and analyzed at a central receiving site. From this data, research on emerging infectious disease can be conducted (Talan et al., 1998). But data from systems like EMERGency ID NET may be limited in that they only collect data on certain types of patients, collecting all the data is difficult and time consuming, the distribution of results to the individuals assigned to analyze the data may be delayed, and findings may have little relevance for local efforts (Barthell et al., 2002). This type of system is too slow to trigger rapid response by public health officials.

Some surveillance systems, whether manual or electronic, capture syndromics. Syndromic surveillance is the surveillance of disease syndromes (signs and symptoms), rather than specific, clinical, or laboratory defined diseases (Henning, 2003). It is a relatively new concept in public health surveillance. The problem with non-syndromic systems is that outbreaks of disease may be difficult to diagnose; delays in diagnosis can result in larger number of casualties and a more prolonged outbreak. Syndromic surveillance may improve early detection of an outbreak (Henning, 2003). The key is to have systems that can help staff recognize index cases (i.e., the first 1–3 patients), as well as "clusters" of cases presenting to different hospitals in an area.

The most sophisticated of surveillance systems are real-time syndromic surveillance systems. Several large cities (New York, Chicago, Boston, Seattle) began operating their systems, beginning largely in 1999, with special funding from CDC (Henning, 2003). An example is Insight, a computer-based clinical information system at the Washington Hospital Center (WHC) in Washington, D.C., designed to record and track patient data, including geographic and demographic information. The software proved useful during the 2001 anthrax attacks, when it enabled the WHC to send complete, real-time data to the CDC, while other hospitals were sending limited information with a lag of one or more days. The success of Insight attracted considerable grant funding for expansion; WHC hospital earmarked $7 million for Insight to build links to federal and regional agencies and to integrate other hospital systems into Insight (Kanter and Heskett, 2002).

Although most public health officials are quickly embracing surveillance systems, particularly syndromic systems, more research is needed on their effectiveness. A review of surveillance systems was undertaken recently by Bravata and colleagues to critically evaluate their utility for detecting illnesses and syndromes related to bioterrorism. Researchers reviewed 115 systems (at EDs and other locations) including 9 syndromic surveillance systems. The authors found that few surveillance systems have been comprehensively evaluated, therefore there is a lack of information on the ability of surveillance systems to facilitate decision making by clinicians and public health officials (Bravata et al., 2004b).

CHALLENGES IN RURAL AREAS

The focus of emergency preparedness has been centered on urban areas in part because of the perceived increased risk of terrorism in these areas. However, there is a danger associated with neglecting rural areas. Indeed, one may argue that rural areas may be even more vulnerable to a terrorist attack. Many nuclear power facilities, hydroelectric dams, uranium and plutonium storage facilities, agricultural chemical facilities, and all U.S. Air force missile launch facilities are located in rural areas and are potential targets for attack. Additionally, if individuals with infectious diseases, such as smallpox, enter the country through Canadian or Mexican boarders, rural providers may be the first to identify the threat (Office of Rural Health Policy, 2002). Although fewer individuals may be harmed by an incident in a rural area compared with one in an urban area, mass disasters are relative depending on the size of the local population and capacity of the hospital. The demand for health and hospital care by 200 people could overwhelm a 20-bed facility (AHA, 2001).

But the emergency preparedness challenges that EDs face are exacerbated in rural areas because rural hospitals often lack the resources and staff needed to swiftly respond to a catastrophic event (Office of Rural Health Policy, 2002). In fact, several studies indicate that urban areas are generally further along in bioterrorism preparedness planning than rural areas because urban areas have more experience dealing with public health emergencies and have more resources to draw upon (Schur et al., 2004). Rural facilities tend to be limited in medical supplies, life-sustaining equipment (such as ventilators), and auxiliary power sources (Gursky, 2004). Additionally, rural hospitals have even more limited surge capacity than hospitals in urban areas; five hundred rural hospitals are Critical Access Hospitals, which are limited to only 15 beds (Office of Rural Health Policy, 2002). Rural hospitals also tend to lack decontamination facilities. In a 2001 study of hospitals in FEMA region III, none of the 22 rural hospitals had decontamination stations that could process 10 to 15 patients at a time; four of those hospitals had no decontamination plans in place (Treat et al., 2001). Instead, some rural hospitals rely on local EMS personnel to perform decontamination; however, this is concerning because past experience has shown that the vast majority of disaster victims seek care in emergency rooms without accessing EMS (Treat et al., 2001). Communications systems in rural emergency departments tend to be unreliable and interrupted by terrain and weather (Gursky, 2004).

Staffing is another crucial problem for rural hospitals. Although AHA and other groups recommend that rural hospitals develop a reserve staff (retired health workers, persons in training), existing shortages make this difficult. Additionally, some hospital personnel, particularly nurses, work part-time in nearby urban areas and these individuals may not be available in the event of a crisis. Training staff on emergency preparedness is often complicated by the fact that often training meetings are held in urban areas that may be quite a distance for staff to travel from rural hospitals. One-day training may require 2 or 3 days away from the hospital to accommodate travel time (Schur et al., 2004). Additionally, rural hospitals that rely heavily on contract staff may be reluctant to invest in training opportunities for those individuals since they might not continue at that hospital long-term.

Rural hospitals may not have access to the same federal funding for bioterrorism as urban hospitals. This may be particularly problematic for rural hospitals, many of which are older and more isolated and therefore preparedness efforts may actually be more expensive (Schur et al., 2004). Rural hospitals have not benefited from MMRS funding since that funding is targeted to metropolitan areas. On the other hand, rural hospitals have access to other funding streams that

urban hospitals do not; in 2003, HHS allocated $45 million in federal grants for rural and frontier hospitals (Gursky, 2004).

FEDERAL FUNDING FOR HOSPITAL PREPAREDNESS

Federal funding for bioterrorism preparedness has been made available indirectly to hospitals primarily through two programs: the Metropolitan Medical Response System (MMRS) and the Bioterrorism Hospital Preparedness Program. However, a review of each of these programs indicates that the amount going specifically to hospitals to improve preparedness efforts has been slim (IOM, 2002).

The MMRS was created in 1996 to enhance and coordinate local and regional response capabilities for highly populated areas that could be targeted by a terrorist attack using WMD. A total of 124 jurisdictions receive funding under the program. The organizing principles and resources of the program are also applicable to large-scale incidents, such as hazardous material incidents, natural disasters and disease outbreaks. MMRS was funded at $50 million for both FY 2003 and FY 2004, and was reduced to $30 million in both FY 2005 and FY 2006. Each of the 124 jurisdictions will receive $232,030 for FY 2006. Hospitals are aided indirectly through this program by participation in preparedness planning. However, hospitals initially did not participate in the program; it took several years before hospitals were integrated into MMRS planning (DHS, 2005a). MMRS was transferred from the Department of Health and Human Services to the U.S. DHS in 2003, and now resides in the Office of Grants and Training (GAO, 2003b).

A second federal program, the Bioterrorism Hospital Preparedness Program, is targeted more specifically to hospital preparedness. The primary focus of the program is to develop and implement regional plans to improve the capacity of hospitals to respond to bioterrorist attacks. It made its initial awards in 2002, and the funding is distributed through cooperative agreements with states and selected municipalities, which have considerable flexibility to determine how the funding is allocated across hospitals. The cooperative agreements consist of two phases. In phase I, states were required to develop a needs assessment for a comprehensive bioterrorism preparedness program for hospitals and other health care entities and begin the initial implementation of the plan. In phase II, states were required to submit more detailed implementation plans, including how they were going to address a series of critical benchmarks outlined by HRSA (GAO, 2003a). Funding for this program grew from $125 million in 2002 to $498 million in 2003 and $515 in 2004 (Gursky, 2004), but fell to $491 million in FY 2005 (HRSA, 2006). The amount going directly to the hospitals varied greatly by state, and in many cases hospitals received only a limited amount. According to one study, the “typical” award to hospitals was approximately $5,000 to $10,000, though some hospitals received funding in the range of $50,000 to $100,000 (McHugh et al., 2004). The funding under the program has generally not been sufficient to purchase the equipment needed for one critical care room or to retrofit an airborne infection isolation room in one hospital (Hick et al., 2004).

Because of the current political climate, there is widespread recognition of the importance of improving our understanding of optimal disaster preparedness and management, whether in response to natural or man-made incidents. While current anti-terrorism funding is, to a large extent, focused on bioterrorism, the fact remains that the vast majority of terrorist events have involved conventional explosives and nonbiological agents (DePalma et al., 2005).

The controversial appropriations bill passed in 2005 allocates "hospital preparedness" appropriations to states on a per-hospital bed basis, rather than on the basis of likelihood of disaster. Critics argue that this apportionment is essentially pork, rather than an attempt to rationally allocate preparedness dollars based on need. States facing limited risk can receive substantial funding under this approach, while cities such as Washington D.C., which have a much greater risk, receive a lesser share (ER One, 2005).

Trauma systems represent a critical component of disaster response. Federal support for the development of these systems and their coordination with other regional disaster planning efforts, does not appear to recognize this fact. Federal funding for state trauma system development and planning has been inconsistent; it was recently dealt a blow with the defunding of the Trauma/EMS Systems Program for FY 2006.

States and communities should play an important role in determining how they will prepare for emergencies. To the extent that they are supported in this through federal preparedness grants, the critical role and vulnerabilities of hospitals must be more widely acknowledged, and the particular needs of hospitals and hospital personnel must be taken explicitly into account. Therefore, the committee recommends that **Congress significantly increase total disaster preparedness funding in FY 2007 for hospital emergency preparedness in the following areas:**

- **strengthening and sustaining trauma care systems;**
- **enhancing ED, trauma center, and inpatient surge capacity;**
- **improving EMS response to explosives;**
- **designing evidence-based training programs;**
- **enhancing the availability of decontamination showers, standby ICU capacity; negative pressure rooms, and appropriate personal protective equipment;**
- **conducting international collaborative research on the civilian consequences of conventional weapons (CW) terrorism.**

RECOMMENDATIONS

7.1: The Department of Homeland Security, the Department of Health and Human Services, the Department of Transportation, and the states should collaborate with the Veterans Health Administration to integrate the VHA into civilian disaster planning and management.

7.2: All institutions responsible for the training, continuing education, and credentialing and certification of professionals involved in emergency care (including medicine, nursing, EMS, allied health, public health, and hospital administration) incorporate disaster preparedness training into their curricula and competency criteria.

7.3: Congress should significantly increase total preparedness funding in FY 2007 for hospital emergency preparedness in the following areas:

- **strengthening and sustaining trauma care systems;**
- **enhancing ED, trauma center, and inpatient surge capacity;**
- **improving EMS response to explosives;**

- **designing evidence-based training programs;**
- **enhancing the availability of decontamination showers, standby ICU capacity; negative pressure rooms, and appropriate personal protective equipment;**
- **conducting international collaborative research on the civilian consequences of conventional weapons (CW) terrorism.**

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8
Enhancing the Emergency Care Research Base

Emergency care research is a broad field of inquiry involving many disciplines and crosscutting themes. It is unlike many other areas of medical research, which tend to be defined by organ systems or types of conditions. Emergency care is uniquely defined by the urgency and location of treatment. The emergency care research field has spawned multiple branches, generally defined by specialty or research discipline, that have developed distinct but overlapping identities. It also veers into disciplines well outside of the traditional scope of medical research. Each branch includes bench science, clinical research, and health services research activities.

The field of emergency care research defies easy description, and this has been proven to be one of the principal challenges facing the field as it seeks its niche in the medical research and funding establishment. Figure 8-1 represents an attempt to sort out the field, and necessarily oversimplifies it. The lines demarking the branches tend to suggest stronger distinctions than actually exist.

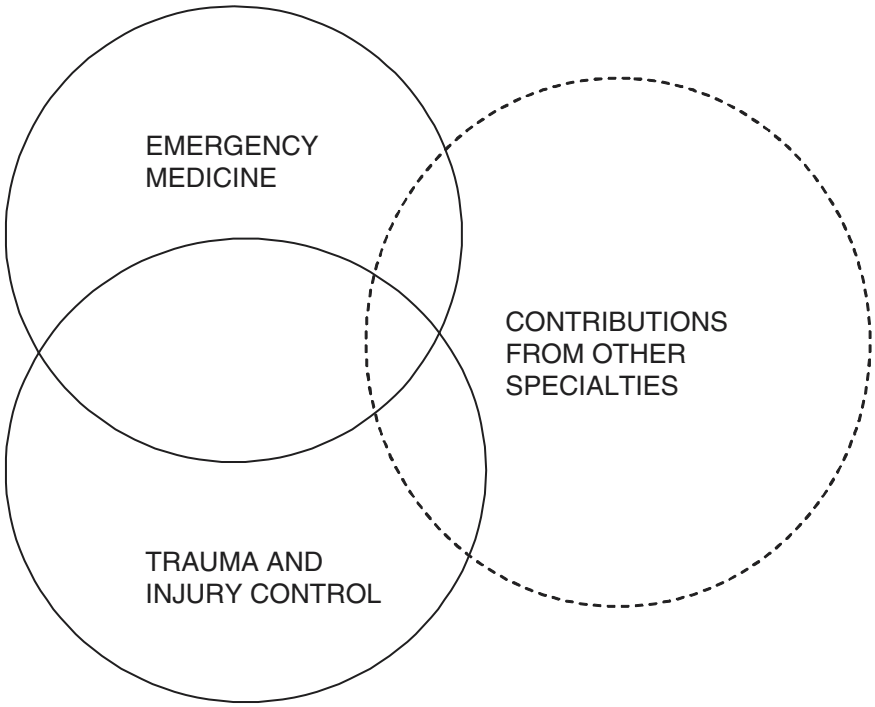

FIGURE 8-1 The scope of emergency care research.

The first branch, emergency medicine research, is defined by time and place. It principally addresses conditions and interventions common to prehospital EMS and the hospital emergency department settings, and its focus is on the acute management of patients. It is conducted by emergency physicians, often in collaboration with specialists in other fields, such as pediatrics or cardiology. Emergency care research also has significant extensions into prevention.

Trauma research represents a parallel field of study that is also defined by time and place. Trauma principally deals with the acute management of patients with traumatic injuries. Like emergency medicine research, trauma research is concerned with the care of these patients in the pre-hospital and hospital settings. It reaches further into the inpatient setting, particularly the ICU and surgical departments, and is concerned with critical care and the operative management of traumatic patients. In addition to trauma surgeons, it involves specialists in critical care, anesthesiology, as well as collaborators in organ and disease specialties such as neurology and orthopedics. A significant branch of trauma research focuses on service delivery and the effectiveness of trauma systems.

The injury control field can be thought of as a branch of trauma research that has developed a distinct, or rather several distinct, areas of focus. It is concerned principally with the prevention of injury, but also has significant overlap with the acute management of injury, and has an additional focus on long term rehabilitation following traumatic injury. It is one of the most interdisciplinary fields in all of medicine, involving the collaboration of trauma surgeons, numerous medical specialties, engineers, behavioral scientists, and epidemiologists, just to name a few.

The third branch represents many other specialties—disease-, organ system-, population-based—that lack a direct link to the emergency care setting, but which either independently or through collaboration with emergency medicine researchers, make research contributions that impact emergency care. A significant amount of the research effort in both emergency and trauma care involves translation of findings from these fields into practice in emergency care settings. There has also been substantial research in emergency care that has flowed back to the specialties.

Nursing research is a growing field which spans all three fields, and is principally involved in the clinical management of patients in each setting.

This chapter will focus on describing the development and current status of emergency medicine and trauma and injury research, as these are most germane to the present study, with reference to the other specialties when appropriate. The focus will be on hospital-based, adult emergency care research—pediatric and prehospital EMS research is addressed in the two companion reports in the Future of Emergency Care series. The chapter will also address problems in emergency care that are common to both fields and describe the committee's recommendations for enhancing the emergency care research enterprise.

EMERGENCY MEDICINE RESEARCH

Emergency and trauma care research are vital to the health of Americans. They address the care of patients in their most vulnerable moments—when injury or sudden illness strikes. While most Americans have a need for emergency care only rarely, they count on it to be there when needed. There were nearly 114 million visits to the emergency department in 2003. Traumatic injury is the leading cause of death among non-elderly adults. Unlike the vast majority of patient encounters in medicine, the quality and speed of the care that is provided in the relatively brief

emergency care encounter can mean the difference between life and death or a prolonged period of disability.

Although emergency medicine and trauma surgery are relatively young specialties, researchers have made important contributions to both basic science and clinical practice that have dramatically improved emergency care, and have resulted in significant advances in general medicine. Examples include assessment and management of cardiac arrest, including the development and refinement of guidelines for CPR, pharmacology of resuscitation, understanding and treatment of hemorrhagic shock, EKG analysis of ventricular fibrillation, toxicology and detoxification, injury prevention and control, and uses of diagnostic methods and treatment protocols.

Emergency Care Research Infrastructure and Funding

Because emergency medicine and trauma surgery are young fields, they are not strongly represented in the political infrastructure of the NIH, its various institutes, and its study sections. As a result, scant resources are allocated to advance the science of emergency care and few training grants are offered to develop researchers who want to focus on emergency care.

A conference held in 1994 highlighted the need to strengthen the academic structure and funding for emergency care research (Josiah Macy Jr. Foundation, 1995). The report from that conference recommended that academic departments in emergency medicine should be increased in number and enhanced, and that the specialty develop a research agenda and strategic plan to implement it. In response, the specialty took a number of actions to enhance academic departments and develop the research capacity and funding within emergency care. In 2003, the ACEP research Committee reported on progress in emergency medicine research (Pollack et al., 2003). Their findings include:

- Academic departments more than doubled between 1991 and 2001, growing from 18 percent to 48 percent of medical schools. These increases were disproportionately among higher ranked medical schools. Sixty-three percent of medical schools have either an academic department or a residency program, and 44 percent have both.
- Post-residency fellowships increased from 18 in 1988 to 74 in 2002, although only 12 percent of fellowships available have a primary focus on research.
- By 1999, 54 investigators had been named as principal investigators (PIs) on grants from NIH, CDC, AHRQ and others. In 2001, there were 40 active grants with emergency-trained PIs, but there is no data on the number of applications rejected.
- The Emergency Medicine Foundation, a small specialty supported foundation administered by the American College of Emergency Physicians, has provided development awards to 89 investigators at 53 academic institutions. But more than 50 percent of the dollars have been concentrated on 12 individuals at 7 institutions.

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A report of the ACEP Research Committee in 2005 noted that emergency medicine residency programs had grown rapidly, from one program in 1970 to 81 in 1990, to 132 in 2005. Currently there are 3909 emergency medicine residents. The number of federally-funded emergency medicine investigators has also increased rapidly but remains low—with only 87 in 2005 (ACEP Research Committee, 2005). Only 0.05 percent of NIH training grants awarded to medical schools go to departments of emergency medicine—an average of only $51.66 per graduating resident. In contrast, other medical specialties have much higher levels of support, for example,

internal medicine receives approximately $5,000 per graduating resident per year (see Table 8-1).

