

**The Role of Linkages Between  
The Trauma Care System  
And Public Health  
In Disaster Preparedness**

***Prepared by a Working Committee of:***

The American Trauma Society

The National Association of Emergency Medical Technicians

The National Association of Emergency Medical Services Physicians

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## EXECUTIVE SUMMARY

There are enormous benefits of a close collaboration between the trauma care system and public health in both emergent situations, including disasters, and day-to-day operations. This paper is designed to articulate opportunities for improved linkages between these systems. The goals of this paper are:

- To educate public health agencies at the national, state and local levels about the evolution and current status of trauma systems in the U.S. and the role of these systems in disaster preparedness
- To educate trauma and EMS providers about the existing public health infrastructure at the national, state and local levels the role of public health agencies in disaster preparedness
- To articulate the opportunities for improved linkages between acute care providers and public health agencies
- To make recommendations that would improve these important linkages.

The disasters we may face encompass the spectrum of all possible threats—both man-made and natural—necessitating an “all hazards” approach to preparedness. In spite of the recent emphasis on the threat of bioterrorism, most terrorist attacks in the world to-date have involved conventional weapons, such as bombs and rockets. The effects of these attacks occur as a direct and immediate result of the attack. In these situations, emergency medical services and hospitals closest to the scene of the event will see the greatest influx of casualties. These types of disasters are the primary focus of this paper.

This focus by no means minimizes the importance of bioterrorism preparedness. But biological attacks will be more insidious—even if an agent were to be introduced at one particular location, incubation periods vary, and it would be days or even weeks before the effects of the attack were noticed. By that time, many of the affected individuals would have migrated far from the original source of the agent and would begin to appear in increasing numbers at many different healthcare facilities both in and away from the affected region(s).

The current national focus on preparedness for terrorist attacks has drawn renewed attention to the need for improved communication between acute care settings, such as trauma centers, and public health departments, especially on the regional and local levels. The possibility of disasters caused by terrorism, not surprisingly, is the most challenging for emergency responders. The continuum of terrorist threats seems limitless, ranging from suicide bombers, conventional explosives, and military weapons, to weapons of mass destruction (nuclear, biological, or chemical).

Two critical components of effective disaster response are the *medical response* and the *public health response*. In a mass casualty incident—an event incurring casualties in large enough numbers to overwhelm the public health and medical services of the affected community—the medical response consists of rescue and recovery of the injured; triage and initial stabilization; definitive medical care close to the disaster site; and medical evacuation. The public health response involves water, food, shelter, sanitation, safety, transportation, communication, and detection, prevention, and control of endemic and epidemic diseases. Clearly, these two components must work closely together to respond most effectively during a disaster, and if channels of communication between these two components are to function seamlessly in emergency situations, they must be in place and in routine use before a disaster strikes.

### **MEDICAL RESPONSE: THE TRAUMA CARE SYSTEM**

The Trauma Care System (TCS) is a model of integrated care that includes injury prevention activities, pre-hospital services (Emergency Medical Services, or EMS), acute care provided in both trauma centers and non-trauma acute care settings, and rehabilitation services. Two of these elements are described below.

#### *Emergency Medical Services (EMS)*

For the critically ill patient, EMS serves as the gateway to the trauma care system. The goals of pre-hospital care are:

- Prompt arrival at the scene
- Assessment of patient's needs through medically approved protocols for triage—including the determination of the hospital type that matches patients with appropriate clinical resources
- Preliminary resuscitation and treatment
- Rapid transport to the nearest, most appropriate acute care facility.

#### *Trauma Centers and Acute Care*<sup>1</sup>

Trauma centers are the hub of the Trauma Care System and are classified into four types by the American College of Surgeons Committee on Trauma:

- Level I—A specialized unit within a regional tertiary care facility designed to serve population-dense areas and capable of treating the most severely injured patients. Level I trauma centers must have immediate availability of specialized surgeons, emergency

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<sup>1</sup> The term “acute care” used throughout this paper is synonymous with the more specific term “acute injury care.”

physicians, anesthesiologists, specialized nurses, resuscitative equipment, and surgical facilities. Level I trauma centers also conduct research and injury prevention activities.

- Level II—Similar to Level I but without research and prevention activity requirements. In a population-dense areas close to a Level I trauma center, a Level II Center works cooperatively with the Level I center to optimize treatment resources for seriously injured people in their area. Level II centers may also be located in less population-dense areas, in which cases they serve as the lead trauma facility for that geographic area.
- Level III—A facility that has emergency services and the availability of general surgeons, generally serving a rural area that does not have a Level I or II center.
- Level IV—A hospital or clinic in a remote area designed to resuscitate and stabilize patients and arrange for their transfer to the closest, most appropriate level of trauma care.

Trauma centers (TC) have a cadre of specialty providers, ranging from anesthesiologists to infectious disease physicians and psychiatrists, that the trauma team can call upon 24 hours a day, 7 days a week. This enables the TC to respond to most situations involving injury, including mass casualty incidents. Further, trauma centers have the capacity to “staff up” far beyond their day-to-day staffing levels in order to respond to emergencies. In this sense, trauma centers represent dual use capacity—the centers are designed to provide ongoing trauma care as well as being able to “ramp up” to meet disaster conditions.

Another important hallmark of trauma centers is a well-established communication system. Trauma centers have pre-existing communication linkages with EMS, public safety, and to some extent, public health (e.g., the surveillance activities that might occur in emergency rooms).

## **THE PUBLIC HEALTH SYSTEM**

The Mission of public health is to "fulfill society's interest in assuring conditions in which people can be healthy." Public health carries out this mission through organized, interdisciplinary efforts that address the physical, mental, and environmental health concerns of communities and populations at risk for disease and injury.

In broad terms, public health is proactive whereas acute care is reactive; and public health is population-focused whereas acute care is focused on the individual. But public health and acute care are not mutually exclusive: on the contrary, cooperation between public health and acute care yields improved responsiveness, greater efficiency, and enhanced effectiveness.

Public health systems exist at all levels—from the very highest national level (the U.S. Public Health Service Commissioned Corps led by the Surgeon General), to local cities' and towns' health departments. When a disaster occurs, it is the local assets—fire, police, EMS, trauma and acute care centers, and public health departments—that respond first. Therefore, it is at the local, county, and state levels that coordination efforts must be first directed.

The public health response to disasters encompasses many elements, including the safety of the food and water supply; the availability of shelter, communication, and transportation; and the detection, prevention, and control of endemic and epidemic diseases.

Clearly, in any disaster situation, including those caused by terrorist attacks, it is critical for acute care settings, such as trauma centers, to work cooperatively and synergistically with local, regional, and national public health departments.

## **CRITICAL GAPS**

### *Lack of Federal Oversight*

In spite of the strength and resilience of the trauma care system, as it exists in the United States today, there remain significant impediments to a uniformly excellent system. These impediments include the following:

- *While the Department of Homeland Security exists to prevent a terrorist attack on America, there is no equivalent federal agency that oversees the medical response to a mass casualty incident.*
- *Because of this lack of federal oversight and regulation, there is no logical integration of EMS and trauma functions at the state, county, and local levels.*

### *Lack of Uniform Data Reporting*

- *There is no uniform data set that exists from one EMS/trauma care jurisdiction to another, or even across the EMS, trauma care, and public health systems within a single jurisdiction, making uniform data analysis all but impossible.*
- *This lack of uniformity in data collection has led to a research gap.*
- *The lack of standardized trauma care system research has made it impossible to determine evidence-based best practices for the care of the acutely injured.*

### *Lack of Coordination Between Public Safety, Trauma Systems, and Public Health*

In spite of recent terrorist events and the emphasis on emergency preparedness prompted by them, there is still little coordination between public safety, the trauma care system, and public health.

- *Data and communications systems are not designed to standards that allow interoperability—different departments and agencies use radios and communication devices that cannot be accessed by other emergency agencies.*
- *Even if Interoperability standards were to be implemented, person-to-person communications between different emergency response disciplines is unpracticed and inadequate. Public safety personnel (e.g., police and fire), EMS and trauma personnel, and public health personnel are said to speak “different languages,” but need must learn to use one common vernacular when responding to a disaster or other public health emergency.*

#### *Cross-Knowledge of the Public Health and Trauma Care Systems*

Strides have been made, including the development of this linkages position paper, to close the gaps, identified above, between public health and trauma care systems. While this is a good start, the critical importance of linking these two systems is not yet widely understood in trauma care and public health systems across the country.

- *There is no broad-based opportunity for EMS, trauma, or public health practitioners to learn about the roles and responsibilities of the other, especially in a disaster situation.*

#### *Funding*

The Department of Homeland Security (DHS) is responsible for *preventing* terrorist attacks on the United States; the trauma care and public health systems, on the other hand, are responsible for *responding* to any such attacks, or other disasters, should they occur. While DHS receives billions of dollars annually for their efforts, the trauma care and public health infrastructures in many parts of the country are threatened, largely because their funding comes primarily from state, county, and local jurisdictions, most of which are in fiscal crisis themselves.

- *Trauma care systems are unevenly developed across the country. This will deeply impact their capacity to respond with emergency medical services should a disaster occur.*
- *The public health infrastructure in many parts of the country is in serious disrepair, seriously impacting the government’s capacity to reach millions of Americans in a disaster. Just as military and law enforcement “boots on the ground” are important in the fight to prevent terrorism, public health “boots on the ground” will be critical in successfully responding to an attack on the public’s health.*

## RECOMMENDATIONS

- 1) Congress and the administration should consider enacting federal oversight authority for EMS and trauma care systems throughout the United States. This authority should include funding capacity to enable the development of a uniform set of EMS and trauma care standards and capacities across the country. This would facilitate the collection of uniform data from each state and jurisdiction, thereby prompting research into best practices. Further, it would eliminate (or at least minimize) the lack of trauma care coordination across states and the lack of integration within states.
- 2) Research on EMS and trauma best practices should be undertaken immediately—even with the uneven data currently available.
- 3) Technological interoperability problems continue to plague emergency response. Efforts must continue to make communications and data systems compatible with each other.
- 4) “Human interoperability” problems also exist. Efforts must also be made to develop the capacity for emergency personnel from different agencies in a single jurisdiction—public safety, public health, and the trauma care system—to get to know each other, to be at the same table in preparing for disaster response, and to know how to find key people from other agencies in the event of a disaster. These person-to-person linkages must be made before a disaster occurs in order to be effective.
- 5) A model curriculum on public health and its role in disaster response should be developed for physicians and EMTs. This could be developed as a CME/CEU eligible course and/or as a part of the core medical school/EMT curricula.
- 6) The Linkages Working Group strongly suggests that Congress and the Administration consider increasing funding to trauma care and public health systems across the country in order to fully develop the capacity of these agencies to respond to a disaster and/or a public health emergency anywhere in the United States of America.

## I. INTRODUCTION

### A. Goals of This Paper

There are enormous benefits of a close collaboration between the trauma care system and public health in both emergent situations, including disasters, and day-to-day operations. This paper is designed to articulate opportunities for improved linkages between these systems. The goals of this paper are:

- To educate public health agencies at the national, state and local levels about the evolution and current status of trauma systems in the U.S. and the role of these systems in disaster preparedness
- To educate trauma and EMS providers about the existing public health infrastructure at the national, state and local levels the role of public health agencies in disaster preparedness
- To articulate the opportunities for improved linkages between acute care providers and public health agencies
- To suggest the “next steps” that would improve these important linkages.