TABLE 8-1 NIH Funding to Medical School Departments for Training Grants in 2003

	Awards	Dollars	% Total	Active Resident/ Fellows	NIH Training Grant $ per Resident
Overall	1,281	$370,186,331	100.0%		
Internal Medicine	354	$107,209,870	29.0%	21,351	$5,021.30
Pathology	78	$28,289,147	7.64%	2,257	$12,533.96
Psychiatry	78	$18,176,767	4.91%	4,522	$4,019.63
Pediatrics	81	$17,547,387	4.74%	7,773	$2,257.48
Surgery	41	$8,302,760	2.24%	7,623	$1,089.17
Neurology	24	$5,654,160	1.53%	1,339	$4,222.67
Opthimology	16	$3,346,324	0.90%	1,260	$2,655.81
Anesthesiology	10	$2,640,197	0.71%	4,719	$559.48
Obstetrics/Gynecology	13	$2,324,220	0.63%	4,681	$496.52
Dermatology	13	$2,183,009	0.59%	994	$2,196.19
Otolaryngology	11	$1,989,202	0.54%	1,071	$1,857.33
Urology	9	$1,138,828	0.31%	1,038	$1,097.14
Neurosurgery	2	$599,544	0.16%	775	$773.61
Orthopedics	4	$390,055	0.11%	3,024	$128.99
Emergency Medicine	**1**	**$198,012**	**0.05%**	**3,909**	**$50.66**
Family Medicine	0	0	0.00%	9,529	$0.00

SOURCE: ACEP Research Committee, 2005.

While the pace and quality of emergency care-related research efforts have improved steadily over the last two decades, substantial barriers to research progress still remain. These barriers include: (1) a limited number of adequately-trained laboratory, clinical, and health-services investigators; (2) poorly defined professional research tracks (Stern, 2001; Lewis, 2004); (3) limited interdisciplinary collaboration and multi-institutional research networks; and (4) funding streams that are poorly geared toward the nature of emergency care investigations (ACEP Research Committee, 2005).

Research Training Support

Research training grants and fellowships related to emergency care are funded by a number of sources, including institutions, foundations, and federal agencies. Post graduate fellowships can be divided into those that are primarily clinical, but include a research component (e.g., EMS, pediatric emergency medicine, toxicology) and those that are dedicated research training fellowships. The former category is frequently funded by institutional resources and includes a substantial clinical care component. Frequently, patient care provides the financial support for the fellowship, limiting the amount of "protected time" the trainee has to develop his/her research career. It is generally accepted, however, that a research training program that does not include two years of dedicated research training (e.g., greater than 80 percent research time) is unlikely to result in long-term success in today's research climate (NIH, 2003). Thus, it is unlikely that post-graduate fellowship programs that are supported by clinical activity can be an effective tool for improving our nation's research capacity in emergency care.

A substantial number of institutions offer dedicated post-graduate research fellowships, which may be funded using institutional resources, may be contingent on the individual applicant securing extramural funding, or may be supported by extramural support to the institution (e.g., T32 mechanism). Currently, there is only one emergency care-related institutional training program supported by the T32 mechanism, and its focus is pediatric emergency medicine. No institutional (T32) or Career Development (K12) Grant has ever been awarded directly to an academic department of emergency medicine (ACEP Research Committee, 2005) although some departments may have submitted grant applications under the name of the academic medical center hospital rather than the medical school.

The primary foundation-based supporters of emergency care research training are the Emergency Medicine Foundation (EMF) affiliated with the American College of Emergency Physicians (ACEP) and the Society for Academic Emergency Medicine (SAEM). Both entities fund individual research fellowships for trainees who have completed residency training in emergency medicine, or in the case of SAEM, in pediatrics with the intent to pursue pediatric emergency medicine fellowship training. Currently, the EMF fellowship grants supply only a single year of training, although they may add two-year fellowships. The SAEM individual research training grants provide two-years of training. SAEM also funds an institutional training grant, through which two years of support is provided to the institution, with the intent that the institution will then recruit an appropriate trainee. This funding mechanism was explicitly modeled after the T32 funding mechanism.

A handful of emergency care research trainees have secured individual F32 NRSA fellowship funding. Further, a notable number of emergency care researchers have obtained support for career development and educational activities through the K08 and K23 mechanisms (ACEP Research Committee, 2005).

As detailed in the ACEP report (ACEP Research Committee, 2005), a substantial fraction of all emergency medicine trainees intend to pursue an academic career while, paradoxically, the research and research-training support devoted to emergency care research and training activities is very low, especially when compared to other medical specialties. While existing foundation support has modestly increased the number of well-trained emergency care investigators, a substantial increase in the total available research training support will be required to expand the emergency care research capability nationwide.

Many have noted a concerning lack of young investigators, both in industry-sponsored clinical trials and among the ranks of federally-supported clinical investigators (Sung et al., 2003). Specifically, Sung reports that "8 percent of principal investigators conducting industry-sponsored clinical trials are younger than forty years" and "less than 4 percent of competing research grants awarded by the National Institutes of Health (NIH) in 2001 were awarded to investigators aged thirty-five years or younger" (Zisson, 2001; Goldman and Marshall, 2002). In contrast, emergency care specialties, including emergency medicine, pediatric emergency medicine, and EMS, are characterized by relative youth. Physician-scientists in these fields are generally recently-trained and, with the receipt of additional clinical research training, may be well positioned to initiate a productive, long-term, clinical research careers. In its research report, ACEP calls for the development of 100 new investigators within 10 years through the NIH institutional Mentored Career Development Award Program (K12) at an estimated cost of $50 million over ten years.

A paper by Sung et al. presented to the IOM Clinical Research Roundtable recommended, as part of a strategy to increase the number of well-trained clinical investigators, that academic

health centers and research sponsors, including federal sponsors, "increase opportunities for training in all areas of clinical research, including health services and outcomes research, clinical trials, and research synthesis, and develop a mechanism for collecting longitudinal data on training program outcomes" (Sung et al., 2003).

Similarly, many have noted a lack of a sufficient pool of well-trained laboratory and patient-oriented investigators in emergency care. Nevertheless, emergency medicine investigators have made important contributions in laboratory investigations of shock, ischemia-reperfusion, cellular injury, early biomarkers for cardiac ischemia, cerebral resuscitation, and neuroprotection. For many years, medical training in the specialties of emergency medicine, pediatric emergency medicine, and trauma surgery were heavily focused on the development of clinical skills, with little formal training and research methodology. As noted by Stern formal fellowship training is now a well-recognized requirement when embarking on a successful long-term research-based academic career (Stern, 2001). To address the shortage of training for new investigators in emergency medicine, the committee recommends that **academic medical centers support emergency and trauma care research by providing research time and adequate facilities for promising emergency care and trauma investigators, and by strongly considering the establishment of autonomous departments of emergency medicine.**

Research Funding

A 1994 review of nonmilitary research articles published in three emergency medicine journals revealed that the majority of articles did not list a source of funding. This is in contrast to other specialties where the majority of published research was funded. The literature review also found that funded studies published in emergency medicine literature were less likely to be federally funded and more likely to be funded by industrial sources than studies published in the literature in other specialties (Wright and Wrenn, 1994). Although these results may be dated, federal funding, and in particular, NIH funding, remain difficult for emergency medicine researchers to obtain (Morris and Manning, 2004). The limited amount of funding available for emergency care research is spread across a wide range of institutes, programs and sponsors, although NIH remains the key sponsor.

Because of the cross-cutting nature of emergency care, it overlaps with many other medical disciplines making it difficult to establish a unique funding home within NIH and other research sponsors that tend to have a traditional disease or body part orientation. Relevant areas of trauma and injury research funding are spread across multiple NIH institutes and centers—for example, National Institute of General Medical Sciences (NIGMS) Research Centers in Trauma, Burn, and Perioperative Injury, The National Heart Attack Alert Program within the National Heart Lung and Blood Institute (NHLBI) and the National Institute of Neurological Disorders and Stroke (NINDS). The little injury control research that is currently being pursued is sponsored by the CDC Center for Injury Prevention and Control.

On the other hand, the cross-cutting nature of emergency care exposes it to many opportunities for collaboration with other research specialties and disciplines, and collaborating with established researchers in other fields may be a good way for emergency care investigators to establish or expand their research funding.

National Institutes of Health (NIH)

The NIH includes 20 Institutes, seven Centers, and four Program Offices contained within the Office of the Director (OD). The NIH is the largest single source of support of biomedical research in the world, with a budget of over $27 billion in 2004 (IOM, 2004). All Institutes, but only some of the Centers, provide research funding, while several other centers provide general support activities (e.g., the Center on Scientific Review [CSR]). All Institutes and four of the Centers receive individual congressional appropriations. The NIH Institutes are organized in five types of categories, some by disease (e.g., NINDS), some by organ system (e.g., NHLBI), some by stage of life (e.g., NICHD), some by scientific discipline (e.g., NHGRI), and some by profession or technology (e.g., NINR, NIBIB) (IOM, 2003). None of the current Institutes or Centers is defined either by the site of care or the timing or urgency of care—defining characteristics of emergency care research. Perhaps for this reason the NIH does not have an institute or center focused specifically on emergency services. Thus, many important emergency care clinical questions extend beyond the domains of single NIH institutes or centers. While both a 2003 IOM report (IOM, 2003) and the NIH Roadmap Initiative (Zerhouni, 2003) emphasize the importance of stimulating and funding trans-NIH research, and emergency care research questions naturally span multiple institutes' and centers' domains, the lack of attention to emergency care has not been effectively addressed. In fact, the term "emergency care" does not appear in the NIH Roadmap.

Other Federal Agencies

Many other federal agencies provide small amounts of research funding in emergency care. The Agency for Healthcare Research and Quality (AHRQ), for example, like NIH, does not have a dedicated funding stream for research on emergency services, though it does have a long track record of funding grants in emergency care, such as a study on the effects of cost sharing on use of the emergency department, evaluation of technologies for identifying acute cardiac ischemia in emergency departments, and the measurement of ED crowding (AHRQ, 2004).

The Health Resources and Services Administration (HRSA), through its Emergency Medical Services for Children (EMS-C) Program, sponsors the Pediatric Emergency Care Applied Research Network (PECARN), the first federally-funded multi-institutional network for research in pediatric emergency medicine. The EMS-C Program also sponsors the National EMS Data Analysis Resource Center (NEDARC), which was established in 1995 to help states collect and analyze data on pediatric EMS systems and to populate the pediatric trauma registry. The HRSA Trauma-EMS Systems Program and the Office of Rural Health Policy also support research efforts in emergency care.

The Centers for Disease Control and Prevention's National Center for Injury Prevention and Control, NCIPC, sponsors investigations in injury prevention and control, and recently developed a research plan, the Acute Care Research Agenda for the Future. The NCIPC and the CDC, and the Consumer Product Safety Commission cosponsor the National Electronic Injury Surveillance System (NEISS), a longitudinal database with information from 100 hospital emergency departments on consumer-product-related injuries, and since 2000, on all injuries. The NCIPC also sponsors the Data Elements for Emergency Department Systems (DEEDS) project, a national effort to develop uniform specifications for data entered in emergency department patient records.

The Office of EMS in the National Highway Traffic Safety Administration (NHTSA) plays a lead role in coordinating activities related to EMS system development and research. Together

with HRSA, the EMS Division sponsored the development of the National EMS Research Agenda (NHTSA, 2001). The Division currently funds two key research initiatives, the Emergency Medical Services Outcomes Project (EMSOP), a study to develop metrics for use in EMS-related outcomes research, and the Emergency Medical Services Cost Analysis Project (EMSCAP), a study to develop metrics to assess the costs and benefits of EMS. NHTSA and HRSA co-sponsor the National EMS Information System (NEMSIS), a national database on EMS systems and outcomes that is operated by the National Association of State EMS Directors. NHTSA's Office of Human-Centered Research sponsors the Crash Injury Research and Engineering Network (CIREN), a network of Level I trauma centers that collect and share detailed research data on automobile crashes, injuries, and outcomes.

Although not research funding per se, the NHTSA EMS Division is also funding the National EMS Scope of Practice Model project, a joint initiative of the National Association of State EMS Directors (NASEMSD) and the National Council of State EMS Training Coordinators (NCSEMSTC). The Longitudinal Emergency Medical Technician Attribute & Demographics Study (LEADS) is a NHTSA funded project of the National Registry of EMTs. An annual LEADS survey collects information on the EMS workforce.

The Centers for Medicare & Medicaid Services (CMS), the Department of Homeland Security, and the Department of Veterans' Affairs also provide small amounts of funding related to emergency care.

Private Funders

The Society of Academic Emergency Medicine (SAEM) and the Emergency Medicine Foundation (EMF) both provide investigator training grants, as described earlier. EMF awarded 18 grants in 2004–2005 totaling almost $500,000 (Pollack and Cairns, 1999; ACEP, 2005). The Robert Wood Johnson Foundation (RWJF) funded the Urgent Matters project, which provided grants to ten hospitals and their communities to evaluate approaches to reducing crowding and improving patient flow. A small number of emergency medicine researchers received research training through the Robert Wood Johnson Clinical Scholar's program. The National Emergency Medicine Association (NEMA) also provides research grants in trauma and emergency care.

Future Directions in Emergency Care Research

Pressing gaps remain in our understanding of emergency care in all three research areas: basic, translational, and service delivery. There have been several recent attempts to identify research priorities and key opportunities in emergency care (Aghababian, et al., 1996; Maio et al., 1999; Seidel et al., 1999; Becker et al., 2002). The EMS Research Agenda for the Future project (Sayre et al., 2005) has identified priority issues for targeted research efforts, including asthma, acute cardiac ischemia, circulatory shock, major injury, pain, acute stroke, and traumatic brain injury, as well as education and system design issues. Critical research questions identified by these groups cut across basic science, clinical care, and delivery systems. Some fertile areas of research in each are described below.

Basic Science

Because emergency medicine is defined by time and place, rather than body part or disease process, research is often mischaracterized as being strictly translational in nature. But emergency medicine requires both basic discovery and translation of those discoveries to the clinical setting. Basic research projects involving emergency medicine investigators include:

- Characterization of the molecular events that cause delayed neuronal death after brain ischemia, and other studies on neuronal injury (Multiple NINDS grants).
- The pathophysiology of carbon monoxide poisoning and the mechanisms for benefit of hyperbaric oxygen therapy (multiple NIH grants).
- Understanding the events that occur following ischemia/reperfusion injury from cardiac arrest, using animal models as well as cardiomyocyte cell culture models as well as methods for inducing hypothermia for treatment of patients following cardiac arrest (NIH).
- The pathophysiology of acute lung injury and acute respiratory failure (NHLBI).
- Minimizing the risk of secondary ischemic brain injury during limited resuscitation from hemorrhagic shock and traumatic brain injury (DoD).
- Identification of effective neuroprotective agents to limit tissue loss and enhance recovery following acute traumatic brain injury or stroke (NINDS, CDC).
- Pathophysiology and treatment of traumatic spinal cord injury (NIH).
- Hypothermia and gene expression following cardiac arrest (NIH).
- The pathophysiologic processes that contribute to the destruction of articular cartilage in a variety of disorders, including an evaluation of immunoprobes for lubricin from human synovial fluid (NIH).
- Understanding the human genomic and proteomic response to injury and injury recovery.

Translational Research

Because of the wide range of patients, diseases, and interventions seen by physicians in emergency practice, these practtitoners are afforded a unique window on the state of treatment options available, including their shortcomings. This gives them both motivation and opportunity for focused effort on translating research into better modes of treatment. Consequently, translational research represents the most active area of emergency care research. Examples include:

- The efficacy, safety and dosage guidelines of medications for infants, children, adolescents, adults and elderly.
- Defining an effective and practical diagnostic and risk-stratification strategy for patients with possible pulmonary embolism (Kline and Wells, 2003; Brown et al., 2005; Courtney and Kline, 2005; Kline et al., 2004, 2005).
- Development of evidenced based protocols for common pediatric conditions (fever for example).
- Evaluating the pharmacokinetics and efficacy of promising clinical therapies to treat acute traumatic brain injury (Wright et al., 2005).
- Development and testing of new therapies and strategies for the resuscitation of the multiply injured trauma patient (Bickell et al., 1992; Coimbra et al., 1997; Angle et al., 1998; Sloan et al., 1999a; Cooper, 2004).
- Evidence-based criteria to determine which patients with community acquired pneumonia require hospitalization (current national guidelines are largely based on a risk stratification model created from data that did not include manipulation of the decision to admit (Fine et al., 1997).

- Defining and testing strategies to determine which patients with possible acute coronary syndromes require hospitalization and, for those requiring hospitalization, to define the appropriate level of care.
- Identification and testing of new strategies for the prevention of secondary brain injury after both traumatic and ischemic insults (The Hypothermia after Cardiac Arrest Study Group, 1921; Stern et al., 2000; Neumar, 2000; Bernard et al., 2002; Nolan et al., 2003; Abella et al., 2004).
- Paramedic use of blood substitutes.
- Evaluation of simplified methods of CPR instruction (Kellermann et al., 1989; Eisenberg et al., 1995; Todd et al., 1998, 1999).
- Assessing the potentially deleterious effects of hyperventilation on successful resuscitation following cardiac arrest (Auf der Heide et al., 2004).

Health Services Research

Emergency medicine by definition requires timely and efficient approaches to the delivery of services. The impact of the organization and mode of delivery has long been recognized to have a major impact on the quality of care and outcomes, first codified in R. Crowley's "golden hour" and Pantridge's cardiac care in the field, and reinforced through military and civilian experience. But the organization and delivery of services is perhaps the weakest link in the emergency care evidence base. Even accepted doctrine, such as the value of paramedics in the field, has been recently overturned. This then represents a formative and essential area for research. Some of the key research questions in service delivery include:

- The impact on ED crowding of bottlenecks in different hospital units (ICU, telemetry, etc.) on patient flow.
- The effectiveness of queuing theory in smoothing of patient volume on crowding, boarding and diversion.
- The effect of timeliness of out-of-hospital response stratified by etiology and/or severity of injury.
- Identifying which components of trauma systems impact outcomes and cost-effectiveness.
- The causes and solutions for missed diagnosis in the ED.
- Validation of using prehospital 12-lead electrocardiography to direct patients with acute STEMI to interventional cardiac centers.
- The impact of medical direction in EMS systems.
- Use of prehospital electrocardiography to identify and directly transport patients to a cardiac catheterization lab for percutaneous coronary intervention.
- The impact of pre-arrival instructions by dispatchers about the condition of patients upon arrival at hospital and long-term outcome.
- Evaluation of safe alternatives to endotracheal intubation to secure the airway in prehospital and emergency department settings.
- Feasibility and cost-effectiveness of implementing "point of care" HIV testing of high risk patients in the emergency department.
- Development of practical testing technology to evaluate mild traumatic brain injury and other causes of cognitive impairment in prehospital, sports, and ED settings.

- Use of computers to screen ED patients for a variety of health risk behaviors including intimate partner violence, depression, substance abuse and suicide.

These lists are not meant to be all-inclusive, or even representative of current research challenges or priorities, but merely to suggest the breadth of important research questions that are in need of attention.

Multicenter Research Networks

Many of the important successes in emergency care research have been based on the establishment of large-scale multicenter research collaborations. Multicenter networks enable researchers to assemble sufficiently large data sets to establish robust research findings.

Some important successes in emergency care research have been based on the establishment of large-scale multicenter research collaborations. There are a number of examples of successful studies. The NEXUS study, for example, has investigated the use of cervical spine radiography in patients suffering blunt trauma (Hoffman et al., 1998, 2000). The Multicenter Airway Research Collaboration (MARC)/Emergency Medicine Network (EMNet) studies respiratory disease management strategies in the ED (EMNet, 2005). The EMERGEncy ID Net collaboration provides important information on the characteristics and management of infectious diseases in the ED (Cydulka et al., 2003; Kim et al., 2004), as well as sentinel detection of emerging infectious diseases (Talan et al., 1998, 1999, 2003; Moran et al., 2000). The Resuscitation Outcomes Consortium network, sponsored by NIH and DoD, is addressing prehospital based trauma and cardiac arrest resuscitation in North America. A number of emergency medicine departments are participating or heading programs related to this endeavor. The Inflammation and the Host-Response to Injury study is an NIGMS Glue Grant[1] that has joined clinical level I trauma centers to genomic centers to proteomic high-throughput centers as a multi-institutional, multi-disciplinary attempt to explore the genomic, proteomic, and phenotypic host-response to the stress of severe injury (Calvano et al., 2005).

The Pediatric Emergency Care Applied Research Network, sponsored by the HRSA's Emergency Medical Services for Children program, focuses on prevention and management of acute illnesses and injuries in children through four research nodes (PECARN, 2003, 2005). The publication records of these collaborative efforts, as well as the impact of their publications on clinical care, illustrate the power of such research networks to address pressing clinical questions, as well as the ability of the emergency care research community to effectively organize and conduct large-scale clinical research endeavors.

TRAUMA AND INJURY RESEARCH

It is difficult to characterize the fields of trauma and injury research. For one thing, they have expanded dramatically in scope from the early focus on treatment of injuries. As the scope expanded, the field has become increasingly interdisciplinary, and now includes investigators from such far-ranging fields as engineering, epidemiology, behavioral sciences, biomechanics, criminology, and molecular biology, and human factors research. While trauma and injury are, by and large, identical, or at least overlap, the terms do suggest some differences in focus, type of investigator, and setting that differentiate them.

[1] Glue Grants are NIH research initiatives that bring together multidisciplinary team of researchers from different centers to solve a research problem.

Historically, trauma research was clinically focused on treatment of injury, and was strongly influenced by advances in trauma treatment learned from battlefield experiences. Injury research can be thought of as a newer field, and one that has branched out in new directions. But even here the distinctions are nuanced rather than clear cut. The modern fields of trauma and injury research began to take shape in the 1960s as a result of the increasing number of highway deaths. The 1966 report of the NAS/NRC, *Accidental Death and Disability* (NAS and NRC, 1966) was followed by a burst of regulatory activity, including the passage of the Highway Safety Act, establishment of the NHTSA, OSHA, CPSC, and the founding of the American Trauma Society. These events collectively signaled a new national commitment to reducing death and disability due to injury.

The new field of injury science was based on the recognitions that patterns of injury could be recognized with the epidemiology tools of public health. William Haddon, a public health physician, laid out the scientific paradigm for analyzing injury that recognized the interaction between human and environmental factors (Haddon, 1968).

The 1985 NRC report, *Injury in America* (NRC and IOM, 1985), set forth the idea of injury prevention and control as a separate discipline. It proposed the establishment of an injury center at CDC, which led to the passage of the Injury Control Act of 1990. This elevated the Division of Injury Epidemiology and Control to the NCIPC. The NCIPC's focus on non-occupational injuries was designed to complement a new center at NIH that was focused on occupational injuries, the NIOSH. While establishing a science base in injury prevention and surveillance, the development of these centers represented a divergence from trauma research, which remained more focused on treatment and service delivery.

The Trauma Field

The United States military experience during the Korean and Vietnam wars provided evidence that an organized health system with medical capabilities could improve chances of survival (GAO, 1991). Physicians returning from the war tried to apply the advances made and lessons learned during the war to civilian life. Through the availability of helicopters, evacuation time of the wounded from the battlefield was cut dramatically resulting in decreased mortality rates. Other advances during the period include the availability of whole blood, well organized medical teams, well equipped forward hospitals and more effective management of medical resources.

Along with advances made during the Korean and Vietnam wars, several medical and technology advances during this period coincided with the development of trauma centers. In 1956, Drs. Elan and Safar developed mouth-to-mouth resuscitation. In 1959, researchers at Johns Hopkins in Baltimore, Maryland developed the first portable defibrillator as well as perfected CPR. The very first out-of-hospital defibrillation occurred in 1969. These advances provided a means to stabilize victims, thereby providing an opportunity for more critically ill patients to arrive at the hospital for care. During this period, prehospital emergency services became more sophisticated and hand in hand with this advancement was the development and formalization of trauma centers and systems.

The American College of Surgeons Committee on Trauma (ACS COT) has also made significant contributions and played a major leadership role in the development of trauma centers. In 1976 ACS COT first published "Optimal Resources for Care of the Seriously Injured." This document identified the key characteristics for the categorization of hospitals as trauma centers. It was most recently updated in 1999. In 1987 ACS COT initiated an external

review process for trauma centers. ACS COT has also recently published a document "Consultation for Trauma Systems" which provides guidelines for evaluating trauma system development.

In 1981 the year that the seminal article, "Regionalization of Trauma Care" authored by Trunkey was published, funding sharply declined. The Major Trauma Outcome Study was established in 1982 to improve scoring systems, establish national outcomes data, and provide objective evaluations of quality assurance and outcome—by 1989 had recorded 170,000 patients from >150 institutions (IOM, 1999). The American College of Emergency Physicians (ACEP) has also contributed to this area with the publication of "Guidelines for Trauma Care Systems" in 1986, which explores prehospital care.

A significant body of research has focused on the effectiveness of trauma systems. In 1998 the Skamania Conference was convened to review the medical evidence on trauma systems.[2] The conference called for renewed federal funding for trauma system development and the drafting of a visionary document on the future of trauma system development.

Trauma research has also focused on injury scales/scoring systems, leading to a succession of refinements in the precision and usefulness of these scales—e.g., the Abbreviated Injury Scale, the Injury Severity Score, the Anatomic Profile, the New Injury Severity Score, the Glasgow Coma Scale, and the Revised Trauma Score. These scales are important for standardizing measurement of injury and have multiple applications, including triage, diagnosis, and research.

Injury Control

The injury control field is focused less on treatment and more on surveillance and prevention. It links researchers in public health, medicine, and engineering and includes many disciplines. Surveillance and prevention are key areas of research in the injury field. Systematic collection of injury data, through data bases such as the National Electronic Injury Surveillance System (NEISS), the National Trauma Data Bank, the Fatality Analysis Reporting System (FARS), and state trauma registries are critical to gathering sufficient observations to conduct meaningful research. Most states have trauma registries, but the data elements are variable generally not linked with one another. The ACS established the National Trauma Data Bank as a voluntary repository of trauma records. In 2004 the NTDB contained over 1.1 million cases from 405 trauma centers in 43 states, U.S. territories, and the District of Columbia. It represents 55 percent of level 1 and 32 percent of level II trauma centers (NTDB-ACS).

Injury research has led to a wide range of prevention research successes. By far the most important successes have occurred in motor vehicle crash injury prevention and control. Others include childproofing containers, mandated use of smoke alarms, motorcycle and bicycle helmet laws, sports pads and mouth guards, and safe refrigerator disposal to prevent suffocation. Motor vehicle prevention includes everything from seat belts, air bags, and child safety restraint systems to graduated drivers' licensing programs and improvements in highway design. An important current initiative sponsored by NHTSA is the Crash Injury Research and Engineering Network (CIREN). CIREN's mission is "to improve the prevention, treatment and rehabilitation of motor vehicle crash injuries to reduce deaths, disabilities, and human and economic costs" (NHTSA and CIREN Center Staffs, 2003). CIREN's researchers have made a significant impact in improving safety research, automobile safety, and emergency medical care.

[2] A September 1999 supplemental issue of the Journal of Trauma was devoted to the Skamania Conference. See the Journal of Trauma, v. 47, No. 3 (supplement).

Much of this research is concerned with the field of injury biomechanics, which involved the study of physical and physiologic response to both penetrating and nonpenetrating impact. Examples of the disciplines involved in this branch of study include robotics, physical therapy, orthopedics, physical and sports medicine, prosthetics, orthotics, and tissue engineering.

One area that has been very under-researched relative to the magnitude of its impact is primary and secondary prevention of falls. This is a significant problem among toddlers and the elderly, and is now the most common cause of traumatic brain injuries among the elderly. With aging population, it will only grow in importance over time (Wadman et al., 2003).

While much of the injury field has focused on unintentional injuries, it has also moved into the field of intentional injuries–for example, those caused by firearms and suicide. While the trauma field has long been interested in gunshot injuries from a treatment perspective, the injury field has looked at it from the prevention side. While widely accepted today, this led to substantial debate about priorities in the field. Suicide and violence prevention reaches into the realms of behavioral sciences, sociology, and even economics. The widening scope of injury research has been a constant theme over the last two decades, and it now encompasses many disciplines—epidemiology, behavioral sciences, biomedical science, biomechanics, criminology, sociology, engineering, law, molecular biology, and others.

Research Infrastructure and Funding

The majority of support for trauma and injury research comes from NIH and CDC, with limited support coming from NHTSA, HRSA, AHRQ, DoD, and others.

National Institutes of Health

By far the most important source of research funding for trauma is NIH. The 1966 NRC report, *Accidental Death and Disability*, recommended that NIH establish an Institute for Trauma. While this never materialized, trauma research at the NIH has grown. NIH convened a task force to study the trauma research needs and gaps, and produced the *Report of the Task Force on Trauma Research* (NIH, 1994). This report recommended doubling funding to trauma research centers, but sufficient funding was never appropriated to carry this out. Trauma research at NIH is principally supported through three institutes. The most important is the National Institute for General Medical Science (NIGMS), which includes a Program on Trauma and Burns. The National Institute on Neurological Disorders and Stroke (NINDS) includes a Program on Trauma, Regeneration and Pain, which is almost exclusively focused on neurotrauma. The National Institute for Child Health and Human Development (NICHD) has a National Center for Medical Rehabilitation Research, which includes both injury-related and non-injury-related rehabilitation.

Total NIH support for trauma and injury is very limited in contrast to their importance in terms of mortality, disability and dollars. Injury is the number one killer of non-elderly adults, and costs of trauma approach 10 percent of health care spending (IOM, 1999). Traumatic injury has surpassed heart disease as the most expensive category of medical treatment, resulting in $71.6 billion dollars in expenditures per year (AHRQ, 2006). In 1998, injury was the third leading causes of death in terms cause of years of potential life lost (YPLL). Yet NIH injury research dollars were collectively less than $200 million. In terms of YPLL, trauma received only $.10 compared to $3.51 for HIV/AIDS and $1.65 for cancer (IOM, 1999).

Just as important, with research spread across programs there is little opportunity for coordination or the development of comprehensive research centers. The 1999 IOM report,

Reducing the Burden of Injury: Advancing Prevention and Treatment, stated that "NIH lacks a focal point and a mechanism for coordinating disparate injury research projects and programs" (IOM, 1999). The report recommended expanding the program within NIGMS, and elevating the Trauma and Burn Program to a Division. In addition, there is scant support for investigator development.

Centers for Disease Control and Prevention (CDC)

In 1985, the NRC/IOM report, *Injury in America: A Continuing Public Health Problem*, considered and rejected the development of an NIH injury center in favor of a CDC version (NRC and IOM, 1985). This led to the Injury Control Act of 1990, which elevated the CDC's Division of Injury Epidemiology and Control to become the National Center for Injury Prevention and Control (NCIPC). NCIPC focused on non-occupational injuries to complement the CDC's National Institute on Occupational Safety and Health.

The NCIPC includes three divisions: Unintentional Injury Prevention; Violence Prevention; and Injury and Disability Outcomes. It operates much like an NIH Center, with a focus on extramural research grants, plus cooperative agreements with states. NCIPC has nurtured biomechanics research and funded comprehensive Injury Control Research Centers. Some have argued that, relative to NIH, CDC has funding limitations and lacks the infrastructure to pursue a strong basic and clinical research agenda (IOM, 1999). NCIPC supports no investigator training grants, but NIOSH does have a small number of pre-and post-doctoral training grants in occupational injury prevention. The 1999 IOM report recommended that the Center develop interdisciplinary training in epidemiology, biostatistics, biomechanics, and behavioral sciences, through collaborations with NHTSA, HRSA, NIOSH and others.

Other Agencies

With the exception of the CIREN program, described above, which is supported by NHTSA, there is only limited support for trauma and injury research in other agencies. Most research in system design is sponsored by NCIPC and AHRQ, but health services research is not well funded in general, and trauma and injury research represent a very small component of that research. The HRSA EMS and Trauma Systems Program supported the development and evaluation of trauma systems until it was de-funded for FY 2006.

Current and Future Research Directions

Current directions in trauma and injury research have been the subject of several recent reports. The NIH and DoD Working Group on Trauma Research Program convened in 2003 and developed a report that identified and summarized current trauma research priorities (Hoyt et al., 2004). It identified priorities in three key areas: basic science, clinical trials, and clinical research. In basic sciences, it identified cellular injury (immune response following injury); bleeding & thrombosis; central nervous system injuries; and multiple organ failure. Areas that are in need of clinical trials to establish efficacy include: airway management; fluid resuscitation; therapies for controlling bleeding; adjuvants to control post-injury immune response; and body temperature management. The three top areas for clinical research were: physiological monitoring; automated clinical data collection; and development of large-scale longitudinal data sets for research.

The report cited the continuing lack of an organized infrastructure as an impediment to progress in resolving a number of key issues, and discussed ways to build this infrastructures for

resuscitation research, including: consistent informed consent process (for multicenter trials); development of an animal model consortium; increased use of multicenter trials; centralized tissue banks; and standardized data collection and analysis.

In 2002, the CDC NCIPC developed a research agenda, which outlined research priorities in 7 broad injury categories: injuries at home; sports; transportation; domestic violence; suicide; youth violence; acute care; disability; and rehabilitation. It also identified four cross-cutting research priorities: translating research into programs and policies; improving parenting and controlling alcohol abuse; identifying the costs and consequences of injury; and building the research infrastructure.

In 2005, the CDC updated the Acute Care chapter of the 2002 Agenda. This revision identified 7 research priorities:

- better translation of findings into patient care through guidelines
- evidence based protocols.
- how trauma systems improve care
- how mass casualty impacts acute care
- clinical prevention
- psycho-social impact of injury
- short term and long term outcome measures development.

The report also called for the enhancement of research capacity through 4 actions: the development of acute care injury research networks, the development of research derived by mining current and future databases, the development of new investigators though training grants, and reductions in the institutional barriers to research, such as EMTALA regulations. Finally, it noted the need for more research on morbidity and disability outcomes (National Center for Injury Prevention and Control, 2005).

BARRIERS TO EMERGENCY CARE RESEARCH

There are unique logistical problems associated with conducting emergency care research, such as lack of a coordinating funding structure, the difficulty of establishing informed consent in emergency care situations, and the challenge of linking medical records to reconstruct an episode of care across prehospital, ED, and inpatient settings.

Organization and Funding of Emergency Care Research

Taken as a whole, the emergency care enterprise has accomplished a great deal. Much of this has been done through bootstrap funding and poorly supported researchers in a disconnected fashion. But the field has reached a level of maturity that requires a new approach. There are well-defined areas of critical inquiry that require a coordinated and well-funded approach. In addition, an integrated research effort across disease lines that breaks down departments and requires multidisciplinary approaches to achieve effective translational research is essential. This approach must include a wide range of disciplinary strengths, from epidemiology, pathophysiology, and toxicology, to surgery, psychology, and biomechanics, in order to effectively integrate the wide range of interrelated medical and sociological issues presenting to the modern ED. It should be clear that the current uncoordinated approach to organizing and funding emergency and trauma care is ineffective. Therefore the committee recommends that **the**

Secretary of the Department of Health and Human Services (DHHS) conduct a study to examine the gaps and opportunities in emergency and trauma care research, and recommend a strategy for the optimal organization and funding of the research effort. **This study should include consideration of training of new investigators, development of multi-center research networks, funding of General Clinical Research Centers (GCRCs) that specifically include an emergency and trauma care component, involvement of emergency and trauma care researchers in the grant review and research advisory processes, and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency and trauma care research (including the Department of Transportation, the Department of Health and Human Services, the Department of Homeland Security, and Department of Defense) should implement the study's recommendations.** This study should consider the broad sweep of emergency care research, including emergency medicine, trauma, and injury research, including basic clinical, and health services aspects, and should consider ways to enhance coordination of emergency care research across topics, disciplines, and agencies.

The inclusion of emergency care researchers on advisory and review committees has special merit in the view of the committee. NIH, for example, utilizes a wide variety of advisory committees: (1) initial review groups (IRGs, also known as study sections) and special emphasis panels (SEPs), (2) national advisory councils, (3) boards of scientific counselors, and (4) program advisory committees. The IRGs and SEPS perform the first level of peer review, scoring grant applications for technical and scientific merit. The national advisory councils perform a second level of peer review, providing advice to the Institute or Center both on the funding of individual applications and on more general issues related to the mission and goals of the Institute or Center. The combined review by the IRGs/SEPs and by the national advisory councils is commonly termed the "dual review system" (IOM, 2003).

The boards of scientific counselors perform retrospective reviews of intramural research programs and will not be further discussed here. Lastly, the program advisory committees provide input on research programs, future research directions, and the development of extramural research initiatives (IOM, 2003). The vast majority of members of advisory committees is appointed either by the NIH Director or by the directors of the individual Institutes or Centers.