#### *A Note on the Terminology Used in This Paper*

*In the professional literature, the terms “emergency medical services (EMS)” and “trauma systems” are sometimes used interchangeably. One of the reasons for this ambiguity is that emergency medical services are organized at the state level, while trauma systems are not, and therefore, are sometimes seen to represent the entire spectrum of emergency medical care.*

*In this paper, we will refer to the “trauma care system” as a comprehensive system of pre-hospital emergency medical services (EMS), acute care (provided in trauma centers or other acute care facilities), rehabilitation, and injury prevention. While pre-hospital EMS and trauma centers are integral parts of the trauma system, they will sometimes be discussed as their own topics for particular emphasis. The trauma care system is explained more fully in Section III.*

### B. Disaster Response Preparedness—The Need For an Integrated Approach

The trauma care system in the United States is expected to work when efforts to prevent terrorism fail. EMS personnel have been and will be the front-line responders to an actual terrorist attack and, as such, are as much a part of the public safety net as Fire and Police. The gravity of this responsibility is what compels the development of linkages between public health, public safety, and the trauma care system.

## 1. What are the Threats for Which We Must Prepare?

The disasters we may face encompass the spectrum of all possible threats—both man-made and natural—necessitating an “all hazards” approach to preparedness. In spite of the recent emphasis on the threat of bioterrorism, most terrorist attacks in the world to-date have involved conventional weapons such as

*Remarkably, there is no EMS system architecture above the state level—the states all have different specific authorities and requirements relating to the administration of EMS. This factor is critical to national preparedness. Following the attacks of September 11, 2001, had the President wanted to meet with the federal administrator responsible for emergency medical services, there was not—and still is not—such a person.*

bombs and rockets. The effects of these attacks occur as a direct and immediate result of the attack. Chemical agent attacks and natural disasters follow this pattern as well. In these situations, EMS services and hospitals closest to the scene of the event will see the greatest influx of casualties. These disasters will be the primary focus of this paper.

This focus by no means minimizes the importance of bioterrorism preparedness. But biological attacks will be more insidious—even if an agent were to be introduced at one particular location (i.e. point source distribution), incubation periods vary, and it would be days or even weeks before the effects of the attack were noticed. By that time, many of the affected individuals would have migrated far from the original point source and would begin to appear in increasing numbers at many different healthcare facilities both in and away from the affected region(s). Of course, this pattern would be far more complicated with a communicable agent—one that is transmitted from person to person.

The possibility of disasters caused by terrorism, not surprisingly, is the most challenging for emergency responders. The continuum of terrorist threats seems limitless, ranging from suicide bombers, conventional explosives, and military weapons, to weapons of mass destruction (nuclear, biological, or chemical). Terrorist events have the greatest potential of all man-made disasters to generate large numbers of casualties and fatalities. If the first World Trade Center bombing attack in February 1993 had materialized as the terrorists planned, one tower would have collapsed onto the other causing 50,000 casualties. Complicating matters even further, terrorists do not limit themselves to conventional technology or weaponry. The devastation caused in the second World Trade Center bombings on September 11, 2001, was beyond anyone’s imagination, as terrorists crashed fully fueled jumbo jets into the twin towers generating massive destruction of property and killing over 2,500 people.

Many medical providers and public health officials hold the erroneous belief that all disasters are different, and, therefore, that the response to each disaster must be unique. This way of thinking has

caused one of the most significant problems in mass casualty management today—the fact that we do not prepare for disasters; we simply respond to them.

In reality, all disasters, regardless of their etiology, have similar medical and public health consequences—they *differ* in the degree to which these consequences occur, and the degree to which they disrupt the medical and public health infrastructures. Similarly, the response to each disaster involves common principles that, when observed, promote the organization of all response assets in a way to ensure effective communication and collaborative action.<sup>1</sup>

## 2. The Trauma Care System and Public Health Must Work Cooperatively in Disaster Response

The current national focus on terrorist attacks and the casualties they may cause has drawn renewed attention to the need for improved linkages between trauma care systems (particularly EMS acute care hospitals) and public health, especially on the regional and local levels. It would seem that coordination between these two systems could be easily achieved. However, several obstacles impede this type of coordination. Structured trauma care systems exist in most states, but because there is no federal oversight of these systems, not all systems are organized in the same way. This is especially true of EMS services, where, even within states, there is diversity in the organization of these services. For example, in a 2000 survey of EMS systems in the country's 200 most populous cities, the following was found:

- 35 percent of these cities had EMS organized under their Fire Departments;
- 24 percent utilized private EMS providers;
- 16 percent used a combination of Fire Department and private services;
- 16 percent were operated by the cities as separate agencies (“third service”)
- 7 percent were hospital based; and
- 2 percent utilized some other organizational structure.<sup>2</sup>

Second, trauma care systems are often overlooked in the disaster response planning process. In the thirty-five states that appear to have a state-level body coordinating disaster preparedness activities, 40 percent of the reporting state EMS offices are not included in the membership of their state preparedness committees, and of those that are, about one-fourth report that EMS issues are not given adequate agenda time and attention.<sup>3</sup>

Past disasters have taught us that it is critical that all first responders—fire, police, EMS, acute care hospitals, and other officials—operate under unified incident command structure and converse in a common language with inter-operable communication systems. We have learned many lessons in

disaster response, but none more devastating than the lesson learned on September 11, 2001, when hundreds of firefighters may have died because of a lack of coordination and communication.<sup>4</sup>

If channels of communication are to function in emergency situations, they must be in place and in routine use before a disaster strikes.

It is imperative that a common command structure, incorporating all emergency responders, including fire, police, and EMS, and trauma centers be established and practiced in table-top drills and live exercises on a regular basis in order to achieve the levels of cooperation and synergy needed for effective disaster response.

*In the September 11 World Trade Center attacks, firefighters rushed into the towers without first checking in at command posts and staging areas, resulting in the Fire Chief not knowing how many firefighters were in the building and where they were. To make matters worse, the radio repeaters within the building (devices that received, amplified, and “repeated” radio signals to allow them to reach otherwise inaccessible locations in the buildings) were not functioning properly. Because of this, FDNY radios operated only sporadically within the towers, making it difficult for commanders to coordinate rescue efforts, and making it impossible for many firefighters to hear critical commands—including the urgent command to evacuate the buildings before their collapse.*

Similarly, it is also critical that linkages between trauma systems and public health be made before a disaster in order for these systems to work together effectively. In a disaster situation, the public health needs assessment of the magnitude of the event and the degree of infrastructure disruption must be performed concurrently with the provision of emergency health services, necessitating a high degree of cooperation and shared communication. Further, in a potential bioterrorist attack, detection of the event will likely be made through public health surveillance activities, first providing evidence of the emergence of an endemic disease or syndrome, and second, determining its cause and origin. In this case, cooperation between public health and acute care settings is especially crucial.

### 3. Roles of the Trauma Care System and Public Health in Mass Casualty Incidents (MCIs)

Disasters, whether caused by natural or man-made acts, can be classified into three categories:

- Level 1—disasters that are readily managed using local resources
- Level 2—disasters that require help from adjacent jurisdictions
- Level 3—disasters that require state or federal assets, e.g., assets assigned to the disaster site by the National Disaster Medical System (NDMS).

Disasters with significant impact on the health and well being of a population are referred to as mass casualty incidents (MCIs)—events incurring casualties in large enough numbers to disrupt the normal deployment of emergency healthcare services within the affected community.<sup>5</sup> The severity

and diversity of injuries and the number of victims are factors in determining whether a mass casualty incident overwhelms the local medical and public health infrastructures.

Regardless of the type and etiology of the mass casualty incident (MCI), there are two critical, inter-related components of effective response: the medical response and the public health response. While each has its own focus, it is clear that they must work cooperatively in order to achieve optimal results.

In an MCI, the medical response consists of four key elements: rescue and recovery of the injured; triage and initial stabilization; definitive medical care close to the disaster site; and medical evacuation. Rapid assessment by experienced personnel will focus the actions of first responders on the particular elements needed to achieve the primary objective of reducing mortality.

Disaster medical care is significantly different from the medical care healthcare providers deliver on a daily basis: in conventional medical care, the objective is to do the greatest good for the *individual* patient; in a mass casualty incident, the objective is to do the greatest good for the *greatest number* of patients.<sup>6</sup>

The public health response to disasters involves ensuring a clean water supply, food, shelter, and sanitation. Public health officials are also charged with communicating with the public about potential risks; ensuring safety, transportation, and communication; and, importantly, detecting, preventing, and controlling endemic and epidemic diseases. Another critical element of the public health response is the assessment of the scope of damage and the impact of the disaster on the public health and medical infrastructure. Responders need to know the magnitude of the event as well as the elements of the health-care infrastructure that have been disrupted within the affected community in order to respond appropriately. Finally, public health must deal with the myriad of post-event issues, including assessing the impact of injury on the population, dealing with the mental health sequelae of the event, and ensuring that all affected individuals follow up with needed treatment.

### **C. Linkages Benefit the Trauma Care System and Public Health in Day-to-Day Activities**

Collaboration between trauma care systems and public health benefits the community in every day activities as well as in disaster preparedness. The *EMS and Public Health Bulletin: A Strategy for Enhancing Community Health Care*, a report prepared in 2001 by a working group from the National Association of EMS Physicians (NAEMSP) and the American Public Health Association (APHA), articulated both the similarities and differences between EMS and public health systems as well as a vision of collaboration between them. (These findings can be generalized to the relationship between

the entire trauma system and public health.) Highlighted in the box below is their description of the differing approaches to health care taken by these systems.

Importantly, the report also elucidates the many benefits that would derive from a closer day-to-day collaboration between EMS (and, derivatively, the entire trauma care system) and public health. Some of these are summarized on the following page as well.<sup>7</sup>

*Advantages of Linkages to the Trauma Care System for Public Health*

- *Prevention* - EMS providers offer a credible voice and a ready, mobile workforce for delivering injury or illness prevention messages.
- *Visibility* - public health agencies will benefit from the high level of recognition and support that EMS enjoys in the community.
- *Response Capability* - EMS offers a well-developed access and response system that could be used to extend the outreach of public health services.
- *Rapid Communication* - the emergency communications system utilized by EMS could be of great value to public health, particularly during critical health emergencies.
- *Data Collection* – Given adequate coordination between local EMS and public health departments, patient information relating to EMS responses can provide aggregate data sources for public health surveillance purposes such as assessing the spread of illness symptoms.
- *Access to Populations* - through the EMS system, public health can take advantage of routine access to a variety of high-risk community populations.

*Perhaps the key difference between the methods of EMS and public health is the basic approach to health care taken by the two disciplines. EMS is traditionally a reactionary service, optimized to respond quickly and effectively to acute episodes of illness or injury, and relying on a sophisticated public access communication system to detect incidents and target the response. In contrast, public health is primarily proactive, utilizing the epidemiologic method to systematically identify threats to community health, and intervening mainly through manipulation of environmental factors, such as air and water quality, or through strengthening the community immunity to disease.*

*EMS and public health also differ with respect to the direction of intervention. EMS provides individual patient-based, while public health is a community or population-based service. This difference is evident in the tools used by either group, public health utilizing policy and regulation to guard the community well-being and EMS using a fleet of mobile emergency care providers to deliver a focused response, render quick on-scene care, and transport patients to definitive care facilities.*

*Advantages of Linkages to Public Health for the EMS (and the Trauma Care System)*

- *More Analytic Approach* - EMS will benefit from the data-driven problem identification and evaluation methods utilized by public health professionals.
- *Use of Public Health Data for EMS Purposes* - public health data will enable EMS to target resources and evaluate interventions more effectively.
- *More Satisfaction From Issue Resolution* - by adopting the public health approach, EMS providers will have opportunities to become more proactive in community injury and illness prevention programs.
- *Strong Partnership* - public health can be a strong ally, collaborating and coordinating with EMS and other agencies involved in community health issues and helping to increase the recognition of EMS as a community health resource.
- *Broader Community Perspective* - linkage with public health will broaden the outlook and approach of EMS systems from an individual focus to a community perspective.
- *Expertise* - affiliation with public health will offer EMS access to specific technical expertise such as epidemiology and disease management.
- *Greater Coverage* - localized problems and high-risk populations identified through public health data can help EMS target services and expand community coverage.