Emergency care providers often have a unique perspective on the evaluation and management of specific syndromes and diseases, as they routinely manage the most acute and extreme manifestations and must often act decisively with only preliminary clinical information. Thus, emergency care providers can provide important complimentary perspectives during the framing of clinical research questions to be addressed by interdisciplinary clinical research teams and during the evaluation of research applications and proposals. This can be particularly valuable for judging proposals that require the timely recruitment of research subjects in acute care situations, and the logistical challenges of conducting well-controlled clinical research in emergency departments, trauma centers and other acute-care environments.

The IOM previously recommended that, in an effort to retain and enhance the integrity of the process, "appointments to advisory counsels should be based solely on a person's scientific clinical expertise" and "a substantial proportion of an (advisory) council's scientific membership should consist of persons whose primary source of research support is derived from a different Institute or Center or from outside NIH" (IOM, 2003). Emergency care specialists, with their broad clinical perspective as well as insights into the strengths and limitations of the current

healthcare system, are uniquely qualified to provide broadly based clinical expertise to advisory councils. Further, some of the most successful and highly-regarded research scientists in emergency care have derived a substantial fraction of their funding from non-NIH resources (e.g., CDC, AHRQ, Army, pharmaceutical sponsors) and thus are relatively free of conflicts of interest.

General Clinical Research Centers (GCRCs) play a critical role in supporting the clinical research enterprise and serving as a fertile ground for the development for the training of young clinical investigators. There are currently 87 general clinical research centers (GCRCs) supported by National Center for Research Resources (NCRR), which include both inpatient facilities and ambulatory research clinics associated with academic health centers. These facilities are potentially valuable in providing mentorship to new clinical investigators and junior faculty, and facilitating the enrollment of subjects into clinical research studies. However, GCRCs rarely, if ever, support clinical research conducted in the emergency department, much less in out-of-hospital settings. There are no GCRCs that specifically include an emergency care component, whether in the out-of-hospital emergency department setting. Thus, emergency care investigators had not had access to an important national resource. One reason is that most GCRCs are funded to conduct scheduled clinical research protocols. They are not well staffed, if staffed at all, to conduct emergency and trauma care research on a 24/7/365 basis. While it would be neither feasible or perhaps prudent to staff all GCRCs this way, a subset of GCRCs, particularly those based in hospitals that have a major ED and level I trauma center, might be encouraged to compete for supplemental awards to support time-critical clinical trials on resuscitation and trauma care research.

Protection of Human Research Subjects

There are federal rules that govern the protection of human subjects, and these rules are carried out by institutional review boards (IRBs). Additional rules to protect the privacy of human subjects were defined by the HIPAA “Privacy Rule.” The Office of for Human Research Protections (OHRP) within DHHS is the agency assigned to carry out human subject protections. The rules attempt to balance the value of important research against the potential harm to patients resulting from that research. Some have argued that current rules overly restrict critically important research, particularly in emergency and trauma research (Newgard et al., 2005).

Informed consent requirements represent an important tool to evaluate new and promising therapies in an ethical and publicly-transparent manner; however, complying with the requirements can be overly burdensome for emergency care researchers. Patients treated in the emergency care setting frequently suffer acute, debilitating illnesses or injuries that affect their capacity to make informed decisions (e.g., cardiac arrest, traumatic brain injury). Thus, potential research subjects frequently cannot participate in the informed consent process prior to participating in an interventional clinical trial, even when the investigational therapy holds out the prospect of direct benefit to the individual subject. Furthermore, because care must often be administered immediately, it is difficult to secure informed consent. Currently, federal regulations (21 CFR §50.24) allow a narrow exception to the general requirement for prospective, written informed consent for participation in research studies, in the setting of an acute, debilitating illness or injury for which there is no accepted effective therapy (Biros et al., 1995; Biros et al., 1998; Biros et al., 1999; Baren et al., 1999; Sloan et al., 1999b; Lewis et al., 2001). Under this exception, some flexibility around the informed consent requirements is allowed in emergency situations, but the rules remain difficult to comply with in many situations

(National Highway and Traffic Safety Administration (NHTSA), 2001). As noted by Mann, "…the logistical application of these ethical standards across institutions or among different research studies remains complex and variable (Mann, 2005). Furthermore, state regulations occasionally preempt the federal exception for emergency care research. Active guidance from the DHHS Office for Human Research Protections to states and individual IRBs could eliminate some of the current obstacles that discourage innovation in treatment approaches that could benefit critically ill or injured patients.

Patient Confidentiality Protection

Under new rules established in 2000, all entities participating in federally funded research must obtain a federalwide assurance (FWA) from the OHRP. The FWA is a document that assures the intent of the research organization to comply with applicable federal laws and standards for the protection of human research subjects. The FWA program was intended to streamline the previous, more cumbersome system of single-project and multiple-project assurances.

But many patients treated in the emergency care setting, either those initially treated by EMS or those treated in community EDs, produce important healthcare utilization and outcome data stored at non-academic community-based medical facilities. These facilities are unlikely to participate in federally-supported research in general and, therefore, generally do not have an FWA in place. Newgard describes difficulties associated with obtaining FWA agreements with community hospitals in order to obtain patient-level outcome data from a low-risk EMS study (Newgard et al., 2005). The study involved an attempt to validate a triage rule for children seriously injured during automobile crashes through a retrospective chart review of cases at 27 pediatric receiving hospitals in Los Angeles County. The researchers were unable to achieve participation from all 27 hospitals, which they attribute to the complexity and risk of the FWA requirement. All 27 hospitals had agreed to participate in an interventional randomized controlled trial of airway management in children several years earlier, before the FWA requirement was in place (Gausche et al., 2000). In order to have robust and generalizable results, it is important to include outcome information from the full range of receiving facilities to which the EMS system delivers patients. The NIH Roadmap itself cites the need to remove barriers to collaborative clinical research between community-based providers and academic researchers (Zerhouni, 2003).

In addition there is limited guidance regarding FWAs in EMS research. In the Field Administration of Stroke Therapy–Magnesium (FAST–MAG) trial, a $16 million dollar NIH grant, investigators had to seek help from OHRP and finally it was decided that hospitals had to either have an FWA, apply to have an FWA, or use an academic medical center as a "parent FWA" and sign a written agreement with the parent for their IRB to ensure protection of human subjects. Further, each of the 41 EMS agencies in LA County had to sign an agreement with the Los Angeles EMS Agency to allow the Agency to serve as their FWA and oversee protection of human subjects. While for the most part successful, this effort has taken 2 years. So that important emergency care research can be performed on representative populations in the community, the committee recommends that **Congress modify Federalwide Assurance Program (FWA) regulations to allow the acquisition of limited, linked, patient outcome data without the existence of an FWA.** One approach that has been suggested is to allow an experienced academic medical center IRB to serve as a regional IRB for community hospitals

within a certain area, at least for minimum risk research (Christian et al., 2002; Newgard et al., 2005).

RECOMMENDATIONS

8.1: Academic medical centers should support emergency and trauma care research by providing research time and adequate facilities for promising emergency care and trauma investigators, and by strongly considering the establishment of autonomous departments of emergency medicine.

8.2: The Secretary of the Department of Health and Human Services (DHHS) should conduct a study to examine the gaps and opportunities in emergency and trauma care research, and recommend a strategy for the optimal organization and funding of the research effort.

> **8.2a: This study should include consideration of training of new investigators, development of multi-center research networks, funding of General Clinical Research Centers (GCRCs) that specifically include an emergency and trauma care component, involvement of emergency and trauma care researchers in the grant review and research advisory processes, and improved research coordination through a dedicated center or institute.**
>
> **8.2b: Congress and federal agencies involved in emergency and trauma care research (including the Department of Transportation, the Department of Health and Human Services, the Department of Homeland Security, and Department of Defense) should implement the study's recommendations.**

8.3: States should ease their restrictions on informed consent to match federal law.

8.4: Congress should modify Federalwide Assurance Program (FWA) regulations to allow the acquisition of limited, linked, patient outcome data without the existence of an FWA.

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Appendix A
Committee and Subcommittee Membership

Gail Warden, MHA, *Chair*

SUBCOMMITTEES				
Pediatric Emergency Care (PEDS)	**Prehospital Emergency Medical Services (EMS)**	**Hospital-Based Emergency Care (ED)**		
David Sundwall, MD - Chair	Shirley Gamble, MBA - Chair	Benjamin Chu, MD, MPH - Chair	Thomas Babor, PhD, MPH	MAIN COMMITTEE
George Foltin, MD	Robert Bass, MD	Stuart Altman, PhD	Robert Gates, MPA	
Darrell Gaskin, PhD	Brent Eastman, MD	Brent Asplin, MD, MPH	William Kelley, MD	
Marianne Gausche-Hill, MD	Arthur Kellermann, MD, MPH	John Halamka, MD	Mark Smith, MD, MBA	
Richard Orr, MD	Jerry Overton, MA	Mary Jagim, RN		
	Nels Sanddal, MS, REMT-B	Peter Layde, MD, MSc		
		Eugene Litvak, PhD		
		John Prescott, MD		
		William Schwab, MD		
Rosalyn Baker	Kaye Bender, PhD, RN	Kenneth Kizer, MD		SUBCOMMITTEE ONLY
Mary Fallat, MD	Herbert Garrison, MD	John Lumpkin, MD		
Jane Knapp, MD	Mary Beth Michos, RN	Daniel Manz, EMT		
Thomas Loyacono, EMT-P	Fred Neis, RN	Joseph Wright, MD		
Milap Nahata, PharmD	Daniel Spaite, MD			
Donna Ojanen Thomas, RN				

Appendix B
Biographical Information for Main Committee and Hospital-Based Emergency Care Subcommittee

Gail L. Warden, M.H.A., F.A.C.H.E., MAIN COMMITTEE CHAIR, is President Emeritus of Henry Ford Health System in Detroit, Michigan, one of the nation's leading vertically integrated health care systems.

Warden is an elected member of the Institute of Medicine of the National Academy of Sciences. He served on its Board of Health Care Services, Committee on Quality Health Care in America, and served two terms on the Governing Council. He chairs the board of the National Quality Forum, the Healthcare Research and Development Institute, and the newly created National Center for Healthcare Leadership. Warden co-chairs the National Advisory Committee on Pursuing Perfection: Raising the Bar for Health Care Performance. He is a member of The Robert Wood Johnson Foundation Board of Trustees, the Institute for Healthcare Improvement Board, and the RAND Health Board of Advisors. He is director emeritus and past chairman of the Board of the National Committee on Quality Assurance. In 1997 President Clinton appointed him to the Federal Advisory Commission on Consumer Protection and Quality in the Health Care Industry. In 1995 Warden served as chairman of the American Hospital Association Board of Trustees. He served as a member of the Pew Health Professions Commission, the National Commission on Civic Renewal, and past chairman of the Health Research and Education Trust Board of Directors.

Warden served as president and Chief Executive Officer of Henry Ford Health System from April 1988 until June 2003. Before joining Henry Ford Health System, Warden served as president and chief executive officer of Group Health Cooperative of Puget Sound in Seattle from 1981 to 1988. Prior to that he was executive vice president of the American Hospital Association from 1976 to 1981; and from 1965 to 1976, he served as executive vice president and chief operating officer of Rush-Presbyterian-St. Luke's Medical Center in Chicago.

Warden is a graduate of Dartmouth College and holds an M.H.A. from the University of Michigan. He has an honorary doctorate in public administration from Central Michigan University and is a member of the faculty of the University of Michigan School of Public Health.

Benjamin K. Chu, M.D., M.P.H., ED SUBCOMMITTEE CHAIR, was appointed president, Kaiser Foundation Health Plan, Inc. and Kaiser Foundation Hospitals, Southern California Region, in February 2005. Before joining Kaiser Permanente, Dr. Chu was President of the New York City Health and Hospitals Corporation with primary responsibility for management and policy implementation at the Corporation. Prior to that, Dr. Chu was Senior Associate Dean at

Columbia University College of Physicians and Surgeons. He has also served as Associate Dean and Vice President for Clinical Affairs at the New York University Medical Center managing and developing the clinical academic hospital network. Dr. Chu is a primary care internist by training with extensive experience as a clinician, administrator and policy advocate for the public hospital sector. He was Senior Vice President for Medical and Professional Affairs at the Corporation from 1990-1994. During that period he also served as Acting Commissioner of Health for the New York City Department of Health and Acting Executive Director for Kings County Hospital Center. Dr. Chu also has extensive experience in crafting public policy. He served as legislative assistant for health for Senator Bill Bradley as a 1989-90 Robert Wood Johnson Health Policy Fellow. Earlier in Dr. Chu's career, he served as Acting Director of the Kings County Hospital Adult Emergency Department. His area of interests includes health care access and insurance, graduate medical education policy, primary care and public health issues. He has served on numerous advisory and not-for-profit boards which focused on health care policy issues. Dr. Chu received a Master in Public Health from the Mailman School at Columbia University and his Doctorate of Medicine at New York University School of Medicine.

Stuart H. Altman, Ph.D., is the Sol C. Chaikin Professor of National Health Policy at the Heller Graduate School for Social Policy and Management. He served as dean of the Heller School from 1977 to a 1993. In August of 2005 he again assumed the deanship of the Heller School. Professor Altman has had extensive experience with the federal government, serving as deputy assistant secretary for planning and evaluation/health in the U.S. Department of Health, Education, and Welfare, 1971-76, chairman of the congressionally–mandated Prospective Payment Assessment Commission, 1983-1996, and a member of the Bipartisan Commission on the Future of Medicare, 1999-2001. In addition, from 1973 to 1974, he served as deputy director for health of the President's Cost-of-Living Council and was responsible for developing the council's program on health care cost containment. Dean Altman has testified before various congressional committees on the problems of rising health care costs, Medicare reform and the need to create a national health insurance for the United States. He chaired the Institute of Medicine's Committee on the Changing Market, Managed Care, and the Future Viability of Safety Net Providers. His research activities include several studies concerning the factors causing the recent increases in the use of emergency rooms. He holds a Ph.D. in economics from the University of California, Los Angeles, and has taught at Brown University and the University of California, Berkeley.

Brent R. Asplin, M.D., M.P.H., F.A.C.E.P., is Department Head of Emergency Medicine at Regions Hospital and HealthPartners Research Foundation in St. Paul, MN, and is an Associate Professor and Vice Chair of the Department of Emergency Medicine at the University of Minnesota. After receiving his degree from Mayo Medical School, he completed the University of Pittsburgh's Affiliated Residency in Emergency Medicine. To develop his interests in research and health care policy, Dr. Asplin completed the Robert Wood Johnson Clinical Scholars Program at the University of Michigan, where he obtained a M.P.H. in Health Management and Policy. He is currently studying methods to improve the reliability and efficiency of health care operations, particularly strategies to improve patient flow in hospital settings.

Thomas F. Babor, Ph.D., M.P.H., spent several years in postdoctoral research training in social psychiatry at Harvard Medical School, and subsequently served as head of social science research at McLean Hospital's Alcohol and Drug Abuse Research Center in Belmont,

Massachusetts. In 1982 he moved to the University of Connecticut School of Medicine. He has served as the Scientific Director at the Alcohol Research Center and the interim Chair of the Psychiatry Department.

Dr. Babor's primary interest areas are psychiatric epidemiology and alcohol and drug abuse. In 1998, he became Chair of the Department of Community Medicine and Health Care, where he directs an active research program. Dr. Babor is Regional Editor of the international journal, "Addiction." In addition, he previously served on two Institute of Medicine committees—including "Prevention and Treatment of Alcohol-Related Problems: An Update on Research Opportunities" and "Treatment of Alcohol Problems".

Robert R. Bass, M.D., F.A.C.E.P., received his undergraduate and medical degree from the University of North Carolina at Chapel Hill in 1972 and 1975 respectively. Prior to completing his undergraduate education, he was employed as a police officer in Chapel Hill, NC and served as a volunteer member of the South Orange Rescue Squad. Dr. Bass completed an internship and residency in the United States Navy and is currently board certified in both emergency medicine and family medicine. He has served as a medical director for emergency medical services (EMS) systems in Charleston, SC, Houston, TX, Norfolk, VA, and Washington, DC.

Since 1994, he has been the Executive Director of the Maryland Institute for EMS Systems, the state agency responsible for the oversight of Maryland's EMS and trauma system. He is a Clinical Associate Professor of Surgery (Emergency Medicine) at the University of Maryland at Baltimore and is an Associate Professor in the Emergency Health Services Program at the University of Maryland, Baltimore County.

Dr. Bass is currently the President of the National Association of State EMS Officials and a founding member and the Immediate Past-President of the National Association of EMS Physicians. Additionally, he serves on the Board of Director of the American Trauma Society, the University of Maryland Medical System, and is a past Chairman of the EMS Committee of the American College of Emergency Physicians.

A. Brent Eastman, M.D., joined Scripps in 1984 as Director of Trauma Services at Scripps Memorial Hospital La Jolla, and was appointed Chief Medical Officer in 1998. He continues to serve in the role of Director of Trauma.

Dr. Eastman received his medical degree from the University of California, San Francisco, where he also did his general surgical residency and served as Chief Surgical Resident. He spent one year abroad in surgical training in England at Norfolk and Norwich Hospitals.

Dr. Eastman served as Chairman of the Committee on Trauma for the American College of Surgeons from 1990-1994. This organization sets the standards for the trauma care in the United States and abroad. The position has led to his involvement nationally and internationally in the development of trauma systems in the United States, Canada, England, Ireland, Australia, Brazil, Argentina, Mexico, and South Africa. Dr. Eastman has authored or co-authored more than 25 publications and chapters principally relating to trauma. He has held numerous appointments and

chairmanships over the last two decades, including Chairman, Trauma Systems Committee for the U.S. Department of Health and Human Services; Board of Directors, American Association for the Surgery of Trauma; and Chairman, Grant Review Committee, Center for Injury and Prevention and Control at the U.S. Centers for Disease Control and Prevention.

George L. Foltin, M.D., F.A.A.P., F.A.C.E.P., began his involvement with the Emergency Medical Services for Children (EMSC) Program of the Health Resources and Services Administration in 1985. He is board certified in pediatrics, emergency medicine, and pediatric emergency medicine. Dr. Foltin served on the Medical Oversight Committee for the EMT-Basic National Standard Curriculum project and was a subject expert for the Project to Revise EMT-Intermediate and Paramedic National Standard Curriculum. He is a former board member of the National Association of EMS Physicians and served on the Committee on Pediatric Emergency Medicine of the American Academy of Pediatrics. Currently Dr. Foltin co-chairs the Statewide AAP Committee on Pediatric Emergency Medicine and sits on the Regional Medical Advisory Committee of New York City. He has published extensively in the field of Emergency Medical Services for Children, has been the Principal Investigator of several federal grants, and serves as a consultant to the New York City and State Departments of Health, as well as to federal programs such as the Maternal and Child Health Bureau (MCHB), the Agency for Healthcare Research and Outcome (AHRQ), and the National Highway Traffic Safety Administration (NHTSA).

Shirley Gamble, M.B.A., served as the Senior Advisor to The Robert Wood Johnson Foundation's Urgent Matters initiative, which is working to help hospitals eliminate emergency department crowding and help communities understand the challenges facing the health care safety net. Ms. Gamble has over 20 years experience in the health care industry serving as an executive with Incarnate Word Health Services, Texas Health Plans HMO, and Tampa General Hospital. As Partner of Phase 2 Consulting, a health care management and economic consulting firm, Ms. Gamble led performance improvement and strategic planning engagements for major hospital systems, managed care entities, and university faculty practice plans. She currently is the Chief Operating Officer for the United Way Capital Area in Austin, Texas. She has an M.B.A. and B.A. from the University of Texas at Austin.

Darrell J. Gaskin, Ph.D., M.S., is Associate Professor of Health Policy and Management at The Johns Hopkins Bloomberg School of Public Health and Deputy Director of the Morgan-Hopkins Center for Health Disparities Solutions. Dr. Gaskin's research interests focuses on healthcare disparities and access to care for vulnerable populations. His primary aim is to promote policies and practices that eliminate disparities in health care utilization and barriers to care for low income and minority groups. Dr. Gaskin's most recent project studies disparities in the quality of hospital care. He seeks to identify characteristics of hospitals that provide high quality care to low income and minority patients. Dr. Gaskin has studied race and ethnic differences in preventable hospital stays and usual source of care, the effects of residential segregation on health care utilization, and disparities in prescription drug spending for Medicare seniors. Dr. Gaskin has studied several issues concerning safety net hospitals. He has examined the effects of managed care and price competition of safety net hospitals' provision of care to Medicaid and the uninsured patients. Dr. Gaskin was awarded the Academy Health 2002 Article-of-the-Year Award for his *Health Services Research* article entitled, "Are Urban Safety-Net Hospitals Losing Low-Risk Medicaid Maternity Patients?"

Dr. Gaskin is active in professional organizations. He is a member of Academy Health, the American Economic Association, the National Economics Association (NEA), the International Health Economics Association, the American Society of Health Economists, and the American Public Health Association (APHA). Dr. Gaskin has served as a member of the Board of Directors of the NEA. He has been a member of the Governing Council of APHA and is currently Solicited Program Chair and Section Councilor for the Medical Care Section of APHA. He has chaired the disparities program committee for Academy Health. He is a member of the Board of Directors for the Maryland Citizen's Health Initiative. He earned his Ph.D. in health economics at The Johns Hopkins University a master's degree in economics from the Massachusetts Institute of Technology and a bachelor's degree in economics from Brandeis University.

Robert C. Gates, M.P.A., began his career in the County of Los Angeles Chief Administrative Office, where he was the principal budget analyst for the public health, hospital, and mental health departments. He left Los Angeles to become Chief Operating Officer for the University of California, Irvine, Medical Center in Orange County. While in Orange County he was instrumental in creating their paramedic system.

Mr. Gates then returned to Los Angeles County and spent 6 years as the Chief Deputy Director of the Department of Health Services, guiding the creation of the Los Angeles County Trauma Center system. Mr. Gates was then appointed Director of Health Services for Los Angeles County and served in that capacity for over 11 years. Mr. Gates is currently serving as Medical Services for Indigents Project Director for the Orange County Health Care Agency.

Marianne Gausche-Hill, M.D., F.A.C.E.P., F.A.A.P., serves as professor of Clinical medicine at the David Geffen School of Medicine at the University of California, Los Angeles (UCLA). She is the Director of Emergency Medical Services (EMS) and EMS Fellowship and Director of Pediatric Emergency Medicine Fellowship at Harbor-UCLA Medical Center. Dr. Gausche-Hill also serves as Director of Pediatric Emergency Medicine at the Little Company of Mary Hospital in Torrance, CA. Board certified in both emergency medicine and pediatric emergency medicine, she earned her medical degree and completed her residency at UCLA. Dr. Gausche-Hill is the first emergency physician in the United States to have completed a pediatric emergency fellowship and passed the sub-Board examination.

Dr. Gausche-Hill has done extensive research on prehospital pediatric care, authoring *Pediatric Advanced Life Support: pearls of Wisdom* in 2001 and *Pediatric Airway Management for the Prehospital Professional* early in 2004. Her research and methodology that tracked the results of use of wind-pipe tube method versus the traditional bag-and-pump method as oxygen treatment for pediatric emergencies were published in the Journal of the American Medical Association (JAMA) and in Annals of Emergency Medicine. In May 1999, her worked earned the prestigious "Best Clinical Science presentation" from the Society for Academic Emergency medicine (SAEM).

John D. Halamka, M.D., M.S., is Chief Information Officer of the CareGroup Health System, Chief Information Officer and Associate Dean for Educational Technology at Harvard Medical

School, Chairman of the New England Health Electronic Data Interchange Network (NEHEN), Acting CEO of MA-Share, Chief Information Officer of the Harvard Clinical Research Institute and a practicing Emergency Physician.

As Chief Information Officer at CareGroup, he is responsible for all clinical, financial, administrative and academic information technology serving 3000 doctors, 12000 employees and one million patients. As Chief Information Officer and Associate Dean for Educational Technology at Harvard Medical School, he oversees all educational, research and administrative computing for 18000 faculty and 3000 students. As Chairman of NEHEN he oversees the administrative data exchange in Massachusetts. As CEO of MA-Share he oversees the clinical data exchange efforts in Massachusetts. Chair of HITSP he coordinates the process of electronic standards harmonization among all the stakeholders nationwide.

Mary M. Jagim, R.N., B.S.N., C.E.N., FAEN, is an experienced emergency/trauma nurse with extensive leadership background in program development and implementation, emergency department management and nursing workforce issues, Emergency Preparedness, government affairs, and community based injury prevention. She is currently the Internal Consultant for Emergency Preparedness and Pandemic Planning for MeritCare Health System in Fargo, North Dakota. Well versed in current issues affecting emergency/trauma nursing and emergency care, Jagim has served on the Emergency Nurses Association Board of Directors and as national President in 2001. Jagim currently serves chair of the Emergency Nurses Association Foundation, is a member of the faculty for Key Concepts in Emergency Department Management and is a Fellow in the Academy of Emergency Nursing. Jagim also served on the Centers for Disease Control and Prevention (CDC) National Strategies for Advancing Child Pedestrian Safety Panel to Prevent Pedestrian Injuries and currently is Co-Chair for Advocates for Highway and Auto Safety. Jagim received her B.S.N. from the University of North Dakota in 1984.

Arthur L. Kellermann, M.D., M.P.H., is Professor and Chairman of the Department of Emergency Medicine at the Emory University School of Medicine, and Director of the Center for Injury Control at the Rollins School of Public Health of Emory University. His primary research focus is injury prevention and injury control. He has also conducted landmark research on prehospital cardiac care, use of diagnostic technology in emergency departments, and health care for the poor. His papers have been published in many of the nation's leading medical journals. He is a recipient of the Hal Jayne Academic Excellence Award from the Society for Academic Emergency Medicine, the Excellence in Science award from the Injury Control and Emergency Health Services Section of the American Public Health Association and the Scholar/Teacher Award from Emory University. A member of the Institute of Medicine (IOM), Dr. Kellermann served as Co-Chair of the IOM's Committee on the Consequences of Uninsurance from 2001-2004.

William N. Kelley, M.D., currently serves as Professor of Medicine, Biochemistry and Biophysics at the University of Pennsylvania School of Medicine. Previously, he served as Chief Executive Officer of the University of Pennsylvania Medical Center and Health System and Dean of the School of Medicine from 1989 to February 2000. At the University of Pennsylvania, Dr. Kelley led the development of one of the first academic, fully integrated, delivery systems in the nation. He also built and implemented the largest Health and Disease Management program

in the country, with over 500 physicians and staff and 60 separate clinical sites engaged in implementing the program. Dr. Kelley also holds a patent in a frequently used gene transfer technique that has allowed for numerous advances in the application of gene therapy.

Dr. Kelley received his M.D. from Emory University School of Medicine and completed his residency in Internal Medicine at Parkland Memorial Hospital in Dallas. After a fellowship with the National Institutes of Health and a teaching fellowship at Harvard Medical School, he began his academic career as an assistant professor of Medicine at Duke University School of Medicine, moving on to head Duke's Division of Rheumatic and Genetic Diseases, before becoming chair of Internal Medicine at the University of Michigan Medical School.

Kenneth W. Kizer, M.D., M.P.H., expanded his role as Chairman of the Board for Medsphere Systems Corporation to become its Chief Executive Officer in December of 2005. Kizer joined Medsphere after serving as the President and Chief Executive Officer of the National Quality Forum (NQF), a Washington, DC-based private, non-profit voluntary consensus standards setting organization which was established in 1999, pursuant to a Presidential commission. Prior to that, he served for five years as the Under Secretary for Health in the U.S. Department of Veterans Affairs (VA). In this capacity, he was the highest ranking physician in the federal government and the CEO of the veteran's healthcare system, the largest integrated healthcare system in the U.S.

Dr. Kizer also served as Director of the California Department of Health Services and was California's top health official for over six years, and prior to that, he was Chief of Public Health for California and, before that, Director of California's Emergency Medical Services Authority. He practiced emergency medicine and toxicology in both private and academic settings for over fifteen years.

Dr. Kizer is an honors graduate of Stanford University and UCLA. He is board certified in six medical specialties and/or subspecialties, and has authored over 350 original articles, book chapters and other reports in the medical literature. He is a fellow of numerous professional societies and a member of the Alpha Omega Alpha National Honor Medical Society, the Delta Omega National Honorary Public Health Society, and the Institute of Medicine (IOM).

Peter M. Layde, M.D., M.Sc., is Professor and Interim Director of the Health Policy Institute at the Medical College of Wisconsin. Dr. Layde has been an epidemiologist for over 25 years and an active injury control researcher for over 20 years. He has published extensively on agricultural injuries and methods for injury epidemiology, including early work on use of case–control studies for homicide and on the epidemiological representativeness of trauma center–based studies. He has been an ad-hoc reviewer for the injury Grant Review Committee for over 10 years and served as a member of that committee from 1997–2000. Dr. Layde serves as Co-Director of the Injury Research Center at the Medical College of Wisconsin and as Director of its Research Development and Support Core. He is also Principal Investigator on the Risk Factors for Medical Injury research project.

Eugene Litvak, Ph.D., is a co-founder and director of the *Program for the Management of Variability in Health Care Delivery* at the Boston University Health Policy Institute. He is also is

a Professor at the Boston University School of Management. He received his doctorate in Operations Research from the Moscow Institute of Physics and Technology in 1977. Prior to joining Boston University he was a faculty member at the Harvard Center for Risk Analysis in the Department of Health Policy & Management at the Harvard School of Public Health (HSPH). He still teaches there course "Operations Management in Service Delivery Organizations" at HSPH as an Adjunct Professor of Operations Management. Dr. Litvak arrived in the U.S. in 1988, and joined HSPH in 1990. Prior to that time he was a chief of the Operations Management Group at the Computing Center in Kiev, Ukraine. His research interests include operations management in health care delivery organizations, cost-effective medical decision-making, screening for HIV and other infectious diseases, and operations research. Professor Litvak is an author of more than 60 publications in these areas. He was the leading author of the new cost-effective protocols in screening for HIV and hepatitis, which reduce the cost of screening by a factor of 5 to 10 while simultaneously reducing errors by a factor of 20 to 40. These protocols have been positively evaluated by FDA, NIH and CDC, and currently are the subject of a large-scale international trial supported by the U.S. Agency for International Development. Dr. Litvak serves as a Principal Investigator from the U.S. for this trial. Since 1995 he leads the development and practical applications of innovative variability methodology for cost reduction and quality improvement in health care delivery systems. Professor Litvak was the Principal Investigator in the "Emergency Room Diversion Study" supported by the grant from the Massachusetts Department of Public Health. He is also Principal Investigator in many research and hospital operations improvement studies. Dr. Litvak frequently presents as an invited lecturer at the multiple national and international meetings. He also serves as a consultant on operations improvement to several major hospitals and is a faculty of the Institute for Health Care Improvement.

John R. Lumpkin, M.D., M.P.H., is the Senior Vice President and Director - Health Care Group at the Robert Wood Johnson Foundation (RWJF). Prior to joining RWJF, he was the first African American to hold the position of Director - Illinois Department of Public Health (IDPH). He served the second longest tenure of any director since the present agency structure was created in 1917. As director, Dr. Lumpkin oversaw an agency of 1,300 employees located in Springfield, Chicago, seven regional offices and three laboratories who share primary responsibility for the quality of life in the state. Dr. Lumpkin's career in public health began with his appointment in 1985 as associate director of IDPH's Office of Health Care Regulations, which oversees the licensing, inspection and certification of health care facilities. Dr. Lumpkin served six years as Chairman of the National Committee for Vital and Health Statistics advising the Secretary of the US Department of Health and Human Services on health information policy. Dr. Lumpkin received his medical degree in 1974 from Northwestern University Medical School. He trained in Emergency Medicine at the University of Chicago and earned his M.P.H. from the University of Illinois at Chicago, School of Public Health. Dr. Lumpkin is past president of the Association of State and Territorial Health Officials (ASTHO), a former member of the Board of Trustees of the Foundation for Accountability, a former Commissioner of the Pew Commission on Environmental Health, a former board member of the National Forum for Health Care Quality Measurement and Reporting, a past board member of the American College of Emergency Physicians and past president of the Society of Teachers of Emergency Medicine. Lumpkin has also been the recipient of the Bill B. Smiley Award, Alan Donaldson Award, African American History Maker, and Public Health Worker of the Year.

W. Daniel Manz, B.S., is the Director of Emergency Medical Services for the Vermont Department of Health. He has been in emergency medical services (EMS) for more than 25 years and worked as an emergency medical technician (EMT), volunteer squad leader, hospital communications technician, EMS regional coordinator, EMS trainer and State EMS Director. Much of his work has been in rural areas including Maine and Saudi Arabia. Mr. Manz has been active in the National Association of State EMS Directors, serving as their President for 2 years and representing the association on several national projects including the EMS Agenda for the Future, the HCFA Negotiated Rule Making process, and the recently completed National EMS Scope of Practice Model. Mr. Manz remains active as a volunteer EMT-Intermediate with the local ambulance service in his community. In his spare time he enjoys running, fishing, and sheep farming.

Richard A. Orr, M.D., serves as Professor at the University of Pittsburgh School of Medicine, Associate Director of the Cardiac Intensive Care Unit at the Children's Hospital of Pittsburgh, and Medical Director of the Children's Hospital Transport Team of Pittsburgh, Pennsylvania. Dr. Orr has devoted much of his career to interfacility transportation problems of infants and children in need of tertiary care. He is a member of many professional organizations and societies and has authored numerous articles regarding the safe and effective air and surface transport of the critically ill and injured pediatric patient. Dr. Orr is also a noted lecturer to the air and ground transport community, both nationally and internationally.

Dr. Orr is editor of *Pediatric Transport Medicine*, a unique 700 page book published in 1995. He is the 2001 recipient of the Air Medical Physician Association (AMPA) Distinguished Physician Award and a founding member of the AMPA.

Jerry L. Overton, M.A., serves as the Executive Director, Richmond Ambulance Authority (RAA), Richmond, Virginia, and has overall responsibility for the Richmond Emergency Medical Services system. His duties extend to planning and administering the high performance system design, negotiating and implementing performance based contracts, maximizing fee for service revenues, development of advanced patient care protocols, and employing innovative equipment and treatment modalities. Mr. Overton was previously the Executive Director of the Kansas City, Missouri, EMS system. In addition, he has provided technical assistance to EMS systems throughout the United States and to Europe, Russia, Asia, Australia, and Canada. He designed an implementation plan for an Emergency Medical Transport program in Central Bosnia – Hercegovina. Mr. Overton is a faculty member of the Emergency Medical Department of the Medical College of Virginia, Virginia Commonwealth University, and the National EMS Medical Directors Course, National Association of EMS Physicians. He is the Past President of the American Ambulance Association and is on the Board of Directors of the North American Association of Public Utility Models.

John E. Prescott, M.D., is Dean of the West Virginia University (WVU) School of Medicine, and received both his B.S. and M.D. degrees at Georgetown University. He completed his residency training in Emergency Medicine at Brooke Army Medical Center, San Antonio and was then assigned to Fort Bragg, NC, where he was actively engaged in providing both operational and hospital emergency care in a variety of challenging situations. In 1990 he joined

WVU and soon assumed leadership of the Section of Emergency Medicine. During that same year, Dr. Prescott founded and became the first Director of WVU's Center for Rural Emergency Medicine. In 1993 he became the first Chair of WVU's newly established Department of Emergency Medicine. As past recipient of major CDC and private foundation grants, Dr. Prescott's research and scholarly interests include: rural emergency care; injury control and prevention; medical response to disasters and terrorism; and academic and administrative medicine.

In 1999, Dr. Prescott became WVU's Associate Dean for the Clinical Enterprise and President/CEO of UHA, WVU's physician practice plan. In 2003 he was named Senior Associate Dean was appointed Dean of the WVU School of Medicine in 2004. He has been a Fellow of the American College of Emergency Physicians since 1987 and is the recipient of WVU's Presidential Heroism Award.

Nels D. Sanddal, M.S., REMT-B, is the President of Critical Illness and Trauma Foundation in Bozeman, Montana and is currently on detachment as the Director of the Rural Emergency Medical Services and Trauma Technical Assistance Center (REMSTTAC). Nels has been involved in EMS since the 1970s and has held many state, regional, and national positions in organizations furthering EMS causes, including president of the Intermountain Regional EMS for Children Coordinating Council and core faculty for the Development of Trauma Systems Training Programs for the U.S. Department of Transportation. Nels is a Nationally Registered Emergency Medical Technician-Basic, volunteers with a local fire department, and has been involved with the CIT Foundation since its inception in 1986. He holds a M.S. in psychology and is currently pursuing a Ph.D. in health services.

C. William Schwab, M.D., F.A.C.S., is Professor of Surgery and Chief of the Division of Traumatology and Surgical Critical Care at the University of Pennsylvania. Dr. Schwab's surgical practice reflects expertise in trauma systems, caring for the severely injured patient and incorporating the most advanced techniques into trauma surgery. He is the Director of the Firearm & Injury Center at Penn (FICAP) and holds several grants supporting work on reducing firearm and non-firearm injuries and other repercussions. He has served as a trauma systems consultant to the CDC, New York State and several state health departments. He has established trauma centers and hospital-based aeromedical programs in Virginia, New Jersey and Pennsylvania. He currently directs a network of three regional trauma centers throughout southeastern Pennsylvania. He has been the president of EAST, Vice Chairman of the American College of Surgeons Committee on Trauma and currently serves as the President of the American Association for the Surgery of Trauma.