## II. EVOLUTION AND CURRENT STATUS OF THE TRAUMA CARE SYSTEM IN THE UNITED STATES

### A. History of Federal Involvement in the Development of the Trauma Care System<sup>8</sup>

The theoretical foundations of trauma care and the essential characteristics of trauma systems have been continually refined over the past 30 years. The organized care of injured patients has its roots in military models of trauma care, where definitive care (care that improves a casualty's condition rather than simply stabilizing it, such as surgery) was brought closer and closer to the front line, enabling evacuation and prompt medical treatment for casualties of war. Although the principles learned during wartime were not automatically or easily implemented at home, the military's success in dealing with severe injuries led to heightened public expectations about trauma care and provided an impetus for the development of trauma systems.

The first *de facto* trauma centers were municipal hospitals in major urban areas that mostly provided emergency services to the uninsured. Because these hospitals were usually affiliated with medical schools, injured patients received timely treatment from in-house staff officers while these staff members gained expertise in dealing with injuries. This concentration of expertise and the early development of centers of excellence for trauma care contrasted sharply with the care in suburban hospitals in the same geographic area, which did not have a similar systematic response for injured patients.

In 1966, the publication of the National Research Council/National Academy of Sciences white paper *Accidental Death and Disability: the Neglected Disease of Modern Society* documented gross deficiencies in pre-hospital care and proposed a long range plan for changes in every facet of emergency care. Prompted by the report, Congress passed two laws, the National Traffic and Motor Vehicle Safety Act and the Highway Safety Act of 1966, both of which were designed to reduce injuries on the nation's highways. The Department of Transportation was empowered to set motor vehicle standards, fund research and programs that promoted highway safety, provide leadership for the development of regional EMS systems, and develop standards for EMS provider training. States were required to include EMS as part of their highway safety programs. Several prototype emergency medical systems were developed under the auspices of this funding.

The EMS Systems Act of 1973 was perhaps the single most important piece of legislation affecting the development of regional emergency and trauma care systems. The Act called for the creation of a lead agency under the Department of Health, Education and Welfare and identified 15 components (one being trauma systems) to assist system planners by providing guidance for establishing area-wide or regional EMS programs. At that time, regionalizing services was viewed as one way of

distributing resources more equitably while expanding access to health care systems. A substantial amount of federal funds were devoted to the establishment of an EMS infrastructure in over 300 EMS regions nationwide. A primary failure of the Act, however, was its inability to adequately stimulate initiatives to continually fund EMS at the local level.

In 1981, the Omnibus Budget Reconciliation Act consolidated EMS funding into state preventive health block grants, thereby ceding oversight of EMS to the states and eliminating federal oversight. States were given wide discretion regarding the use of block grant health funds; many states reduced funding to regional EMS management programs, effectively dismantling them, while others responded by increasing their involvement in EMS system development. At the same time, several pivotal studies highlighted the relationship between negative patient outcomes and lack of surgical support or delays in caring for injured patients, which again drew public attention to this area.

In 1984, Congress authorized the Emergency Medical Services for Children (EMS-C) Program to support state-of-the-art emergency medical care for injured children and adolescents. The intent of this program was to ensure that pediatric services were fully integrated into trauma systems.

In 1986, the National Research Council and the Institute of Medicine conducted a 20-year follow-up analysis of advancements made since the 1966 white paper focused the nation's attention on EMS.<sup>9</sup> This report concluded that, while considerable funding and effort had been utilized to develop systems of care, little progress actually had been made towards reducing the burden of injury. The report conceptually introduced the field of "injury control" and called for a major investment in research related to the epidemiology of injury and development of parallel prevention programs. A new injury research center was created to lead national efforts in injury control and establish research programs to study all aspects of injury including prevention, pre-hospital care, acute care, and rehabilitation. The Centers for Disease Control (CDC) was chosen as the site for this new center because of the CDC's strong relationship to state health departments and emphasis on research rather than regulation. Today, this program continues to fund trauma related research and support the growth of Injury Control Research Centers across the country.

Congress enacted the Trauma Care Systems Planning and Development Act of 1990, which created Title XII of the Public Health Service Act (PHSA), to improve emergency medical services and trauma care. From 1992-1994, funds were appropriated to carry out the responsibilities specified in this Act and administered by HRSA. Under this program, a model trauma care system plan was written by a consensus panel of experts to serve as a blueprint for trauma system development.<sup>10</sup> Although many states were making significant progress, Congress failed to appropriate resources for the program in 1995. It was funded again in FY2001 and 2002.

Title XII of the PHSA is responsible for advancing trauma and emergency medical care through system improvement. This goal is accomplished through: (1) a grant program available to state EMS offices to improve the trauma care component of the state's EMS plan; (2) a grant program to improve rural EMS care; and (3) discretionary activities including research, evaluation, and grants for special EMS/trauma initiatives.

In the midst of these changes in federal policy and funding, professional health care associations also provided guidance for trauma system development. The American College of Surgeons Committee on Trauma (ACS/COT) made substantial contributions to the conceptual framework of trauma care systems by advocating for a network of trauma centers with verified capabilities. ACS/COT assumed the mantle of leadership in 1976 by identifying the key characteristics for categorization of hospitals as trauma centers in the first edition of their publication, *Optimal Resources for Care of the Seriously Injured*.<sup>11</sup> Through successive revisions, this document became recognized as the standard for trauma hospitals. In 1987, ACS/COT developed an external review program to verify hospital capabilities, which provided further incentives for the designation of trauma centers. Recently, ACS/COT published a multidisciplinary work group document entitled *Consultation for Trauma Systems*, which provides guidelines for evaluating trauma system development and making system enhancements.<sup>12</sup> In addition, the American College of Emergency Physicians (ACEP) published *Guidelines for Trauma Care Systems*, which provided a detailed description of critical pre-hospital care components in a trauma system.<sup>13</sup>

In 1999, the Institute of Medicine (IOM), with support from several private foundations, published its third assessment of the public and private response to injury. The report, entitled *Reducing the Burden of Injury*, provided evidence of significant advances in trauma system development but also highlighted the profound gap between the current investment in system development and the magnitude of the injury problem.<sup>14</sup> The group recommended additional funding for surveillance, research, training and program evaluation by federal agencies.

## **B. Current Federal Programs Related to the Trauma Care System**

As mentioned earlier, there is no single federal agency responsible for oversight or even coordination of trauma care systems, including EMS, in the country. However, there are many different federal funding sources for the trauma care system, include DHHS block grants, and categorical grants from Emergency Medical Services for Children (EMSC), HRSA, CDC, NHTSA, and other agencies. Some categorical grants support program expansion or creation. Such support has been a major factor in the evolution of trauma care systems at the state level, as described below.

1. Department of Transportation (DOT): The National Highway Traffic Safety Administration (NHTSA)

NHTSA continues to take the lead nationally in the development of safety standards related to automobiles and transportation on the nation's highways, with programs that promote seatbelt use, child and infant car restraint systems, the safety of school buses, and other activities. NHTSA is also responsible for the development and implementation of a standard national curriculum for the training of EMS personnel.

2. Department of Health and Human Services (DHHS): Health Resources and Services Administration (HRSA)

HRSA administers grants authorized by Title XII of the Public Health Safety Act that seek to lay the groundwork for permanent changes in the trauma care system. They do this by funding projects that build and/or enhance the infrastructure of a state's overall EMS and trauma system through activities that:<sup>15</sup>

- Emphasize integrating research-based knowledge and state-of-the-art trauma care development into the existing EMS system;
- Address identified and unique needs of rural EMS;
- Emphasize integration of data collection systems that link or incorporate non-trauma/EMS related information, i.e. crash databases, medical examiner's databases, non-trauma center hospital information, etc.;
- Emphasize innovative uses of new and current communications technology;
- Assess and develop training within their state EMS system and/or trauma system;
- Design innovative protocols and agreements increasing access to necessary pre-hospital care and equipment for transporting seriously ill patients to appropriate facilities;
- Develop or monitor trauma care and EMS system delivery.

3. Department of Health and Human Services (DHHS): Centers for Disease Control and Prevention (CDC)

The CDC began work in home and recreational injuries in the early 1970s and violence prevention in 1983. From these early activities grew a national program to reduce injury, disability, death, and costs associated with injuries both in and outside of the workplace. The CDC now operates many different projects related to trauma system research and development.<sup>16</sup>

- *Improving care through partnerships and research* To increase the number and quality of trauma systems around the nation, CDC works extensively with public and private sector partners responsible for planning and developing such systems. For example, CDC collaborates with the National Highway Traffic Safety Administration on a project called "Trauma Vision," which engages experts and stakeholders in a consensus-building process to design optimal trauma care systems that meet community needs and, ultimately, reduce the adverse effects of injuries. CDC has also supported systematic reviews of scientific literature about patient outcomes in trauma systems and is currently funding a national study comparing outcomes and costs in hospital trauma centers and non-trauma center hospitals. Findings will enable community leaders to make informed decisions about establishing and supporting trauma centers and trauma care systems.
- *National Center for Injury Prevention and Control (NCIPC)* In 1992, CDC established the NCIPC as the lead federal agency for injury prevention. NCIPC works closely with other federal agencies; national, state, and local organizations; state and local health departments; and research institutions. Its goal is to reduce morbidity, disability, mortality, and costs associated with injuries.<sup>17</sup> The NCIPC is also responsible for implementing CDC's Injury Research Agenda, which includes research on trauma systems.<sup>18</sup>
- *Program to establish single source of trauma information* Since the American Trauma Society's CDC-funded Trauma Information and Exchange Program has been on-line, policy makers, stake-holders, researchers and the public now have a convenient, single source for accessing data about trauma centers and systems. This pilot program provides data gathered through a variety of channels and promotes more effective exchange of information.
- *Research in mass trauma events* CDC-sponsored research studies conducted during and after mass trauma events will provide important information for allocating health and emergency resources during the current event and for preventing injuries in future events. Studies may include epidemiologic, behavioral, or health services research and can be conducted by state or local health departments, university researchers, or others. The CDC also publishes fact sheets, for both professional and lay populations, on various types of injury, as do the National Institute of Health and its Agency for Healthcare Research and Quality.

#### 4. Department of Homeland Security (DHS)

DHS, the new federal agency broadly responsible for the country's security, was created by combining several federal agencies and adding additional directorates. Those directly related to trauma care are described briefly below.

##### *a. Federal Emergency Management Agency (FEMA)*

FEMA is now organized as a part of DHS's Emergency Preparedness and Response Directorate. The EP&R Directorate is continuing FEMA's efforts to reduce the loss of life and property and to protect the nation's institutions from all types of hazards through a comprehensive, risk-based emergency management program of preparedness, prevention, response, and recovery. FEMA's National Urban Search and Rescue Response System can be called upon by states to assist in search and rescue activities at local disaster sites.