Mark D. Smith, M.D., M.B.A., has led the California HealthCare Foundation in developing research and initiatives aimed at improving California's health care financing and delivery systems since its formation in 1996. Prior to joining the California Healthcare Foundation, he was Executive Vice President at the Henry J. Kaiser Family Foundation and served as Associate Director of the AIDS Service and Assistant Professor of Medicine and Health Policy and Management at Johns Hopkins University. Dr. Smith is a member of the Institute of Medicine and is on the board of the National Business Group on Health. Previously, he served on the Performance Measurement Committee of the National Committee for Quality Assurance and the editorial board of the Annals of Internal Medicine. A board certified internist, Dr. Smith is a

member of the clinical faculty at the University of California, San Francisco, and an attending physician at the AIDS clinic at San Francisco General Hospital.

David N. Sundwall, M.D., was nominated by Governor Jon Huntsman Jr. to serve as Executive Director of the Utah State Department of Health (UDOH) on January 3, 2005, and was confirmed for this position by the Utah Senate on January 17, 2005. In this capacity he supervises a workforce of almost 1,400 employees, and a budget of almost $1.8 billion. Previously, Sundwall served as President of the American Clinical Laboratory Association (ACLA) in September 1994, until he was appointed Senior Medical and Scientific Officer in May 2003. Prior to his position at ACLA, he was Vice President and Medical Director of American Healthcare System (AmHS), at that time the largest coalition of not-for-profit multi-hospital systems in the country.

Dr. Sundwall has extensive experience in federal government and national health policy, including: Administrator, Health Resources and Services Administration [HRSA}, Public Health Service, U.S. Department of Health and Human Services (HHS), and Assistant Surgeon General in the Commissioned Corps of the U.S. Public Health Service (1986-1988). During this period, he had adjunct responsibilities at HHS including: Co-Chairman of the HHS Secretary's Task Force on Medical Liability and Malpractice, and was the HHS Secretary's Designee to the National Commission to Prevent Infant Mortality. Dr. Sundwall also served as Director, Health and Human Resources Staff (Majority), U.S. Senate Labor and Human Resources Committee (1981-1986).

Dr. Sundwall was in private medical practice in Murray, Utah from 1973-1975. He has held academic appointments at the Uniformed Services University of the Health Sciences, Bethesda, Maryland; Georgetown University School of Medicine, Washington, DC; and the University of Utah School of Medicine. He is board certified in internal medicine and family practice. He is licensed to practice medicine in the District of Columbia, is a member of the American Medical Association (AMA) and the American Academy of Family Physicians (AAFP), and previously served as volunteer medical staff of Health Care for the Homeless Project.

Joseph L. Wright, M.D., M.P.H., is Executive Director of the Child Health Advocacy Institute at Children's National Medical Center in Washington, DC. In that capacity, Dr. Wright provides strategic leadership for the organization's advocacy mission and community partnership initiatives. Academically, he is a Professor and Vice Chairman in the Department of Pediatrics, as well a Professor of Emergency Medicine and Prevention & Community Health at the George Washington University Schools of Medicine and Public Health. He has been attending faculty in the Division of Emergency Medicine at Children's Hospital since 1993 and was recently appointed Interim Executive Director for Hospital Based Specialties at the institution.

Dr. Wright is founding director of the Center for Prehospital Pediatrics at Children's, and serves as the State EMS Medical Director for Pediatrics within the Maryland Institute for Emergency Medical Services Systems (MIEMSS). His major areas of scholarly interest include emergency medical services for children, injury prevention and the needs of underserved communities. Dr. Wright has received recognition for his advocacy work throughout his career including the Shining Star award from the Los Angeles-based Starlight Foundation for outstanding community

service, induction into Delta Omega, the nation's public health honor society and membership in the prestigious Leadership Greater Washington. He has been appointed over the years to several national advisory bodies, including within the Institute of Medicine, the National Association of Children's Hospitals and Related Institutions, and the American Academy of Pediatrics where he serves as chair of the Subcommittee on Violence. Dr. Wright has delivered expert testimony before Congress on several occasions, has made numerous national media appearances and lectures widely to both professional and lay audiences.

Appendix C
List of Presentations to the Committee

February 2–4, 2004

Overview of Emergency Care in the U.S. Health System

- Overview of the Emergency Care System
  Arthur L. Kellermann (Emory University School of Medicine)
- Emergency Care Supply and Utilization
  Charlotte S. Yeh (Centers for Medicare and Medicaid Services)
- Rural Issues in Emergency Care
  John E. Prescott (West Virginia University)

Major Emergency Care Issue Areas

- Patient Flow and Emergency Department Crowding
  Brent R. Asplin (University of Minnesota)
- Evolution of the Emergency Department (circa 2004): A Systems Perspective
  Eric B. Larson (Group Health Cooperative)
- Mental Health and Substance Abuse Issues
  Michael H. Allen (University of Colorado Health Sciences Center)
- Workforce Education and Training
  Glenn C. Hamilton (Wright State University School of Medicine)
- Information Technology in Emergency Care
  Larry A. Nathanson (Beth Israel Deaconess Medical Center)

Pre-Hospital Care, Public Health, and Emergency Preparedness

- Emergency Care and Public Health
  Daniel A. Pollock (Centers for Disease Control and Prevention)
- Overview of the Issues Facing Pre-Hospital EMS
  Robert R. Bass (Maryland Institute for Emergency Medical Services Systems)
- Emergency Preparedness
  Joseph F. Waeckerle (University of Missouri Baptist Medical Center)

Research Agenda

- Overview of Research in Emergency Care
  E. John Gallagher (Montefiore Medical Center)
- Research Needs for the Future
  Robin M. Weinick (Agency for Healthcare Research and Quality)

June 9–11, 2004

Overview of the Emergency Medical Services for Children

- The EMS-C Program History and Current Challenges
  Jane Ball (The EMSC National Resource Center)
- The 1993 IOM Report: Promise and Progress
  Megan McHugh (IOM Staff)

Issues in Pediatric Emergency Care

- Pediatric Equipment and Care Management
  Marianne Gausche-Hill (Harbor-UCLA Medical Center)
- Special Problems in Pediatric Medication
  Milap Nahata (Ohio State University Schools of Pharmacy and Medicine)
- Training and Skills Maintenance
  Cynthia Wright-Johnson (Maryland Institute for EMS Systems)
- Emergency Research and Data Issues
  David Jaffe (Washington University in St. Louis)

Pediatric Disaster Preparedness

- *George Foltin (New York University Bellevue Hospital Center)*

Organization & Delivery of Emergency Medical Services

- System-Wide EMS & Trauma Planning and Coordination
  Stephen Hise (National Association of State EMS Directors)
- Fire Perspective on EMS
  John Sinclair (International Association of Fire Chiefs)
- Trauma Systems
  Alasdair Conn (Massachusetts General Hospital)
- Critical Care Transport
  Richard Orr (Children's Hospital of Pittsburgh)

History and Organization of EMS in the U.S.

- EMS System Overview and History
  Robert Bass (Maryland Institute for Emergency Medical Services Systems)
- Overview of Local EMS Systems
  Mike Williams (Abaris Group)
- Issues Facing Rural Emergency Medical Services
  Fergus Laughridge (Emergency Medical Services, Nevada State Health Division)

Prehospital EMS Issue Areas

- EMS Financing and Reimbursement
  Jerry Overton (Richmond Ambulance Authority)
- EMS Quality Improvement and Patient Safety
  Robert A. Swor (William Beaumont Hospital)
- Overview of the EMS Agenda for the Future
  Ted Delbridge (University of Pittsburgh)
- EMS Data Needs
  Greg Mears (University of North Carolina-Chapel Hill)
- Overview of Current EMS Research
  Ron Maio (University of Michigan)

Agency Reaction Panel

- Health Resources and Services Administration, Maternal and Child Health Bureau
  Dave Heppel (Division of Child, Adolescent, and Family Health) and/or Dan Kavanaugh (EMSC Program)
- National Highway Traffic Safety Administration
  Drew Dawson (EMS Division)
- Agency for Healthcare Research and Quality
  Robin Weinick (Safety Nets and Low Income Populations and Intramural Research)

- Centers for Disease Control and Prevention, National Center for Injury Prevention and Control
  Rick Hunt (Division of Injury and Disability Outcomes and Programs)
- Health Resources and Services Administration, Office of Rural Health Policy
  Evan Mayfield (U.S. Public Health Service and Public Health Analyst)

June 24–25, 2004

Workforce Issues in the Emergency Department

- Issues Facing the Emergency Care Nursing Workforce
  Mary Jagim (MeritCare Hospital)
  Carl Ray (Bon Secours DePaul Medical Center)
  Kathy Robinson (Pennsylvania Department of Health)

Current Initiatives in Patient Flow

- Patient Flow Initiative Implemented at University of Utah
  Jadie Barrie (University of Utah)
  Pamela Proctor (University of Utah)
- Program for Management of Variability in Health Care Delivery
  Eugene Litvak (Boston University Health Policy Institute)

Luncheon Speaker—Medical Technology in Emergency Medicine

- *Michael Sachs (Sg2)*

September 20–21, 2004

Prehospital EMS Issue Areas

- International EMS Systems
  Jerry Overton (Richmond Ambulance Authority)
- Current Status of Federal Emergency Care Legislation and Funding
  Mark Mioduski (Cornerstone Government Affairs)
- Overview of EMS Workforce Issues
  John Becknell (Consultant)
- EMS System Design and Coordination
  Bob Davis (USA Today)

Reimbursement and Funding of Pediatric Emergency Care Services

- Reimbursement Issues in Pediatric Emergency Care
  Steven E. Krug (Northwestern University/Children's Memorial Hospital)
- Current Status of Federal Emergency Care Legislation and Funding
  Mark Mioduski (Cornerstone Government Affairs)

Issues Facing Pediatric Emergency Care

- Funding of Children's Hospitals
  Peter Holbrook (Children's National Medical Center)
- Survey on Pediatric Preparedness
  Marianne Gausche-Hill (Harbor-UCLA Medical Center)

October 4–5, 2004

No open sessions held.

March 2–4, 2005

Public Health Perspectives

- Overview of EMS & Trauma System Issues
  William Koenig (Emergency Medical Services Agency, LA County)
- The Hospital Perspective
  Doug Bagley (Riverside County Regional Medical Center)
- The Safety Net and Community Providers Perspective
  John Gressman (San Francisco Community Clinics Consortium)
- Mental Health & Substance Abuse
  Barry Chaitin (University of California—Irvine)
- The Patient Perspective
  Sandy Schuhmann-Atkins (University of California—Irvine)

On-Call Coverage Issues

- Survey of On-Call Coverage in California
  Mark Langdorf (University of California—Irvine)
- Specialty Physician Perspective—Orthopaedics
  Nick Halikis (Little Company of Mary Hospital)
- Specialty Physician Perspective—Neurosurgery
  John Kusske (University of California—Irvine)

Issues in Rural Emergency Care

- The Family Practice Perspective
  Arlene Brown (Southern New Mexico Family Medicine Residency and Family Practice Associates of Ruidoso, PC)
- Telemedicine in Rural Emergency Care
  Jim Marcin (University of California—Davis)

Appendix D
List of Commissioned Papers

1. The Role of the Emergency Department in the Health Care Delivery System
Consultant: Eva Stahl, Brandeis University

2. Patient Safety and Quality of Care in Emergency Services
Consultant: Jim Adams, Northwestern University

3. Patient Flow in Hospital-Based Emergency Services
Consultant: Brad Prenny, Boston University, Health Policy Institute

4. Models of Organization, Delivery, and Planning for EMS and Trauma Systems
Consultant: Tasmeen Singh, Children's National Medical Center

5. Information Technology in Emergency Care
Consultant: Larry Nathanson, Harvard Medical School

6. Emergency Care in Rural America
Consultant: Janet Williams, University of Rochester

7. The Emergency Care Workforce
Consultant: Jean Moore, SUNY School of Public Health

8. The Financing of EMS and Hospital-Based Emergency Services
Consultants: Richard Lindrooth, Medical University of South Carolina
David Gray, Oregon Health and Sciences University
John McConnell, Oregon Health and Sciences University

9. The Impact New Medical Technologies on Emergency Care
Consultant: Sg2

10. Mental Health and Substance Abuse in the Emergent Care Setting
Consultant: Linda Degutis, DrPH, Yale University

11. Emergency Care Research Funding
Consultant: Roger Lewis, Harbor-UCLA Medical Center

Appendix E
Statistics on Emergency and Trauma Care Utilization

Emergency departments and trauma centers see an enormous variety of patients and conditions on a daily basis. Regardless of income, insurance status, age, or race, people rely on EDs for care in the event of a serious illness or injury, and increasingly for primary care. This section describes some of the key utilization trends in hospital-based emergency care. It is largely based on data from the CDC's National Hospital Ambulatory Health Care Survey for the year 2003, as reported in McCaig and Burt (McCaig and Burt, 2005), and is supplemented by other sources.

INJURIES AND CONDITIONS TREATED

In 2003, the most common medical diagnoses among ED patients, excluding injuries, were acute upper respiratory infections (5.7 percent), abdominal pain (3.9 percent), chest pain (3.7 percent), and spinal disorders (2.5 percent). About 40.2 million visits, or 35.3 percent of visits, were injury related. Of the visits related to injuries, 70 percent were unintentional injures, for example falls, being unintentionally struck by an object, motor vehicle crashes, and injuries from a piercing instrument or object. About 5 percent of injuries were intentional, including assaults and self-inflicted injuries (McCaig and Burt, 2005). Reasons for hospital ED visits are summarized in Table E-1.

There has been also been a marked increase in the number of trauma visits, resulting in a significant increase in emergency workloads and contributing to the crowding problem (Reilly et al., 2005). During the five years between 1999 and 2003, trauma visits rose by 18.1 percent. Most of this increase reflects patients who were seen by the trauma team and released rather than admitted as patients. The authors suggest that over-triage, perhaps related to malpractice and EMTALA concerns associated with treating injured patients at non-trauma centers, may be a major factor.

Over the past several years, increasingly complex cases are being seen in the ED. Patients are presenting with higher severity-of-illness, and many have comorbidities and chronic diseases (Derlet and Richards, 2000; Bazzoli et al., 2003). These patients require more complex and time-consuming workups and treatments.

In 2000, 45.4 percent of Americans had a chronic condition (see Figure E-1). That number is expected to grow to 47.7 percent by 2015 (Partnership for Solutions, 2002). Specifically, the prevalence of cardiovascular disease (CVD) will increase by 18 percent due to the aging of the population. In 2003, 71 million Americans had CVD (AHA, 2006); by 2010, it is projected that 69 million Americans will have the disease. Similarly, the prevalence of neurological diseases, particularly those associated with aging, such as Parkinson's disease, stroke and Alzheimer's disease, will increase.

TABLE E-1 ED visits by 20 leading diagnoses.

Principal Reason for Visit	percent
Contusion with intact skin surface	4.2
Acute upper respiratory infections, excl. pharyngitis	4.0
Abdominal pain	3.9
Chest pain	3.7
Open wound, excluding head	3.6
Spinal disorders	2.5
Otitis media and eustachian tube disorders	2.3
Sprains and strains, excluding neck and back	2.2
Fractures, excluding lower limb	2.1
Open wound of head	2.0
Sprains and strains of neck and ankle and back	2.0
Acute pharyngitis	1.7
Urinary tract infection	1.6
Chronic and unspecified bronchitis	1.6
Superficial injuries	1.6
Cellulitis and abscess	1.6
Pyrexia of unknown origin	1.5
Asthma	1.5
Heart disease, excluding ichemic	1.5
Rheumatism, excluding back	1.5
All other	53.1
Total	99.7

SOURCE: McCaig and Burt, 2005.

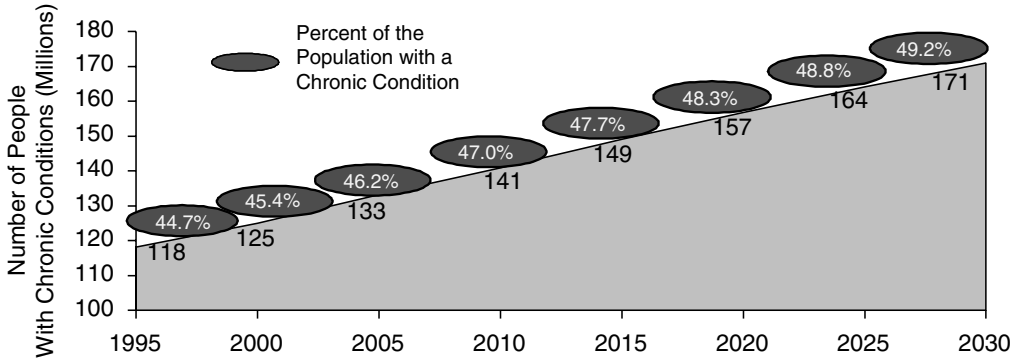

FIGURE E-1 The portion of the United States population with a chronic disease.
SOURCE: Partnership for Solutions, 2002.

Increases in disease prevalence over the coming decade, especially of cardiovascular and neurological disease, will also drive growth in ED use. The use of medical therapies will reduce ED visits in the near term, but those same patients will live longer, resulting in increased ED visits in the longer term. Implantable technologies for cardiac diseases will increase patient survival and the likelihood of increased ED visits later in patients' lives. A higher prevalence of chronic diseases, such as diabetes, asthma, and obesity, will also lead to higher ED utilization. Poor patient management of chronic diseases and poly-pharmacy issues will contribute to increased ED utilization.

ED VISITS BY AGE

Elderly

Older Americans (75+) have a much higher rate of ED visits than other age groups (Table E-2). Care of the elderly presents unique challenges. This pool of patients tends to come to the ED with more severe medical-related conditions, have a higher probability of being admitted to the hospital, and consume more resources than other patients.

Elderly patients may not receive appropriate care, particularly when there is cognitive impairment (Sanders, 2002). Their problems tend to be complex and time consuming, and therefore have a disproportionate impact on emergency care services (Sanders, 2001). For older patients, the workups are more difficult, the length of stay in the ED is greater, and nearly half of older patients (65 and older) are admitted to the hospital compared to 11 percent of younger adults (McNamara et al., 1992; Singal et al., 1992). More patients aged 75 and older arrived by emergency medical transport (40.9 percent, versus 4.2 percent of all patients), and patients 65 and older were most likely to be classified as emergent (25.5 percent versus 15.2 percent of all patients) (McCaig and Burt, 2005). The utilization of the ED by elderly patients is likely to increase as the population ages over the next two decades; by 2050, individuals aged 65+ are expected to comprise over 20 percent of the total U.S. population (U.S. Census Bureau, 2004).