##### *b. National Disaster Medical System (NDMS)*

Formerly a part of the Public Health Service, NDMS is a cooperative asset-sharing program among federal government agencies, state and local governments, and private businesses and civilian volunteers to ensure resources are available to provide medical services following a disaster that overwhelms the local health care resources. The overall purpose of the NDMS is to establish a single, integrated national medical response capability for assisting state and local authorities in dealing with the medical and health effects of major peacetime disasters. NDMS works largely through local Disaster Medical Assistance Teams (DMATs), set up in over 70 locations across the country. DMATs are considered a national asset—they are deployed by NDMS from one city to another, as needed, in response to a disaster that requires outside medical assistance.

### **C. History of State and Local Trauma Care System Development**

Since there is no single federal agency with EMS or trauma care system development as its core mission, the task of systematic administration of EMS services and the wider trauma care system falls to the states, and within each state is typically managed by its respective EMS office. Typical functions include:

- Determining the scope or standards of practice for EMS personnel;
- Evaluating performance of entities providing emergency medical services;
- Developing model decision instruments such as triage criteria, field treatment protocols, training curricula, mutual aid agreements, hospital by-pass and transfer protocols;
- Designating and certifying trauma centers (in some states).

These functions are essential to the capacity of the constituent elements of the trauma care system to act with cohesiveness, consistency, and integrity.

The absence of focused and sustained federal leadership in trauma care system development has led to the evolution of system architectures that are peculiar to each jurisdiction. Relative to EMS alone, educational entry requirements, the number of hours required for training or supervised clinical experience, certification examinations and recertification requirements, standards of practice, ambulance vehicle specifications, dispatching procedures and qualifications, treatment and transport protocols, ambulance equipment, and operational standards all differ in subtle but significant ways between jurisdictions. Different standards also apply to the other elements of the trauma system such as trauma centers, cardiac care centers, burn centers, and poison treatment centers.

In spite of the absence of federal authority in EMS and the wider trauma care system, the government has achieved success in inducing both some degree of homogeneity and linkages between the trauma care system and other public health programs. Predominately, two approaches have been employed to

*The lack of federal oversight has led to inconsistency in trauma center designation: e.g., 38 states currently have legal authority to designate trauma centers (but not all do), four more formally “identify” hospitals that have been designated trauma centers by the American College of Surgeons (ACS), and several others rely upon ACS certification alone. Most states with the authority to do so designate four levels of trauma centers, while some designate five. Several states categorize every hospital with an emergency department at some level of trauma care while others had designated a limited number of level I and level II centers only.*

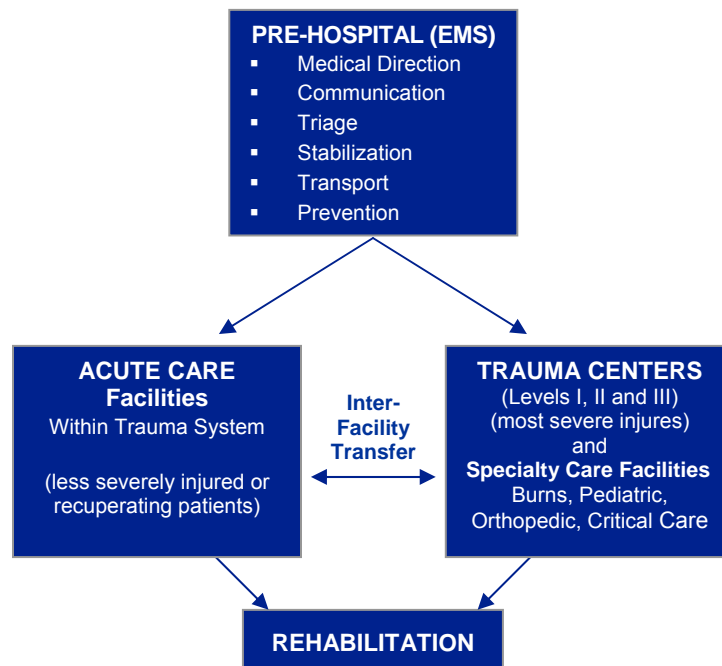
accomplish this: production of federal guidelines that could be adapted by states; and federal grants that specify performance parameters. Examples of federal guidelines include the National Standard EMS Curricula, federal ambulance design specifications, and the Uniform Prehospital Reporting dataset. Not all jurisdictions employ these guidelines and those that do tend to *adapt* rather than *adopt* them. This has produced a general similarity between state EMS jurisdictions rather than uniformity.

### III. THE TRAUMA CARE SYSTEM TODAY—A PRIMER FOR PUBLIC HEALTH PERSONNEL

The CDC first described an inclusive trauma care system in 1990, a model that was later refined by HRSA in 1992. The plan establishes a system that is integrated with the emergency medical service (EMS) system and that strives to meet the needs of all injured, regardless of severity of condition, geographic location, or population density.<sup>19</sup>

In most states, the trauma care system exists as an organized, coordinated structure designed to deliver the full spectrum of care to an injured patient within a defined geographical area, starting at the time of injury, through transport to an acute care facility, and to rehabilitative care.<sup>20</sup> The trauma system consists of three major service areas—prehospital care (EMS), acute injury care, and rehabilitative care—that, when integrated, are designed to ensure a continuum of care.<sup>21</sup>

The day-to-day operational aspects of the trauma care system are depicted graphically below:



## **A. Prehospital Emergency Medical Services (EMS)**

For the critically ill patient, EMS serves as the gateway to the trauma care system. The goals of pre-hospital care are:

- Prompt arrival at the scene
- Assessment of patient's needs through medically approved protocols for triage—including the determination of the hospital type that matches patients with appropriate clinical resources
- Preliminary resuscitation and treatment
- Rapid transport to the nearest, most appropriate acute care facility.

EMS services are organized locally in a number of ways: some fall organizationally under the fire department, others under the police department. Still others are “third service” systems, operated independently or by trauma centers themselves.

Within EMS, there are generally four levels of providers: First Responder; Emergency Medical Technician (EMT)-Basic; EMT- Intermediate; and EMT-Paramedic.

A survey performed by the National Association of State EMS Directors indicated that there is diversity among states in how the scope of practice for these EMS providers is determined. The majority of states reported that EMS personnel scope of practice is uniformly defined within their state/territorial jurisdictions, but by many different mechanisms, including by state statute, regulation, and even court decisions.<sup>22</sup>

## **B. Acute (Injury) Care**

Hospitals and primary care providers provide acute care for most non-critically ill patients. Trauma Centers, however, are medically sophisticated facilities that often treat the most seriously injured.

In 1976, the ACS/COT developed criteria for categorizing hospitals according to the level of trauma care available. These criteria were revised slightly in 1999.<sup>23</sup> Increasingly, states are using these guidelines as a basis for designating or certifying hospitals as trauma centers. In states without formal trauma systems, hospitals have voluntarily sought verification by the ACS/COT. Numerous studies have documented the beneficial effects of trauma systems and trauma centers.<sup>24,25,26,27,28</sup>

Nathens<sup>29</sup> estimate that full implementation of a trauma system is associated with an 8 percent decrease in mortality from motor vehicle traffic deaths. However, since Nathens included casualties that were “dead at the scene,” the percentage of severely injured who were saved would be

considerably higher. Other researchers suggest that when the most severely injured patients are treated at trauma centers, the reduction in the proportion of deaths judged preventable (the save rate) can exceed 50 percent.<sup>30</sup>

ACS/COT guidelines classify trauma centers into four types—Levels I – IV.<sup>2</sup>

- Level I—A regional tertiary care facility with designated trauma care facilities that serves large cities or population-dense areas and is capable of treating the most severely injured patients. Level I trauma centers must have immediate availability of trauma surgeons, specialized surgeons (e.g., neurosurgeons and orthopedic surgeons), physician specialists, anesthesiologists, specialized nurses, resuscitative equipment, and surgical facilities. Level I trauma centers also conduct research and injury prevention activities.
- Level II—Similar to Level I but without research and prevention activity requirements. A Level II trauma center may be located in population-dense areas close to a Level I trauma center, in which case its function is to work cooperatively with the Level I center to optimize treatment resources for seriously injured people in their area. Level II centers may also be located in less population-dense areas, in which cases they serve as the lead trauma facility for that geographic area.
- Level III— A facility that provides assessment, resuscitation and emergency surgery and, if indicated, transfers to a level I or II trauma center. Level III centers often serve communities that do not have a level I or II trauma center.
- Level IV—A hospital or clinic in a remote area designed to resuscitate and stabilize patients and arrange for their transfer to the closest, most appropriate level of trauma care.

In 2002, the American Trauma Society inventoried hospital trauma centers and found 1,154 trauma centers in the United States, including 190 level I centers and 263 level II centers. Several states had categorized every hospital with an emergency department at some level of trauma care while others had designated a limited number of level I and level II centers only.

Since a trauma center can be both designated by a state or regional authority and verified by the ACS/COT, all trauma centers in the inventory can be categorized into 3 mutually exclusive groups. In their inventory of 1,154 centers, the American Trauma Society found the following:

- 970 centers (84 percent) are designated or verified by a state or regional authority only;

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<sup>2</sup> While not recognized by ASC/COT, some states have designated Level V trauma centers as well.

- 107 (9 percent) centers are designated by a state or regional authority and verified by the ACS/COT;
- 77 centers (7 percent) are verified by the ACS/COT, but located in states that do not formally designate or verify trauma centers.

The number of level I and II centers per million population ranges from 0.19 to 7.8 by state. When compared with non-trauma center hospitals, trauma centers are larger, more likely to be teaching hospitals, and more likely to offer specialized services. Although the availability of trauma centers has more than doubled since 1991, challenges still remain to ensure the optimal number, distribution, and configuration of trauma centers—challenges that must be addressed, especially in light of the recent emphasis on hospital preparedness and homeland security.<sup>31</sup>

### The Capacity Crisis

Many trauma centers are reaching or exceeding their capacity even in routine day-to-day operations. For example, in many metropolitan areas, ambulance diversion (i.e. the diversion of ambulances away from the closest appropriate trauma care facility to another facility) continues as a major issue,<sup>32,33</sup> prompting many organizations to develop cooperative diversion guidelines that facilitate communication and coordination between trauma centers and EMS services in order to ensure patient safety.<sup>34,35</sup>

There may be several reasons for this capacity crisis—overcrowded emergency facilities due, in part, to increasing numbers of uninsured who seek what would otherwise be considered primary care in EDs; emergency facilities “backed up” by a lack of inpatient hospital beds; and/or a lack of investment in emergency personnel and infrastructure. Regardless of the etiology, this crisis bears directly on the issue of preparedness for a terrorist attack. If the system is unable to meet day-to-day demands, it will certainly be difficult to gear up to meet the increased demands that result from a mass casualty incident.

Capacity in a disaster situation, however, may not be comparable to capacity in daily operations. In conventional medical care, the objective is to do the greatest good for the *individual* patient, but in a mass casualty incident, it is to do the greatest good for the *greatest number* of patients.<sup>36</sup> However, unlike in conventional medicine, there are no uniformly accepted “standards of practice” for disaster medical response—providers are presumed to be doing the best they can. Standards of practice for disaster medicine must be developed, and providers trained in them, in order to ensure maximum effectiveness and efficiency of any disaster response. At the same time, additional resources must be earmarked for disaster medical response preparation to ensure adequate resources in the event of a disaster—manmade or otherwise.

### C. Rehabilitation Services

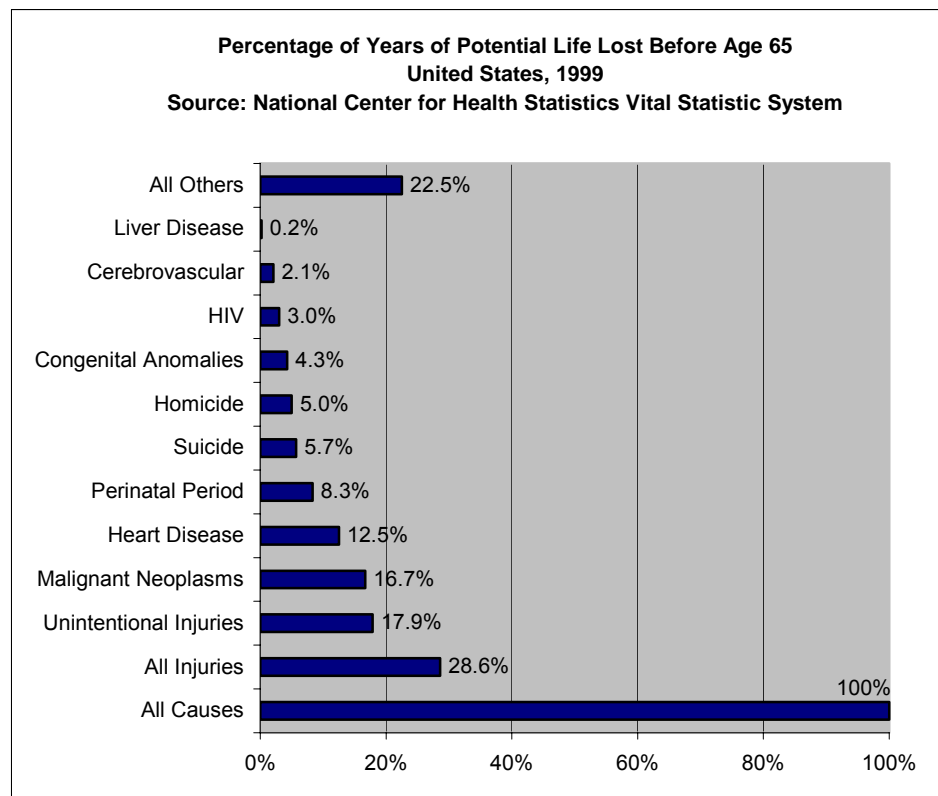
Quality rehabilitative care is essential for patients to return to their approximate pre-injury or pre-illness status. Therefore, rehabilitation services should be an integral part of treatment in the trauma system. These services are designed to:

- Improve physical and mental health
- Prevent or reduce disability
- Enhance personal autonomy and productivity.

Rehabilitation should begin as soon as possible after admission to an acute care hospital. These services are generally provided by a specially designated unit or hospital, and they are often continued at the patient's home or outpatient clinic after discharge from inpatient care. However, in most cases, communication from the rehabilitation centers back to the other components of the trauma care system is lacking, making it difficult to evaluate long-term outcomes.

### D. Injury Prevention

Fatal injuries dominate the causes of death of younger populations and, therefore, they take a terrible toll in terms of years of potential life lost (YPLL). The figure above shows how unintentional injuries (e.g., motor vehicle crashes, falls, fires, drownings, and poisoning), homicides, and suicides rob Americans of millions of years of life every year.



In 1999, of the 11,145,856 YPLL before the age of 65, 28.6 percent were due to injuries.<sup>37</sup>

In recent years, trauma care systems have focused increasingly on injury prevention within three domains—primary, secondary, and tertiary prevention.

- **Primary injury prevention**—pre-event prevention that seeks to completely avoid the occurrence of injury—is variably represented in trauma systems, and is usually considered to rest within the authority of public health. Although primary injury prevention programs have been implemented by pre-hospital and acute care providers, few have been systematically evaluated.
- **Secondary prevention**—the attenuation of injury at the time of its occurrence—has traditionally been undertaken by public health through such activities as seat belt and bicycle helmet campaigns, etc. Increasingly, however, trauma care systems have developed and are implementing injury prevention educational programs, such as “stop, drop, and roll” for fire victims, and child safety seat campaigns targeting parents of young children.
- **Tertiary prevention**—efforts to reduce the impact of an injury once it has occurred and optimize its outcome—are typically at the intersection of public health and trauma care. Ensuring that timely EMS dispatch occurs, that care provided by EMS personnel meets or exceeds current guidelines, that the injured patient is delivered to a trauma facility with appropriate resources (getting the right patient to the right place at the right time) are all examples of tertiary prevention.

*The EMS Agenda for the Future*<sup>38</sup> lists prevention as one of fourteen EMS system attributes. The data from the survey series conducted by the National Association of State EMS Directors seem to indicate an increasing involvement of state and territorial EMS programs with various prevention endeavors. The principal foci have been in areas supported by federal programs and grants; there appears to be a correlation between the types of prevention activities and the federal revenues available for particular prevention endeavors.

- Over a third of the jurisdictions report no in-state revenue to support injury prevention activities, and over 10 percent report no federal revenue to support injury prevention.
- Over half the state and territorial EMS offices do not have any full time staff responsible for overseeing injury prevention activities; yet two-thirds of the respondents felt EMS is more involved with injury prevention than it was 5 years ago.

The trauma care system holds significant promise for programmatic integration with injury prevention. The extent to which this will occur will depend largely on federal leadership and funding.

## E. Trauma Care is Multi-Disciplinary Care

Contrary to the belief of some, the trauma care system consists of far more than EMTs, emergency medicine physicians, and trauma surgeons. Key to the success of the trauma care system is its well-established multi-disciplinary workforce and institutional commitment to integrated care. This trauma care system workforce includes, but is not limited to:

- EMS Personnel
- Communications personnel
- Surgeons—trauma, orthopedic, vascular, neurosurgical, etc.
- Emergency medicine physicians and internists
- Anesthesiologists
- Radiologists
- Burn specialists
- Trauma nurse specialists
- Administrators
- Pediatricians and Gerontologists
- Critical care physicians
- Nurses and nursing assistants
- Respiratory therapists
- X-ray and Lab technicians
- Physical therapists
- Occupational therapists
- Mental health providers
- Pharmacists
- Clerical staff

## F. The Trauma Care System: An Evolving Model

The trauma system structure, as conceived and developed by HRSA in 1992,<sup>39</sup> was separated into administrative and clinical/operational systems. As shown in the chart below, the visible spectrum of an EMS system, comprising those elements that the public may observe, constitutes only a small portion of the infrastructure essential to the comprehensive system. Many “unseen” activities are critical to its success.

### Structure of the Trauma Care System (1992)<sup>40</sup>

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#### **Administrative Components**

Leadership  
System development  
Education and Advocacy  
Finances  
Information systems—aggregate outcomes data  
Systemic evaluation

#### **Clinical/Operational Components**

Injury prevention and control  
Professional resources development

- Workforce resources
- Education resources

Pre-hospital communication and care

- Emergency medical services management agency
- Ambulance and non-transporting guidelines
- Communications systems
- Triage systems
- Emergency preparedness/disaster plans

Definitive care facilities

- Trauma centers (Levels I-IV)
- Inter-facility transfer capacity

Medical rehabilitation care  
Information systems—medical data  
Evaluation  
Research

By all accounts, most states have made progress toward achieving the goals set out in the 1992 model trauma care system proposed by HRSA, but progress has been uneven. HRSA’s “A 2002 National Assessment National Assessment of State Trauma System Development, Emergency Medical Services Resources, and Disaster Readiness for Mass Casualty Events,”<sup>41</sup> revealed that few existing trauma care systems met the criteria established in the 1992 plan. Based on the 2002 national assessment, and prompted particularly by the events of September 11, 2001, HRSA has undertaken efforts to realign the trauma care system within the public health system framework, such as the effort cited below.

*The thought that a public health model can be applied to trauma systems is based on the concept that injury, as a disease can be, if not primarily prevented, controlled to a level that is acceptable to the public. Such actions, i.e. preventing or controlling injury, are similar to those taken for infectious disease. The need for trauma systems that provide care along a continuum that includes injury prevention is ongoing. This continuing need provides support for public health system collaboration on targeted risk reduction programs for both trauma and injury prevention. Specialized trauma care is not enough to minimize the burden of injury to society at large. It must be combined with other risk reduction strategies to reduce the overall burden of physical injury.*

*~ from a working draft of HRSA’s “Model Trauma System Planning and Evaluation: Integration of the Public Health and Trauma Care Systems for Improved Injury Outcomes” (August 6, 2004)*

In realigning the trauma care system with the public health paradigm, the three core functions of public health—assessment, policy development, and assurance—must be addressed. The following chart from HRSA’s ongoing “*Model Trauma System Planning and Evaluation: Integration of the Public Health and Trauma Care Systems for Improved Injury Outcomes*” compares the infrastructure of the 1992 model trauma system (shown above) to today’s public health infrastructure.

<b>A Comparison of Public Health Core Functions and the 1992 Model Trauma System Components<sup>42</sup></b>			
<b>Public Health Core Functions</b>		<b>Trauma Systems Components</b>	
<b>Core Function</b>	<b>Essential Service</b>	<b>1992 Core Component</b>	<b>Subcomponents</b>
Assessment	Monitor health	Evaluation	<ul style="list-style-type: none"> <li>▪ Needs assessment</li> <li>▪ Data collection</li> <li>▪ Research</li> </ul>
	Diagnose and investigate		
Policy Development	Inform, educate, and empower Mobilize community partnerships	Public information and education	<ul style="list-style-type: none"> <li>▪ Injury prevention</li> <li>▪ Trauma system stakeholder development</li> </ul>
	Develop policies	Legislation	<ul style="list-style-type: none"> <li>▪ Trauma system planning and operations</li> <li>▪ Regulations and rules</li> </ul>
Assurance	Enforce laws		<ul style="list-style-type: none"> <li>▪ Lead agency designation</li> </ul>
	Ensure links to care and provision of care	Pre-hospital care  Definitive care	<ul style="list-style-type: none"> <li>▪ Communications</li> <li>▪ Medial direction, triage, and transport</li> <li>▪ Facilities designation, inter-facility transfer, and rehabilitation</li> </ul>

Core Function	Essential Service	1992 Core Component	Subcomponents
Assurance, cont.	Ensure competent workforce	Human resources	<ul style="list-style-type: none"> <li>▪ Workplace resources and educational preparation</li> </ul>
	Evaluation	Evaluation	<ul style="list-style-type: none"> <li>▪ Data collection <ul style="list-style-type: none"> <li>○ trauma system</li> <li>○ trauma center</li> </ul> </li> <li>▪ Research</li> <li>▪ Interdisciplinary review</li> </ul>

An examination of some of the infrastructure elements of the trauma care system is illustrative of some of the problems faced by the system and can identify potential roadblocks to the successful realignment of trauma systems and public health.

### 1. Leadership

State EMS offices have legal jurisdiction over their respective EMS systems. Beyond the EMS system itself, however, there is no coordination mechanism for the larger trauma care system, which includes injury prevention efforts, trauma centers, acute care hospitals, and rehabilitation services. Varying in extent from state to state, this coordination defaults to the EMS office, and efforts to voluntarily coordinate these entities vary.