TABLE E-2 Visits and Visits per 100 by Age, 2003

Age	Number of Visits in Thousands	Visits per 100 Persons
Under 15	24,733	40.8
15–24	17731	44.2
25–44	32906	40.0
45–64	20992	30.8
65–74	7153	39.5
75 and older	10389	64.2

SOURCE: McCaig and Burt, 2005.

Children

In 2003, children under age 15 made over 24 million visits to emergency departments, representing 22 percent of all emergency department visits. This equates to almost 4 visits for every 10 children under age 15 (McCaig and Burt, 2005). Despite the frequent use of emergency services by children, the training, equipment, medications, and technology of emergency care often fails to address their needs (Glaser et al., 1997; Moreland et al., 98; Tamariz et al., 2000; Middleton and Burt, 2006). Children are different from adults in a wide range of clinically significant ways. For example, children have different metabolic and respiratory rates, different blood pressure levels, smaller airways, greater surface to body weight ratios, higher emotional sensitivity, and limited communication skills. The services, drugs, and equipment developed for use by adult patients in an emergency situation are often inappropriate for pediatric patients. The limited availability of pediatric equipment and supplies in ambulances and emergency departments has been well documented in several reports (IOM, 1993; Hamilton et al., 2003). One survey of EDs found that the average hospital in the US had about 80 percent of the AAP's recommended pediatric supplies and only 6 percent of hospitals had all of the recommended equipment (Middleton and Burt, 2006). And while children's hospitals are a unique resource for children, most children are treated in general hospitals rather than children's hospitals (Gausche-Hill et al., 2004). Pediatric emergency care is dealt with comprehensively in the companion IOM report, *Emergency Care for Children: Growing Pains*.

ED VISITS BY RACIAL AND ETHNIC COMPOSITION

The 2002 utilization rate for black Americans is 71 percent greater than that of whites. In addition, blacks have had some of the largest increases in ED utilization rates during the 1990s. Particularly for persons over 65, blacks increased their ED utilization by 59 percent during the nineties while white utilization in the same age bracket remained relatively unchanged (McCaig and Ly, 2002).

Other minority populations also utilize the ED at higher rates than whites, including Hispanic and non-English speaking populations. The proportion of the population that said that they spoke English less than "very well" grew from 4.8 percent in 1980, to 6.1 percent in 1990 and 8.1 percent in 2000 (U.S. Census Bureau, 2004). Language barriers can result in higher rates of resource utilization for diagnostic studies, increased ED visit times (Hampers et al., 1999), and lower satisfaction with care (Carrasquillo et al., 1999). In addition, non-English speaking people may be less likely to trust the emergency system, be unfamiliar with 9-1-1, and fail to understand which services are available to them and at what cost.

While racial disparities in health care have been well documented (IOM, 2002; AHRQ, 2003), the evidence of disparities in emergency services is limited. Studies have shown differences in wait times for Hispanic patients, insurer authorization for ED visits by African Americans (Lowe and Bindman, 1994), and administration of pain medication for African Americans (Todd et al., 2000).

FREQUENT USERS

One particularly challenging group of ED patients includes those who make repeated visits. Estimates from different data sources indicate that 5 to 7 percent of the US population will have two or more ED visits in a given year (Zuckerman and Shen, 2004). A smaller group of individuals, often referred to as "frequent flyers", visit the ED for care even more frequently. Frequent users tend to be in poor health, suffering from high rates of chronic illness, drug disorders, and mental illness Sun et al., 2003; Washington State Department of Social and Health Services, 2004). Many also suffer from socioeconomic distress (Sun et al., 2003). Frequent users are a challenge to ED staff because they require intensive resources, such as mental health, substance abuse, and case management services that are often not available at EDs.

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Appendix F
Historical Development of Hospital-Based Emergency and Trauma Care

The modern emergency department developed at a time when the specialization of medical practice swept the nation after World War II, and it reflects the general trend toward hospitals as a site of medical care, rather than homes and physicians' offices. As the practice of generalist physicians making house calls declined, patients increasingly turned to the local hospital for treatment. This was reinforced by the development of private insurance plans which geared payments toward hospitals and away from home visits (Rosen, 1995). The development of the ED also reflects the passage of the Hill-Burton Act of 1946, which provided states with federal grants to build hospitals, provided that the states meet a variety of conditions including a community service obligation. Among other things, the community service obligation requires hospitals receiving Hill Burton funding to maintain an emergency room. This requirement applies to the vast majority of nonprofit U.S. hospitals in operation today (Rosenblatt et al., 2001).

But hospital-based emergency care was really spurred forward by developments in trauma care that resulted from America's wartime experiences. WWII saw the development of blood transfusions, resuscitation, rapid transport of injured patients to field hospitals, and advances in surgical care of injuries. Military medicine advanced further during the Korean and Vietnam Wars with the introduction of medical evacuations by helicopter to mobile field hospitals. Modern EMS and trauma systems grew out of a growing recognition that these methods could be also applied to civilian populations back home (Boyd, 1983).

Coincident with developments in the treatment of injuries were advances in the treatment of acute coronary syndrome (ACS). In Belfast, Ireland, Dr. Frank Pantridge was demonstrating that a mobile coronary care unit could substantially reduce mortality among heart attack victims (Pantridge and Geddes, 1967). Following his lead, several medical centers in the United States began programs to deliver rapid emergency care to cardiac patients. William Grace, for example, established a mobile coronary care unit at St. Vincent's Hospital in New York City—the first of its kind in America—that transported physicians to the scene of patients experiencing ACS (Key et al., 2005). Other programs were started independently in Los Angeles, Seattle, Columbus, and Miami.

The recognition that injured or acutely ill people could be saved if they received treatment within a short span of time led to the development of prehospital EMS systems designed to get patients to the hospital quickly. This in turn stimulated the development of hospital-based emergency care and the specialty of emergency medicine. The introduction of new technologies that facilitated the rapid diagnosis and treatment of injuries and acute illnesses, such as the CT scan and cardiac monitoring, contributed to this growth.

Public interest in the importance of emergency services was sparked by the 1966 landmark National Academy of Sciences/National Research Council report, *Accidental Death and Disability: The Neglected Disease of Modern Society* (NAS and NRC, 1966). The report described the epidemic of automobile and other injuries—due in part to the expansion of the

interstate highway system—and the deplorable system for treating these injuries nationwide. At the time, most emergency rooms appeared to offer only advanced first aid; only a few facilities had the staff and equipment to provide complete care for seriously ill or injured patients. Patients who appeared at the hospital were often turned away if they did not have funds to pay for their care, and transfers to the city or county indigent care facility was conducted without concern for patient well-being (Rosen, 1995). To many in the field, the 1966 NAS/NRC report marked the beginning of the modern emergency care system that we know today. Coupled with the advancements in military medicine and civilian cardiac care, this report led to the Highway Safety Act of 1966 (P.L. 89-564), which created the National Highway Traffic Safety Administration within the Department of Transportation, and required states to develop regional emergency care systems.

The growing demand for emergency care and the difficulty of finding physicians to staff them led hospitals to require active medical staff to take turns covering the ED at night, and to hire additional ED staff, regardless of their skills or experience. Eventually some physicians gave up their regular practices to work in the ED full time. One of the first to do so was James Mills, M.D., who started the Alexandria Plan in 1961, a physician group made up of doctors who worked only in the ED. Similar plans in Pontiac and Flint, Michigan, soon followed. Because of the advantages to hospitals of having a steady, full time team covering the ED, hospitals began contracting for emergency services, and an increasing number of physicians decided to work in EDs full time. Most private physicians entering this new field had no specialized medical training; they entered ED practice after completing only an internship (Rosen, 1995).

The Emergency Medical Services Systems Act of 1973 (P.L. 93-154) created a new grant program in the Division of EMS in DHEW to foster development of regional EMS systems. NHTSA simultaneously funded the prehospital components of EMS systems and oversaw the development of curricula and training for EMS professionals. A number of advancements resulted from this confluence of effort, including the establishment of state coordinating offices and local EMS planning councils, the proliferation of trained EMTs, and the development of air transport services.

But while EMS systems benefited from an influx of federal funding in the 1970s, emergency departments received less support and deficiencies remained. Throughout the 1970s, a pattern was established of soaring ED patient volume along with relative neglect of the needs of emergency departments.

In the early 1980s, the period of strong federal leadership and funding for the development of Emergency Care came to an end with the passage of the Omnibus Reconciliation Act of 1981 (P.L. 97-35). This replaced the categorical funding for EMS activities in the states with the Preventive Health and Health Services Block Grant that allowed states to allocate federal EMS dollars to other programs. The Act eliminated most emergent care activities under DHEW and spending on EMS dropped dramatically. NHTSA therefore became the de facto federal lead agency, although its emphasis was even more focused on prehospital activities than DHEW's, and its even NHTSA's funding for EMS, provided through Section 402 of the State and Community Highway Safety Program was reduced (IOM, 1993). A GAO report found that funding fell by 34 percent between 1981 and 1983. Funding also shifted to the states—in 1981 about 27 percent of funding was from state and local funds; by 1988, the state and local share increased to 82 percent.

Also in the 1980s, the importance of prevention of injury was becoming more widely recognized, and was highlighted in a 1985 NAS/NRC report, *Injury in America: A Continuing*

Health Problem (NRC and IOM, 1985). This led to the establishment of the CDC Center for Injury Prevention and Control in 1992. Also, a growing recognition of the unmet emergency needs of children, particularly among professional organizations such American Academy of Pediatrics, ACEP, Society of Critical Care Medicine, and the National Association of EMS Physicians, led to the establishment of the EMS-C Program within the Department of Health and Human Services (DHHS) as part of the Health Services, Preventive Health Services, and Home and Community Based Services Act of 1984 (P.L. 98-555). The EMS-C Program, established as a demonstration grant program, despite its longevity, funded two resource centers and established grants to states to develop and implement EMS-C programs. While focused on pediatrics, the program has worked closely and jointly funded general projects with NHTSA and other federal partners in order to both promote general enhancements that will benefit children and promote the integration of children's issues into general emergency care planning and activities.

THE DEVELOPMENT OF TRAUMA CARE

Trauma represents a particular kind of medical emergency. It is typically defined as having a physical wound caused by force or impact, such as a fall, automobile crash, or gunshot wound. Burns and other severe wounds are also considered a form of trauma. Other life threatening emergencies caused by pre-existing conditions, such as a heart attack, are generally not considered trauma. Trauma care is distinguished from care received in a general emergency department by the severity of the traumatic injury and the specialized diagnostic and treatment procedures necessary to care for the traumatically injured patient. Ideally, traumatically injured patients are cared for in a trauma center, a hospital that is able to receive severely injured patients 24 hours a day, seven days a week. Trauma centers are designed to meet the complex surgical demands of critically ill patients immediately. In order to qualify as a trauma center, a hospital must have a number of capabilities, including a resource intensive emergency department, a high quality intensive care ward, and an operating room that is functional at all times.

The development of trauma care mirrors the development of surgery in general and has been stimulated by wartime experiences. The seeds of the modern trauma system can be traced to the beginnings of the American College of Surgeons (ACS), which was founded in 1922 (Trunkey, 2000). The College established a Committee on Fractures, as well as the Hospital Standardization Program, which collected data on fracture injuries to become the first trauma registry. (This program later became JCAHO.) The college later formed the Board of Industrial Medicine and Traumatic Injury in 1926.

Rapid advances in medical treatments in the rapid delivery of patients to hospitals occurred during the World Wars, Korea, and Vietnam, and the current conflict in Iraq continues this pattern with a number of important advances being made. The modern era of trauma is equally concerned with the development of trauma care systems. Several early trauma centers—San Francisco General Hospital, Cook County Hospital in Chicago—began the development of systematic approaches to trauma, and were closely followed by the development of Maryland's statewide trauma system by R. Adams Crowley (Trunkey, 2000). These led to the development of formal criteria for trauma systems, first embodied in the ACS Committee on Trauma's

Optimal Criteria for Care of the Injured Patient

The development of trauma systems, which was limited to a few states before 1990, accelerated greatly with the enactment of the Trauma Care Systems Planning and Development Act (PL 101-590) in 1990, and the number of trauma centers nationwide began to increase rapidly. This program was eliminated in 1995, leaving a gap in federal leadership on trauma systems development until the creation of the Trauma/EMS Systems Program within HRSA's Division of Healthcare Preparedness in 2001. This new program again provided national leadership for planning, infrastructure development, standards development, and coordination with other federal agencies until it too was zeroed out of the federal budget for FY 2006.

A trauma system is a coordinated approach to trauma care and injury prevention. It is based on the premise that optimal care is delivered to injured patients when preconceived processes and resources are coordinated into an organizational plan. A well organized trauma system will allow patients to move seamlessly and expediently through this system. The formality of trauma systems varies by states.

Almost all systems had standardized triage processes and had constant oversight over the trauma centers, but systems vary on many other factors, including designation processes and criteria for interfacility transfers.

The most recent nationwide inventory of trauma centers was published in 2003 based on data collected in 2001–2002. A total of 1154 trauma centers were identified in the fifty states and the District of Columbia; an additional 31 trauma centers treat children only. Every state in the United States has at least one trauma center of some level and all but Arkansas have at least one level I or level II (the most sophisticated trauma centers). An important part of trauma systems is the categorization of hospitals according to the level of trauma services that they provide. This information is then used by regional EMS agencies and community hospitals to direct trauma patients to the most appropriate level of care given their condition and location. The process of categorizing hospitals was pioneered by the American College of Surgeons Committee on Trauma (ACS COT). There are three related steps in the ACS COT process: verification, accreditation, and designation. Verification is a process that confirms that a center meets a specific set of criteria identified by the ACS COT. The Verification Review Committee (VRC), a subcommittee of ACS COT, was established in the late 1980's to conduct on-site consultations and verifications. Finally, local governments designate specific institutions as trauma centers within their system based on the ACS COT verification and accreditation. Through a verification review process a center is accredited as a level I, II, III, or IV trauma center, based on a variety of factors, including volume of severely injured patients, 24-hour availability of trauma surgeons and other specialists, whether these specialists are in-house or on call, the surgical capabilities of the center, and availability of specialized equipment. See Box F-1.

A minority of trauma centers are verified not by the ACS COT process, but by state-by-state verifications processes. The criteria and categorization systems used by states that conduct verification can vary, and some states include a fifth level of triage designation.

BOX F-1 American College of Surgeons Committee on Trauma Classification System of Trauma Center Level

Level I

Provides comprehensive trauma care, serves as a regional resource, and provides leadership in education, research, and system planning.

A level I center is required to have immediate availability of trauma surgeons, anesthesiologists, physician specialists, nurses, and resuscitation equipment. American College of Surgeon's volume performance criteria further stipulate that level I centers treat 1200 admissions a year or 240 major trauma patients per year or an average of 35 major trauma patients per surgeon.

Level II

Provides comprehensive trauma care either as a supplement to a level I trauma center in a large urban area or as the lead hospital in a less population-dense area.

Level II centers must meet essentially the same criteria as level I but volume performance standards are not required and may depend on the geographic area served. Centers are not expected to provide leadership in teaching and research.

Level III

Provides prompt assessment, resuscitation, emergency surgery, and stabilization with transfer to a level I or II as indicated.

Level III facilities typically serve communities that do not have immediate access to a level I or II trauma center.

Level IV/V

Provides advanced trauma life support prior to patient transfer in remote areas in which no higher level of care is available.

The key role of the level IV center is to resuscitate and stabilize patients and arrange for their transfer to the closest, most appropriate trauma center level facility.

Level V trauma centers are not formally recognized by the American College of Surgeons, but they are used by some states to further categorize hospitals providing life support prior to transfer.

Current Issues in Trauma Systems

Although the development of trauma centers and trauma systems have developed extensively over the last 2 decades, there remain a number of critical issues, including:

Lack of regional coordination. Ensuring that each patient is directed to the most appropriate setting for care requires that many elements within the regional system—community hospital, trauma centers, and particularly prehospital EMS—effectively coordinate the regional flow of patients. In addition to improving patient care, coordinating the regional flow of patients is a critical tool in reducing overcrowding in EDs. Few systems nationwide have effective coordination between EMS and hospital EDs and trauma centers, and actively direct patients to the best location based on current availability of beds, ORs, specialists, and critical equipment.

Decreased pool of trauma surgeons and other specialists. There is a declining pool of trauma surgeons and on call specialists due to the large amount of uncompensated care they are required to provide, the extraordinary medical malpractice risk, and the lifestyle burdens associated with providing emergency call day and night.

Loss of trauma centers. Trauma care is expensive to provide and often is poorly compensated. As a result, level I trauma centers have been closing in major cities due to the financial pressure of caring for uninsured and underinsured patients. When a trauma center closes, it puts substantial pressure of nearby centers to take additional patients. Loss of regional trauma capacity can be perilous for patients, as it can increase the time it takes to reach definitive care.

MILITARY EMERGENCY AND TRAUMA CARE

Just as the U.S. civilian emergency care system benefited from military medicine advancements learned during the Vietnam and Korean Wars, the civilian system may also benefit from further military medicine advancements being employed in current U.S. military operations in Afghanistan and Iraq. Indeed, military medics and physicians have better information and tools at their disposal in comparison to previous military engagements and these advancements are expected to reduce battlefield deaths considerably. The Iraq war has produced the lowest casualty fatality rate ever seen in combat among U.S. soldiers injured (Connolly, 2004). In many respects, military medicine is well ahead of the civilian trauma system in place today.

One important advancement has been the development and implementation of a medical information management system for military forces. In past military engagements, soldiers carried paper medical cards to insert into their medical records at a later time. However, the cards would often get damaged or lost, leaving field medics with little information on wounded soldiers (Campbell, 2005). In 1999, the Department of Defense adopted Medical Communications for Combat Casualty Care (MC4), a system that contains digitally secure, accurate medical histories of soldiers and makes that information available to military clinicians around the world. It incorporates information from a pre-and post-deployment health survey and military medics enter additional information from the field using MC4 laptops and handheld devices if a soldier is wounded (Onley, 2003; Steen, 2005). Medics can also use the system to order supplies, find information on drug doses and physician references, and track the movement of patients as they receive higher levels of care (Onley, 2003). The central database allows medical specialists to track trends and conduct surveillance, with the hope of eliminating the phenomenon that occurred after the Gulf War when soldiers came back with unusual symptoms and there was no paper trail documenting what chemicals they were exposed to or what care they may have received. Although a number of brigades in Iraq are still using paper records, over 10,000 deployable medical and ancillary professionals have been trained on the MC4 and the system is being used by more than 250 units in Iraq (Onley, 2003; Steen, 2006).