Whether by design or default, the federal government’s leadership role has long been confined to the provision of funding incentives and the production of guideline documents aimed at improving system uniformity. Again, this points to the lack of an oversight agency at the federal level.

### 2. Education and Advocacy

Each state has standards that identify the requirements for the minimum educational content and number of hours for refresher and continuing education for EMS personnel. In many instances, these requirements are set forth in state regulation, and contain specific subject matter references for required education. These provisions are in place to protect the public interest by assuring the quality and applicability of continuing education to the continued practice of the profession. Similarly, in acute care, board certification for physicians and surgeons sets the standards for training.

Subject matter related to disasters, terrorism, and weapons of mass destruction might seem appropriate for inclusion in minimum required ongoing education, but is generally not included. Requirements for ongoing education are outlined in state regulations, but regulatory change can be difficult to accomplish, given other state priorities and political issues. However, states can also develop elective content to supplement the minimum required ongoing education content for trauma and EMS providers. Elective content in weapons of mass destruction could be used in most states and territories to meet the required number of continuing education hours.

### 3. Pre-hospital Communication

Nationwide “911” coverage still has not been realized. Especially in rural areas, people may have to dial a seven-digit number to access ambulance service. In some instances, separate numbers exist for law enforcement, fire, and EMS, which leads to lack of optimal coordination. Dispatchers in rural areas may not be trained to give important, often life-saving instructions to callers as they are in most urban settings.

As we saw in the tragedy of the World Trade Center bombing on September 11, 2001, interoperability of communications equipment is often inadequate to facilitate multi-agency coordination in large-scale disasters.<sup>43</sup> Much communications equipment in use by many rural providers is so old that replacement parts are no longer available.

Both a National Response Plan and a National Incident Management System (NIMS) have been drafted by FEMA within the Department of Homeland Security.<sup>44</sup> The NIMS provides a consistent nationwide approach for Federal, State, territorial, tribal, and local governments to work effectively and efficiently together to prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity. However, expectations of full and uniform implementation by all states, given the current patchwork of system authority, may be unrealistic.

### 4. Information Management

There currently are no nationally utilized EMS information systems. Roughly half the states collect some form of prehospital data. Even among those states, the data are not truly comparable because of differing data definitions, and differences in the requirements related to the types of services that must be reported.

The National Association of State EMS Directors is currently working on a federally funded project to establish a national EMS information system. However, without considerable federal commitment (both leadership and funding) to uniform implementation, the potential benefit of such a system—uniformly recorded and reported data on pre-hospital EMS utilization— may never be fully realized.

### 5. Finances

At the local level, trauma and EMS operations may be funded in varying ways, depending on the type of organization providing the service. The provision of prehospital EMS may be through private ambulance companies, private for-profit or not-for-profit hospitals, existing municipal or county governmental entities such as a fire or police departments, or as “third service” operations, usually run by counties or cities, but not associated directly with fire or police departments.

The current health care financing system provides a partial compensation to EMS companies for services actually performed. In some environments, this may lead to a practice of providing costly and resource intensive services when alternative care may have been both less expensive and more appropriate.

Information from the NASEMSD survey of state EMS funding suggests that the funding to support state EMS operations has not been significantly improved by federal grants designed to improve preparedness and response to terrorism. Although every state EMS office is tasked with some additional responsibilities to assure readiness, the monies to support training, planning, exercises, and equipment are virtually non-existent at the system level.

In spite of the millions spent on homeland security, federal resources constitute only a small percent of the overall budget for state EMS offices, as most homeland security funds have gone into the public safety sector. FEMA provides no EMS funding, and state EMS offices receive only nominal amounts from other federal agencies. Further, the federal money that is received is categorically targeted and generally cannot be blended or moved from one category to another. Therefore, many state EMS offices rely primarily on state general revenue funds. Widespread state budget shortfalls bode ill for these offices.

## 6. Research

Research in the field of trauma care has been insufficient to validate the EMS and trauma care policy and practice standards in effect today. The dearth of quality of trauma care-related research, and the lack of any central coordination for these research efforts represent significant issues of concern. For example, interventions, devices, and medications are sometimes put into service in pre-hospital EMS without a thorough and scientific basis for their application in the pre-hospital environs, and without evaluation for reduction in morbidity, mortality and improvement in quality of life for patients.

Further, the little research and evaluation that is performed on existing treatment modalities is sporadic, retrospective, and often performed only on a local level. Often, the full results of this research are not taken into account in the development of public policy.

The National Highway Traffic Safety Administration, in collaboration with the Maternal and Child Health Bureau, commissioned a report entitled "The National EMS Research Agenda." This report reviews the history and current status of EMS research, and suggests strategies for improving the quality and quantity of EMS research with the goal of providing a scientific foundation upon which to base current and future prehospital care.

## 7. Technology

Many technological innovations have been introduced into trauma care practice over the last three decades. Often, new devices are put into service in the pre-hospital setting before thorough consideration of the differences between laboratory environment, the hospital environment, and the field environment. Equipment on ambulances is subjected to particulates, vibration and temperature variables much higher than those for which many technologies are tested. Further, the capacity to use some of these new technologies in the field may not have been adequately considered. For example, many EMS departments deploy Mark I anti-nerve agent kits in their ambulances, but little research has been done on the administration of IM medicines while the administering personnel, in this case the EMS providers, are in full level A personal protection equipment. In short, research and development seldom anticipate the rigors ubiquitous in the pre-hospital environment.

Moreover, ambulance equipment and EMS scope of practice is so regulated in some states that new technologies are likely to find their way into the hands of the providers before regulatory change can be implemented to allow use by EMS personnel. Some jurisdictions have experienced this phenomenon with “Epi-Pens” and Automated External Defibrillators. In this scenario, the *marketing* of new technologies has outstripped the regulatory mechanisms supporting the EMS system.

## 8. Disaster Preparedness and Response

The involvement and leadership of state EMS offices in planning and preparations for terrorist attacks or other public health emergencies is less clear and even less uniform than in routine day-to-day operations. A NASEMSD survey, *Involvement of EMS Offices in Bioterrorism Grant and Planning Efforts*, was conducted to ascertain the extent to which state EMS offices are involved in federally supported bioterrorism preparedness activities occurring at the state level. Most EMS offices reported that they had, and may continue to have, some level of involvement in preparedness planning. While some survey responders seemed enthusiastic and optimistic that EMS was “at the table” in discussions at the state level, others expressed concern that EMS was included in name only. That the experiences are quite mixed may reflect the EMS policy inconsistencies between states and territories, the lack of a unifying (federal) voice on the role of the trauma care system in disaster planning and response, and/or a lack of knowledge about the true need for integration of the trauma care system into disaster planning and response by policy makers. Further, 20 percent of state EMS directors surveyed by the National Association of State EMS Directors (NASEMSD) indicated that state budget issues and/or hiring/spending freezes were hindering the implementation of emergency preparedness activities funded by federal homeland security grants. Almost a third of the respondents indicated little or no benefit to EMS resulting from these grants.

Thirty-five states appear to have a state-level body coordinating preparedness activities. Forty percent of the reporting state EMS offices indicated they were not included in the membership of their state preparedness committees. Of those that are included, about one-fourth report that EMS issues are not given adequate agenda time and attention. Roughly the same amount expressed dissatisfaction with the sufficiency of input from EMS.

Similarly, the larger trauma care system, including trauma centers, acute care hospitals with emergency response capacity, and rehabilitation services, is seldom included in disaster preparedness planning unless the constituent members of this system strongly advocate for involvement. The relationship between the Conference of Boston Teaching Hospitals (COBTH), Boston EMS, the Boston Public Health Commission, and Boston's Police and Fire Departments is an example of a working relationship that has been arduously constructed over many years. Perhaps this is a result of the fact that Boston EMS is situated departmentally within the Boston Public Health Commission, which has been charged by Boston's Mayor to coordinate disaster response planning.

#### 9. Legislative Authority

As has been mentioned, the nature and extent of legislative authority among state EMS offices varies. Federal efforts at promoting uniformity have been marginally successful at best. In the absence of federal direction and fiscal support, each state system has evolved and adapted individualized approaches and system characteristics. The evolving roles of these 56 different state and territorial EMS offices in preparing their respective systems for a potential terrorist attack must be better understood if the nation is to stand truly prepared. Without a thorough understanding of the "state of the states" in disaster preparedness, we will not be able to move to a more unified and system of preparedness.

#### **G. Role of State and Local Trauma Systems in Initial Disaster Response (First 24 hours)**

In a mass casualty incident (MCI) corresponding to a level 2 or 3 disaster (those requiring assistance from adjacent jurisdictions or federal assets), the trauma care system may be called upon to handle scores or even hundreds of casualties in a short time. The system must be able to mobilize personnel, equipment, supplies, and bed space. To accomplish this effectively, the different elements of the trauma care system must thoroughly pre-plan and work in accordance with pre-established protocols.

The Hospital Preparedness Program is the mechanism for acute care settings within the trauma care system to prepare for such a disaster. The purpose of the hospital preparedness program is:

- To upgrade the preparedness of the nation's hospitals and collaborating entities to respond to bioterrorism and other disasters;
- To develop and implement regional plans to improve the capacity of hospitals, their emergency departments, outpatient centers, EMS systems, and other collaborating health care entities for responding to incidents requiring mass immunization, treatment, isolation and quarantine in the aftermath of bioterrorism or other outbreaks of infectious disease.

## 1. The Effects of Mass Trauma: Acuteness of Injuries and Utilization of Acute Care Resources in Mass Casualty Incidents <sup>45</sup>

Conventional terrorist bombings have caused, and can be expected to cause, the following pattern of casualties. We have learned many lessons in responding to these attacks over time:

- One third (1/3) of acute casualties are critical—dead on scene, die at or en-route to the hospital, require emergency surgery, or require hospitalization.
- The number of available operating rooms is a major factor in determining a hospital's capacity to care for critically injured casualties.
- Two thirds of acute casualties are non-critical—treated and released from the emergency department. (Many of these can be treated at non-trauma care settings.)
- The capacity of the radiology department is a major factor in determining a hospital's capacity to provide care for non-critical casualties. Each casualty exposed to a blast should have a chest X-ray to screen for fractures, blast lung, or other injuries. Each X-ray takes around 10 minutes of X-ray machine time. Therefore, the radiology department should be able to see 6 patients per hour for each available machine.

- *The capacity to care for critical casualties ~ number of available operating rooms*
- *The capacity for non-critical casualties/hour ~ (number of x-ray machines\*) X (6 pts/hour)*

## 2. Patterns of Hospital Use in Mass Casualty Incidents

MCI's caused by a disaster (whose effects are immediate) show predictable patterns of hospital use. It is possible to estimate initial casualty volume and pattern after a MCI. Public health professionals and hospital administrators can use this information to handle resource and staffing issues during a mass trauma event.

- Within 90 minutes following an event, 50-80 percent of the acute casualties will likely arrive at the closest medical facilities. Other hospitals outside the area usually receive few or no casualties.
- The less-injured casualties often leave the scene without assistance and go to the nearest hospital on their own. As a result:
- On average, it takes 3-6 hours for a casualty to be treated in the emergency department (ED) before s/he is admitted to the hospital or released.