The military has also improved access to medical care so that wounded soldiers receive higher levels of care more quickly. In order to do so, the military has moved its medical assets closer to the front lines and improved air medical capabilities (Miles, 2005). The U.S. Marine Corps and Navy introduced Forward Resuscitative Surgery Systems (FRSS), which are small, mobile trauma surgical teams of 8 individuals (including 2 surgeons and support staff) designed to provide tactical surgical intervention of combat casualties in the forward area (Chambers et

al., 2005). The units can erect a battlefield hospital with two operating tables and four ventilator-equipped beds in less than one hour (Gawande, 2004). New medical technologies, such as compact ultrasound and X-ray machines, generators that extract pure oxygen from the air, and computerized diagnostic equipment, have allowed the teams to provide fairly sophisticated care (Barnes et al., 2005). However, with these new surgical teams, the U.S. military's strategy is to conduct damage control in the field—stop bleeding, keep a patient warm—and leave the definitive care to physicians at a hospital. Surgeons limit surgery to two hours or less and send the patient off to the next level of care.

Air medical evacuation procedures and equipment have improved to allow rapid transport of a critically injured solider. Thanks to those advances, the Air Force is transporting patients that they would have never considered moving in previous wars (Miles, 2005). From the field surgery teams, patients are brought by helicopter to a larger combat support hospital in Iraq. Air medical evacuations are now lighter and more adaptable; patient support pallets can be moved from one aircraft to the next and medical teams carry much of their equipment in backpacks. If a soldier is critically wounded, a Critical Care Air Transport (CCAT) team joins the air medical evacuation to help transport the patient to a combat hospital in Iraq, which has additional equipment.

But patient stays at military hospitals in Iraq are brief. Patients are transported as quickly as possible on an aircraft to a U.S. hospital in Germany. Today, the military is able to transport patients on a larger variety of aircraft than in the past, so there is no need to wait for a specific plane to arrive. One aircraft, the C-17 Globemaster III, has the ability to move 70 patients at a time, including 9 with critical injuries. The plane is quieter, vibrates less, and has more temperature control than its predecessors. With medical information systems in place, air medical evacuation teams have detailed information about patients' medical history, medications, medical conditions, and procedures already performed (Miles, 2005). Whereas it took an injured soldier in Vietnam 45 days to reach a U.S. facility, today soldiers go from battlefield to a U.S. hospital in less than four days and continuous medical care is provided throughout the journey (Gawande, 2004).

The training of medics has also advanced. In the past, medics learned from books, and rarely practiced on live patients. Today, training is conducted using specially-developed computer software that asks trainees to make critical-care decisions and then provides feedback on the impact on the patient. The practice mannequins have mechanized lungs and vital signs controlled by computer (Online NewsHour, 2003).

Soldiers and medics also have new medical tools in Iraq. Soldiers carry a new tourniquet designed for one-handed application, so that a solider can apply the tourniquet to himself or herself if necessary (Crisp, 2005). Additionally, many soldiers and medics now carry bandages coated with blood clot-forming compounds that can stop life-threatening bleeding quickly. Anticlotting products are critical since profuse bleeding is a primary reason for casualties on the battlefield (Kolata, 2003). In the past, medics relied simply on gauze and tape (Mishra, 2003). Many special operations medics are carrying hetastarch instead of bulky bags of intravenous saline solution. Hetastarch is a more compact material, making it easier to carry, and it stays in the vascular system longer than saline, helping to maintain blood pressure (Barnes et al., 2005).

The armed forces continue to investigate new ways to improve survival rates in combat zones. As an example, the U.S. Army and Navy commissioned an outside firm to conduct an expert panel to review and rank research proposals for resuscitation fluids and therapies to determine which held the most promise for improving survival. A second expert panel was

convened to examine and improve the ways in which the military obtains scientific research for military medicine (Krupa, 2005). Air Force officials report working daily to improve air medical communications, equipment, and procedures (Miles, 2005).

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Appendix G
Recommendations and Responsible Entities from the *Future of Emergency Care* Series

HOSPITAL-BASED EMERGENCY CARE: AT THE BREAKING POINT

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
Chapter 2: The Evolving Role of Hospital-Based Emergency Care											
2.1 Congress should establish dedicated funding, separate from DSH payments, to reimburse hospitals that provide significant amounts of uncompensated emergency and trauma care for the financial losses incurred by providing those services. • Congress should initially appropriate $50 million for the purpose, to be administered by the Centers for Medicare and Medicaid Services. • CMS should establish a working group to determine the allocation of these funds, which should be targeted to providers and localities at greatest risk; the working group should then determine funding needs for subsequent years	X	X									
Chapter 3: Building a 21st-Century Emergency Care System											
3.1 The Department of Health and Human Services and the National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with		X	X							X	

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.											
3.2 The National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients.			**X**							**X**	
3.3 The Department of Health and Human Services should convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance.		**X**									
3.4 The Department of Health and Human Services should adopt regulatory changes to the Emergency Medical Treatment and Active Labor Act (EMTALA) and the Health Insurance Portability and Accountability Act (HIPAA) so that the original goals of the laws are preserved but integrated systems may further develop.		**X**									
3.5 Congress should establish a demonstration program, administered by the Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate $88 million over 5 years to this program.	**X**	**X**									
3.6 Congress should establish a lead agency for emergency and trauma care within 2 years of the publication of this report. The lead agency should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and	**X**	**X**									

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency and trauma care.											
Chapter 4: Improving the Efficiency of Hospital-Based Emergency Care											
4.1 Hospital chief executive officers should adopt enterprise-wide operations management and related strategies to improve the quality and efficiency of emergency care.							**X**				
4.2 The Centers for Medicare and Medicaid Services should remove the current restrictions on the medical conditions that are eligible for separate clinical decision unit (CDU) payment.		**X**									
4.3 Training in operations management and related approaches should be promoted by professional associations; accrediting organizations, such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the National Committee for Quality Assurance (NCQA); and educational institutions that provide training in clinical, health care management, and public health disciplines.										**X**	**X**
4.4 The Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) should reinstate strong standards that sharply reduce and ultimately eliminate ED crowding, boarding, and diversion.											**X**
4.5 Hospitals should end the practices of boarding patients in the ED and ambulance diversion, except in the most extreme cases, such as a community mass casualty event. The Centers for Medicare and Medicaid Services should convene a working group that includes experts in emergency care, inpatient critical care, hospital operations management, nursing and other relevant disciplines to develop		**X**					**X**				

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
boarding and diversion standards, as well as guidelines, measures, and incentives for implementation, monitoring, and enforcement of these standards.											
Chapter 5: Technology and Communication											
5.1 Hospitals should adopt robust information and communications systems to improve the safety and quality of emergency care and enhance hospital efficiency.							X				
Chapter 6: The Emergency Care Workforce											
6.1 Hospitals, physician organizations, and public health agencies should collaborate to regionalize critical specialty care on-call services.							X			X	X
6.2 Congress should appoint a commission to examine the factors responsible for the declining availability of providers in high-risk emergency and trauma care specialties, including the role played by medical malpractice liability in specific, and to recommend targeted state and federal actions to mitigate the adverse impact of the responsible factors and ensure quality of care.	X										
6.3 The American Board of Medical Specialties and its constituent Boards should extend eligibility for certification in critical care medicine to all acute care and primary care physicians who complete an accredited critical care fellowship program.										X	X
6.4 The Department of Health and Human Services, the Department of Transportation, and the Department of Homeland Security should jointly undertake a detailed assessment of emergency and trauma workforce capacity, trends, and future needs, and develop strategies to meet these needs in the future.		X	X	X							
6.5 The Department of Health and Human Services, in partnership with professional organizations, should develop national standards for core competencies applicable to physicians, nurses, and other key		X								X	

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
emergency and trauma professionals, using a national, evidence-based, multidisciplinary process.											
6.6 States should link rural hospitals with academic health centers to enhance opportunities for professional consultation, telemedicine, patient referral and transport, and continuing professional education.						X	X				
Chapter 7: Disaster Preparedness											
7.1 The Department of Homeland Security, the Department of Health and Human Services, the Department of Transportation, and the states should collaborate with the Veterans Health Administration to integrate the VHA into civilian disaster planning and management.		X	X								X
7.2 All institutions responsible for the training, continuing education, and credentialing and certification of professionals involved in emergency care (including medicine, nursing, EMS, allied health, public health, and hospital administration) incorporate disaster preparedness training into their curricula and competency criteria.						X				X	X
7.3 Congress should significantly increase total disaster preparedness funding in FY 2007 for hospital emergency preparedness in the following areas: • strengthening and sustaining trauma care systems; • enhancing ED, trauma center, and inpatient surge capacity; • improving EMS response to explosives • designing evidence-based training programs; • enhancing the availability of decontamination showers, standby ICU capacity; negative pressure rooms, and appropriate personal protective equipment; • conducting international collaborative research on the civilian consequences of conventional weapons (CW) terrorism.	X										
Chapter 8: Enhancing the Emergency and Trauma Care Research Base											
8.1 Academic medical centers should support emergency and trauma							X				

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
care research by providing research time and adequate facilities for promising emergency care and trauma investigators, and by strongly considering the establishment of autonomous departments of emergency medicine.											
8.2 The Secretary of the Department of Health and Human Services should conduct a study to examine the gaps and opportunities in emergency and trauma care research, and recommend a strategy for the optimal organization and funding of the research effort. This study should include consideration of: training of new investigators; development of multi-center research networks; funding of General Clinical Research Centers (GCRCs) that specifically include an emergency and trauma care component; involvement of emergency and trauma care researchers in the grant review and research advisory processes; and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency care research (including DOT, DHHS, DHS, and DoD) should implement the study's recommendations.	X	X	X	X	X						
8.3 Congress should modify Federalwide Assurance Program (FWA) regulations to allow the acquisition of limited, linked, patient outcome data without the existence of an FWA.	X										

EMERGENCY MEDICAL SERVICES AT THE CROSSROADS

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
Chapter 3: Building a 21st-Century Emergency Care System											
3.1 The Department of Health and Human Services and National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.		X	X							X	
3.2 The National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop evidence-based, model prehospital care protocols for the treatment, triage, and transport of patients.			X							X	
3.3 The Department of Health and Human Services should convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance.		X									
3.4 Congress should establish a demonstration program, administered by Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate $88 million over 5 years to this program.	X	X									
3.5 Congress should establish a lead agency for emergency and trauma care within 2 years of the publication of this report. This lead agency should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both	X	X									

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency and trauma care.											
3.6 The Department of Health and Human Services should adopt rule changes to the Emergency Medical Treatment and Active Labor Act (EMTALA) and the Health Insurance Portability and Accountability Act (HIPAA) so that the original goals of the laws are preserved but integrated systems may further develop.		X									
3.7 CMS should convene an ad hoc work group with expertise in emergency care, trauma, and EMS systems to evaluate the reimbursement of EMS and make recommendations regarding inclusion of readiness costs and permitting payment without transport.		X									
Chapter 4: Supporting a High Quality EMS Workforce											
4.1 State governments should adopt a common scope of practice for EMS personnel, with state licensing reciprocity.						X					
4.2 States should require national accreditation of paramedic education programs.						X					
4.3 States should accept national certification as a prerequisite for state licensure and local credentialing of EMS providers.						X					
4.4 The American Board of Emergency Medicine should create a subspecialty certification in EMS.										X	
Chapter 5: Advancing System Infrastructure											
5.1 States should assume regulatory oversight of the medical aspects of air medical services, including communications, dispatch, and transport protocols.						X					

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
5.2 Hospitals, trauma centers, EMS agencies, public safety departments, emergency management offices, and public health agencies should develop integrated and interoperable communications and data systems.							X	X			X
5.3 The Department of Health and Human Services should fully involve prehospital EMS leadership in discussions about the design, deployment, and financing of the National Health Information Infrastructure (NHII).		X									
Chapter 6: Preparing for Disasters											
6.1 The Department of Health and Human Services, the Department of Transportation, the Department of Homeland Security, and the states should elevate emergency and trauma care to a position of parity with other public safety entities in disaster planning and operations.		X	X	X		X					
6.2 Congress should substantially increase funding for EMS-related disaster preparedness through dedicated funding streams.	X										
6.3 Professional training, continuing education, and credentialing and certification programs of all the relevant EMS professional categories, should incorporate disaster preparedness training into their curricula, and require the maintenance of competency in these skills.			X			X				X	X
Chapter 7: Optimizing Prehospital Care through Research											
7.1 Federal agencies that fund emergency and trauma care research should target additional funding at prehospital EMS research, with an emphasis on systems and outcomes research.		X	X	X	X						X
7.2 Congress should modify Federalwide Assurance Program (FWA) regulations to allow the acquisition of limited, linked, patient outcome data without the existence of an FWA.	X										
7.3 The Secretary of Department of Health and Human Services should conduct a study to examine the gaps and opportunities in emergency and trauma care research, and recommend a strategy for the optimal organization and funding of the research effort. This study should	X	X	X	X	X						

	Congress	DHHS	DOT	DHS	DOD	States	Hospitals	EMS Agencies	Private Industry	Professional Organizations	Other
include consideration of: training of new investigators; development of multi-center research networks, involvement of emergency medical services researchers in the grant review and research advisory processes; and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency care research (including Department of Transportation, Department of Health and Human Services, Department of Homeland Security, and Department of Defense) should implement the study's recommendations.											

EMERGENCY CARE FOR CHILDREN: GROWING PAINS

	Congress	DHHS	DOT	DHS	DOD	Hospitals	EMS Agencies	Private Industry	Professional Societies	Other
Chapter 3: Building a 21st-Century Emergency Care System										
3.1 The Department of Health and Human Services and National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop an evidence-based categorization system for EMS, EDs, and trauma centers based on adult and pediatric service capabilities.		X	X						X	
3.2 The National Highway Traffic Safety Administration, in partnership with professional organizations, should convene a panel of individuals with multidisciplinary expertise to develop evidence-based model prehospital care protocols for the treatment, triage, and transport of patients, including children			X						X	
3.3 The Department of Health and Human Services should convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance, including performance of pediatric emergency care.		X								
3.4 Congress should establish a demonstration program, administered by the Health Resources and Services Administration, to promote regionalized, coordinated, and accountable emergency care systems throughout the country, and appropriate $88 million over 5 years to this program.	X	X								
3.5 The Department of Health and Human Services should adopt rule changes to the Emergency Medical Treatment and Active Labor Act and the Health Insurance Portability and Accountability Act so that the original goals of the laws are preserved but integrated systems may further develop.		X								
3.6 Congress should establish a lead agency for emergency and trauma care within 2 years of the publication of this report. The lead agency	X	X								

	Congress	DHHS	DOT	DHS	DOD	Hospitals	EMS Agencies	Private Industry	Professional Societies	Other
should be housed in the Department of Health and Human Services, and should have primary programmatic responsibility for the full continuum of EMS, emergency and trauma care for adults and children, including medical 9-1-1 and emergency medical dispatch, prehospital EMS (both ground and air), hospital-based emergency and trauma care, and medical-related disaster preparedness. Congress should establish a working group to make recommendations regarding the structure, funding, and responsibilities of the new agency, and develop and monitor the transition. The working group should have representation from federal and state agencies and professional disciplines involved in emergency and trauma care.										
3.7 Congress should appropriate $37.5 million each year for the next five years to the EMS-C Program.	X									
Chapter 4: Arming the Emergency Care Workforce with Knowledge and Skills										
4.1 Every pediatric and emergency care-related health professional credentialing and certification body should define pediatric emergency care competencies and require practitioners to receive the appropriate level of initial and continuing education necessary to achieve and maintain those competencies.									X	
4.2 The Department of Health and Human Services should collaborate with professional organizations to convene a panel of individuals with multidisciplinary expertise to develop, evaluate, and update pediatric emergency care clinical practice guidelines and standards of care.		X							X	
4.3 EMS agencies should appoint a pediatric emergency coordinator and hospitals should appoint two pediatric emergency coordinators—one a physician—to provide pediatric leadership for the organization.						X	X			
Chapter 5: Improving the Quality of Pediatric Emergency Care										
5.1 The Department of Health and Human Services should fund studies on the efficacy, safety, and health outcomes of medications used for infants, children, and adolescents in emergency care settings in order to		X								

	Congress	DHHS	DOT	DHS	DOD	Hospitals	EMS Agencies	Private Industry	Professional Societies	Other
improve patient safety.										
5.2 The Department of Health and Human Services and the National Highway Traffic Safety Administration should fund the development of medication dosage guidelines, formulations, labeling, and administration techniques for the emergency care setting to maximize effectiveness and safety for infants, children and adolescents. EMS agencies and hospitals should implement these guidelines, formulations, and techniques into practice.		X	X			X	X			
5.3 Hospitals and EMS systems should implement evidence-based approaches to reduce errors in emergency and trauma care for children.						X	X			
5.4 Federal agencies and private industry should fund research on pediatric-specific technologies and equipment used by emergency and trauma care personnel.		X	X	X				X		
5.5 EMS agencies and hospitals should integrate family-centered care into emergency care practice.						X	X			
Chapter 6: Improving Emergency Preparedness and Response for Children Involved in Disasters										
6.1 Federal agencies (the Department of Health and Human Services, the National Highway Traffic Safety Administration, and the Department of Homeland Security) in partnership with state and regional planning bodies and emergency care provider organizations should convene a panel with multidisciplinary expertise to develop strategies for addressing pediatric needs in the event of a disaster. This effort should encompass the following: 1) Development of strategies to minimize parent-child separation and improved methods for reuniting separated children with their families. 2) Development of strategies to improve the level of pediatric expertise on Disaster Medical Assistance Teams and other organized disaster response teams. 3) Development of disaster plans that address pediatric surge capacity for both injured and non-injured children.		X	X	X	X					

	Congress	DHHS	DOT	DHS	DOD	Hospitals	EMS Agencies	Private Industry	Professional Societies	Other
4) Development of and improved access to specific medical and mental health therapies, as well as social services, for children in the event of a disaster. 5) Development of policies that ensure that disaster drills include a pediatric mass casualty incident at least once every 2 years.										
Chapter 7: Building the Evidence Base for Pediatric Emergency Care										
7.1 The Secretary of DHSS should conduct a study to examine the gaps and opportunities in emergency care research, including pediatric emergency care, and recommend a strategy for the optimal organization and funding of the research effort. This study should include consideration of training of new investigators, development of multicenter research networks, involvement of emergency and trauma care researchers in the grant review and research advisory processes, and improved research coordination through a dedicated center or institute. Congress and federal agencies involved in emergency and trauma care research (including the Department of Transportation, Department of Health and Human Services, Department of Homeland Security, and Department of Defense) should implement the study's recommendations.		**X**	**X**	**X**	**X**					
7.2 Administrators of statewide and national trauma registries should include standard pediatric-specific data elements and provide the data to the NTDB. Additionally, the American College of Surgeons should establish a multidisciplinary pediatric specialty committee to continuously evaluate pediatric-specific data elements for the NTDB and identify areas for pediatric research.										**X**