➤ *Less-injured casualties are not usually triaged at the scene by EMS and, therefore, may arrive at the hospital before the most critically ill!*

When trying to determine how many casualties a hospital can expect after a mass trauma event, it is important to remember that casualties present quickly after an incident:

- Approximately half of all casualties will arrive at the hospital within a 1-hour window.
- This 1-hour window begins when the first casualty arrives at the hospital.
- The total number of casualties at a particular hospital is approximately double the number of casualties the hospital receives in the first hour.<sup>46</sup>

### 3. Degree of Injuries and Utilization of Acute Care Resources in “Delayed Effect” Mass Casualty Incidents

While not the focus of this paper, attacks involving biological and some radioactive agents would likely produce a scenario in which increasing numbers of patients would begin to present at a number of different health care settings, including primary care practices, with the initial symptoms of the agent used, which are often non-specific. For example, fever, malaise, fatigue, cough, and mild chest discomfort are first clinical symptoms of inhalational anthrax. After initial symptoms appear, inhalational anthrax progresses in 2-3 days to severe respiratory distress with dyspnea, diaphoresis, stridor, cyanosis, and shock, with death typically occurring within 24-36 hours after onset of severe symptoms if it is left untreated. In order to prevent death, individuals infected by anthrax would require rapid treatment with antibiotics (intravenously in advancing cases) and possibly ventilatory assistance. Even individuals not showing signs of disease, but who were possibly exposed, would be treated prophylactically.

After a biological attack, upon a state’s request, federal “push packs” containing large amounts of antibiotics and immunizations will be delivered to the scene. It is the responsibility of every city and

state to determine how these medicines would be distributed to large populations of affected individuals. For example, Boston has a plan to move all needed supplies from the staging area to fifteen distribution points across the city within 2 hours of their arrival.

One critical factor in responding to a bioterrorist event is whether the agent used is communicable or not. As bad as an anthrax attack might be, at least the disease will be confined to those originally exposed. The aerosolized dispersal of smallpox or pneumonic plague, both of which are highly contagious, would require isolation and treatment of those infected, mass vaccination and/or prophylaxis of those around infected individuals, and contact tracing to ensure that all exposed individuals are isolated and treated. Clearly, public health surveillance and epidemiology would be critical in this scenario.

Hospitals within the trauma care system must prepare for these contingencies, addressing many different factors, such as:

- Personal protection for healthcare personnel;
- Decontamination of individuals affected by non-communicable biological agents and radioactive materials;
- Quarantine of contagious individuals;
- The capacity to communicate within a particular trauma care system as well as across *different* trauma care systems to coordinate response.

Regional planning efforts should identify which facilities have isolation rooms which meet standards to ensure correct installation and operation of the isolation system: i.e. rooms are under negative pressure, that do not share exhaust with any other hospital ventilation system, and are equipped with high-efficiency particulate air filtration. Regional plans should have pre-event agreements and commitments from hospitals that they will receive patients that require clinical isolation.

Recommendations of requirements that should be met for a Type C (contagious) facility are described in the CDC interim response plan and guidelines on the CDC website ([www.bt.cdc.gov/agent/smallpox.asp](http://www.bt.cdc.gov/agent/smallpox.asp)).

An individual trauma center's disaster planning must include integration with the rest of the trauma case system as well as with outside agencies (e.g., police, fire, military, etc.) and neighboring hospitals and trauma systems. Disaster plans should also include:

- Prearranged agreements with the controlling regional Emergency Operations Center and other regional disaster response agencies (police, fire, military, utilities, etc.);
- An organized response for management of casualties transported from the disaster site;

- A pre-established disaster triage team to respond when requested by the controlling agency or Incident Commander;
- A plan for disasters occurring within or near the hospital itself that requires patient evacuation.

#### 4. The Issue of Surge Capacity in Disaster Response

Absent disasters, hospital surge capacity has been identified as a national crisis. Clearly, this issue will only intensify during mass casualty incidents. In an age when patients are treated in hallways and are held in emergency departments for hours and even days until an in-patient bed is available, the simultaneous presentation of multiple patients from a disaster could stress the system to the point of collapse. While most hospitals deal with this issue daily, regional collaboration is needed to create a plan for the community. This includes planning for additional space, staff, and equipment.

Each state must plan for a potential epidemic or other mass casualty incident involving at least 500 patients in its state or region. Trauma care systems must have a plan that enables them to:

- Increase hospital bed capacity to accommodate increases in admissions from an infectious disease epidemic or other mass casualty incident over an extended period of time;
- Deploy additional medical personnel to provide needed medical care;
- Address overcrowding and the need for hospital diversion, with large numbers of acute casualties arriving on their own or by ambulance;
- Communicate rapidly with EMS units that allows them to determine immediately a destination;
- Communicate between hospitals in the trauma care system;
- Describe how hospitals will receive patients on a daily basis when several hospitals are on diversion simultaneously;
- Ensure movement of equipment maintained by hospitals or EMS systems to the scene of a bioterrorist event or other disaster;
- Meet the special needs of children, pregnant women, the elderly, and those with disabilities that ensures access to medically appropriate care;
- Deliver essential goods and services such as food, water, electricity, and shelter to patients and hospitals

During a mass casualty incident, hospitals within the trauma care system must be able to "flex-up" within a fairly short time to accommodate increases beyond the normal and routine state. This capacity is assessed in terms of:

- Services—medical, surgical, emergency department, etc.;
- Support—laboratory, diagnostics, pharmacy, dietary; and
- Management and Information Systems Infrastructure—information systems, communications, data and tracking systems.

Assessment of hospital capacity must include:

- Existing and immediately available services for inpatient and outpatient care as a baseline for estimate of capacity;
- The hospital's rapid expansion capacity, with attention not only to physical plant, but also to personnel, supplies, pharmaceuticals, and equipment (treatment and diagnostic);
- Consideration of maintenance of standards of medical care and patient monitoring and tracking;
- Contingency plans prepared by hospitals to ensure patient care when demand exceeds readily available resources (e.g., alternative points of service, discontinuance of service thresholds, and patient transfers) that have the effect of freeing up acute care capacity.

Potential approaches to increase surge capacity include:

- Changing “minimum standards of care” during disaster response to allow for realistic and acceptable standards: e.g., using expired drugs if necessary
- Discharging non-critical patients early
- Converting short-stay (outpatient procedure) beds into inpatient beds
- Utilizing hallways or creating alternative inpatient treatment areas (cafeteria)
- Partnering with local health department, emergency management agency, red cross to create emergency inpatient and outpatient treatment capacity outside the hospital—concepts such modular emergency medical system
- Utilizing specially trained medical and nursing students in key disaster response roles
- Initiating Memoranda of Understanding with other healthcare facilities within and outside the immediate region including acute, long-term care and rehabilitation facilities
- Using automated surveillance and tracking systems
- Linking information from physicians, clinics and hospitals to the public health system and the first responder community
- Implementing communication systems to allow rapid dissemination of information to key players and planners in a bioterrorist or other mass casualty event.

Communities will also need to plan on auxiliary locations for providing patient treatment such as schools, hotels or other public buildings; however, legal, financial, political, and logistical issues should be addressed prior to an event. Staffing concerns include training and protection of staff, as well as recruitment and credentialing of additional staff during an event. Special care must be taken that multiple organizations are not relying on the same pool of individuals for support. In planning equipment acquisition, communities must know where it will come from and how it will be delivered and distributed to patient care areas.

#### 5. Special Problems and Preparations in Rural Areas: The Role of Rural Health Departments

Local health departments must coordinate planning among hospitals and other entities including:

- Emergency medical services agencies
- Offices of Rural Health Policy
- Emergency management agencies
- Primary care associations
- VA and military hospitals (if available).

#### 6. The Utility of Real-Time Data Sharing

There are numerous examples of real-time data sharing between organizations. The simplest of these is disease reporting. In the event that a reportable disease is identified in the emergency department, staff will notify the appropriate public health official. While this may not be a high tech means of data sharing, it does work in many jurisdictions. The health alert network is a more sophisticated means of data sharing. This system allows public health officials to quickly disseminate information to medical personal who are on the ground. The *National Electronic Disease Surveillance System (NEDSS)* is a secure web-based disease reporting system that allows real-time tracking of disease outbreaks across the country.

#### 7. Communications Systems

An additional complication of disaster response is incompatibility of communication systems. There are issues with interoperability between all agencies at all levels. For example, in many communities EMS agencies may not be able to communicate with each other or with other first responder agencies (i.e., police and fire). As communication systems are being created it is important to recognize the need for two-way communication that allows all agencies involved in a disaster response to communicate with each other. These systems are needed prior to event as well as during an event. For example, public health officials can use EMS data for real-time disease

surveillance, allowing them to notify EMS providers of a possible outbreak. This could help to reduce the possibility of EMS providers becoming victims themselves.

Of course, the capacity to communicate between departments is a function of more than compatible equipment. Differences in technical and idiomatic language, professional mindsets, and personalities can be obstacles to effective communication as well. Lines of communication between different departments should be established and well practiced before any event occurs.

When considering event communication one must also consider communicating with the general public. First, the public needs to be able to notify the appropriate people that an event is occurring. Current issues with the lack of enhanced 911 for cell-phones (i.e., dispatchers are unable to pinpoint the location of a 911 call) may make it difficult for the average citizen to make the appropriate notification. The ability to locate wireless callers has assumed paramount importance given the wide proliferation of wireless communications. Current technology of triangulation or GPS use is being explored, as the FCC has mandated that E-911 systems be in place by 2007. Even if E-911 systems are put in place, most communication agencies suffer from working with congested, overburdened radio systems.

Further, consideration should also be given to how the public can communicate and get information during an event when they try to find loved ones or determine if and where they should go to receive medical care. Establishing relationships with media outlets may help disaster officials to effectively disseminate information during a disaster.

#### 8. Integration of EMS and Trauma Care into the Larger Response Effort

EMS providers are known for running in when everyone else is running out. As heroic as this may seem, the events of 9/11, the Toronto SARS outbreak, and the fire in Worcester, Massachusetts have all shown that EMS providers are not invincible. The consequences to the disaster response system of losing the services of large numbers of providers due to illness or death can disable the entire system.

Because many different organizations participate in the response to a disaster, the Incident Command System was developed to provide a common organizational structure and language that allows different kinds of agencies, and/or multiple jurisdictions of similar agencies to work together effectively in response to a disaster. EMS and the larger trauma system must be integrated into the ICS structure in order to be effective in a disaster. Currently, there are efforts being made to establish a National ICS Structure to ensure uniformity in disaster response. Regardless of the ICS system, however, several principles remain constant:

- There is ONE Incident Commander who is responsible for disaster response.
- There is a SAFETY OFFICER who reports to the Incident Commander who is responsible for the safety of responders and the public.
- Functional requirements, not titles, determine ICS hierarchy.<sup>47</sup>

Just as EMS and hospitals must be integrated in their emergency response, hospitals themselves must be incorporated into the local Incident Command System to ensure that system components are fully integrated. Many hospitals have adopted and integrated the Hospital Emergency Incident Command System (HEICS) into their response plans. The HEICS incorporates multiple vital departments of a hospital support system, organizes these areas based on functionality, and provides for a well-coordinated infrastructure that is able to address patient care needs and resources as issues or problems arise. Integration of hospitals into chain-of-command will serve to ensure consistency and competency in communications, notification procedures, acute care capabilities, capacity, and bed availability. This integration also facilitates communication between hospitals and field providers regarding patient triage and allocation. This is important to ensure that patients are proportionally and appropriately distributed to receiving hospitals. Integration of command can also facilitate dispatch of specialized rescuers or resources where needed; for example, mobilizing a surgical team to a local hospital without trauma care capabilities.

#### 9. Mental Health Needs of Responders

Disaster responders who choose to be involved in this type of work gain great reward and satisfaction, but can also become secondary victims of stress and other psychological sequelae. This can adversely affect their functioning during and after an event. It can also adversely impact their personal well being as well as their family and work relationships. Everyone experiences stress a bit differently. Some common signs of stress in workers include the following: <sup>48</sup>

- Physiological signs of stress such as fatigue, even after rest, nausea, dizziness, etc.
- Emotional signs of stress such as anxiety, irritability, feeling overwhelmed, etc.
- Cognitive signs of stress such as memory loss, decision-making difficulties, reduced attention span, concentration problems, etc.
- Behavioral signs of stress such as: insomnia, hyper-vigilance, crying easily, inappropriate humor, or ritualistic behavior.

The Incident Commander should take steps to minimize workers' reactions to the stressful environment. Some of these include:

- Reasonable hours;

- Rest/sleep;
- Reasonable diet;
- Regular exercise program;
- Private time;
- Talking to somebody who understands;
- Monitoring signs of stress;
- Identifiable endpoint for involvement.

#### IV. PUBLIC HEALTH INFRASTRUCTURE: A PRIMER FOR ACUTE CARE PROVIDERS

The Mission of public health is to "fulfill society's interest in assuring conditions in which people can be healthy." <sup>49</sup> PH carries out this mission through organized, interdisciplinary efforts that address the physical, mental, and environmental health concerns of communities and populations at risk for disease and injury.

Public health is proactive where acute care is reactive; and public health is population-focused where acute care is focused on the individual. But public health and acute care are not mutually exclusive: on the contrary, cooperation between public health and acute care yields improved responsiveness, greater efficiency, and enhanced effectiveness.

##### Public Health System Services and Functions

As described in HRSA's *Model Trauma System Planning and Evaluation: Integration of the Public Health and Trauma Care Systems for Improved Injury Outcomes*, the public health system provides ten essential services across three core functions.<sup>50</sup> The essential services are:

- To monitor health status to identify community health problems
- To diagnose and investigate health problems and health hazards in the community
- To inform, educate, and empower people about health issues
- To mobilize community partnerships to identify and solve health problems
- To develop policies and plans that support individual and community health efforts
- To enforce laws and regulations that protect health and ensure safety
- To link people to needed personal health services and ensure the provision of health care when otherwise unavailable
- To assure a competent public health and personal health care workforce
- To evaluate effectiveness, accessibility, and quality of personal and population-based health services
- To Conduct research to attain new insights and innovative solutions to health problems.

The three core functions, or domains, are defined as follows:<sup>51</sup>

- **Assessment** is the regular and systematic collection and analysis of data from a variety of sources to determine the status of and cause of a problem, and to identify potential opportunities for intervention.
- **Policy Development** uses the results of assessment in an organized manner to establish comprehensive policies intended to improve the public's health.

- **Assurance**, agreed-on goals to improve the public's health, is achieved by providing services directly, by requiring services through regulation, or by encouraging the actions of others (either public or private).

## **A. The Federal Public Health System**

### 1. Centers for Disease Control and Prevention (CDC)

The Centers for Disease Control and Prevention (CDC) is the lead federal agency for protecting the health and safety of people by providing credible information to enhance health decisions, and promoting health through strong partnerships. CDC serves as the national focus for developing and applying disease prevention and control, environmental health, and health promotion and education activities designed to improve the health of the people of the U. S. CDC accomplishes this by working with partners throughout the nation and world to monitor health, detect and investigate health problems, conduct research to enhance prevention, develop and advocate sound public health policies, implement prevention strategies, promote healthy behaviors, foster safe and healthful environments, and provide leadership and training.

The CDC is an Integral Part of the Federal Response to Terrorism. The CDC prepares for all terrorist acts capable of causing mass casualties whether they involve conventional weapons, biologic agents, chemicals, or radiation. The CDC's public health focus had caused it to invest in the following priorities:

#### *a. Emergency Preparedness and Response*

The Office of Terrorism Preparedness and Emergency Response (OTPER) provides strategic direction for CDC to support terrorism preparedness and response efforts, assures that resources are in place to support activities, and ensure systems are available to monitor performance and manage accountability.

Dedicated in April 2003, the CDC's new Marcus Emergency Operations Center (EOC) was created to promote quicker, better-coordinated responses to public health emergencies across the country and around the globe. The 7,000 square-foot secure communications hub supports, organizes, and manages all emergency operations at CDC and allows for immediate communication between CDC, the Department of Health and Human Services, as well as federal intelligence and emergency response officials, the Department of Homeland Security, and state and local public health officials.

The Marcus EOC now serves as the lead center for mass trauma event response. The EOC coordinates emergency response teams, and undertakes pre-event planning and practice drills.

While a federal asset, the Marcus EOC is designed to assist state and local health departments and other organizations to better respond to mass casualty incidents.

*b. Enhanced Surveillance and Epidemiology*

The CDC has developed several data collection instruments and casualty prediction tools to assist first responders, EMS, and acute care facilities in mass casualty response, including:

- Rapid Assessment of Injuries from Mass Trauma Events, a common data collection instrument that facilitates the collection of common data elements across different local and state jurisdictions.
- The Mass Trauma Casualty Predictor, described earlier, which allows hospitals to predict the total number of casualties by doubling the number of casualties arriving in one-hour window.
- Predicting Casualty Severity and Hospital Capacity, an emergency management-planning tool that allows hospitals to quickly assess their capacity to treat casualties.

*c. The Strategic National Stockpile*

The purposeful release of certain biological or chemical agents targeting the United States civilian population will require rapid access to large quantities of pharmaceuticals and medical supplies. In most cases, adequate supplies would not be readily available within the affected communities unless special stockpiles were created. In response to this need, a national stockpile has been created as a resource for all. As part of the Department of Health and Human Services 1999 Bioterrorism Initiative, CDC was designated to lead an effort working with governmental and non-governmental partners to upgrade the nations' public health capacity to respond to biological and chemical terrorism, and establish a Bioterrorism Preparedness and Response Program. Critical to success of this initiative is to ensure capacity is developed at federal, state, and local levels. The Strategic National Stockpile (SNS) Program is an essential response component of CDC's larger Bioterrorism Preparedness and Response Initiative.<sup>52</sup>

*d. Communications*

The CDC also plays a vital educational role in disaster preparedness. Whether through its web site, <http://www.cdc.gov/masstrauma>, or through the many fact sheets it has developed (e.g., Brain Injuries and Mass Trauma Events, Coping with a Traumatic Event, and Burns), the CDC provides valuable information to clinicians, emergency responders, and the general public.

e. Technical Assistance

The CDC is able to deploy *Field Team Response Teams* to assist local jurisdictions in public health emergencies such as terrorist attacks, natural disasters, and epidemics/outbreaks of disease. Teams are made available to establish surveillance, assist healthcare providers, create and maintain registries, develop and disseminate information, and provide assistance to health departments.

f. Coordination of Efforts

The CDC also plays a pivotal role in ensuring coordination between emergency medical services (EMS), acute care, and injury prevention programs. As a part of its effort to build linkages between acute care and public health, the CDC funded “linkages meetings” involving the American Trauma Society, the National Association of Emergency Medical Technicians, the National Association of State Emergency Medical Services Directors, and the National Association of Emergency Medical Services Physicians—the groups responsible for this white paper.

g. Community Resilience

The CDC helps to build emergency preparedness and response readiness at the local level, and the vertical and horizontal integration of government, civic and faith-based organizations, local business, neighborhood awareness, and volunteerism. The “community cohesiveness” that results from these efforts alleviates fear, promote adaptive behavior, and, in the event of a mass casualty incident, enhances recovery.

2. Office of Public Health and Sciences (OPHS)

The OPHS is a division organized separately from the CDC under the Department of Health and Human Services that serves largely as a coordinator of public health activities. It is subdivided into several offices, including the Office of the Surgeon General.

**B. State and Local Health Departments**

In spite of the richness of the federal public health repertoire described above, public health activities occur primarily on local and state level, and public health laws are generally state-based. Further, as the federal government increasingly devolves authority for spending to the states through block grants, the vast majority of funding for public health comes from, or is managed by, the states. Because of this, state, county, and local health departments vary tremendously in their structure and function. Even smaller towns have “public health departments,” sometimes consisting of a single

public health officer. Making matters worse, budget cuts at the state level continue to erode the public health infrastructure at this level.

State, county and local health departments should play an important role in injury prevention. Many of these health departments perform the following injury prevention functions:<sup>53</sup>

- Collecting and analyzing injury data
- Designing, implementing, and evaluating interventions
- Building a solid infrastructure for injury prevention
- Providing technical support and training
- Influencing public policy.

#### 1. State, County, and Local Public Health Departments and Disaster Response

In a disaster situation, it is critical for state and local health departments to determine the impact of disasters on the public health and medical infrastructure in order to formulate an effective and efficient response. The challenges related to this task are twofold:

- The needs assessment must be performed concurrently with the provision of emergency health services.
- Planning the response will be based on necessity of limited assessment information.

The key in resolving this dilemma is in the pre-planning phase of disaster response: Responders should develop and exercise their capacity to perform needs assessments.

The rapid needs assessment provides a timely evaluation of the impact of a disaster on the public health and medical infrastructure in an affected area.<sup>54</sup> Assessment information can be obtained from a variety of sources:

- Existing information collection systems, i.e. public health surveillance systems
- Relief worker/first-responder reports
- Media reports

Specific assessment functions include:

- Determining the overall magnitude of the event
- Determining the disruption of lifeline services—potable water supply, sanitation capacity, food supply, shelter, and electricity
- Determining the extent of the local response and the impact on the health and medical systems—the trauma care system, other acute care facilities, pharmacies, etc.

## 2. Obstacles to Optimal Disaster Response at the Local Level

Local health departments are highly variable in their capacity to respond to public health disasters. The vast and pervasive under-funding of public health activities throughout the United States further compounds the lack of uniformity in organization and capacity. In addition, those funds that are available for public health are often rigidly and specifically circumscribed with regard to their use.

One of the major consequences of limited funding for public health is that information systems in most local health departments are not designed for high levels of connectivity to other data-collecting systems. Even beyond this deficiency is the fact that many information systems utilized by local health departments simply do not work as intended. Maricopa County in Arizona, as a case in point, has only a small number of staff to maintain its information systems, and their compensation is not competitive with the private sector. In addition, hospitals do not cooperate with health departments in Arizona, and there are many issues that divide state and local public health.

These organizational, technical, and resource issues aside, even the system of routine, required reporting of communicable diseases at the local level does not always work. It depends upon human motivation and compliance and is very labor intensive for the individuals doing the reporting. As a result, the reporting of communicable diseases by some health care providers can be limited.

In looking at approaches to the sharing of public health information among the various collaborating agencies and through the several levels of governmental public health, it is essential that the current separate systems be integrated into a single effective entity.

If disaster response systems are to become fully effective, they must be built on strong, pre-existing relationships between the various groups that must collaborate in operating the system. The best way to ensure this is to develop routine systems of communication and collaboration and utilize these systems day-to-day for “normal” disease reporting and surveillance activities, rather than to wait until a disaster occurs to attempt to establish this level of communication.

## **V. CRITICAL GAPS**

### **A. Lack of Federal Oversight**

In spite of the strength and resilience of the trauma care system as it exists in the United States today, there remain significant impediments to a uniformly excellent system. These impediments are:

- *While the Department of Homeland Security exists to prevent a terrorist attack on America, there is no equivalent federal agency that oversees the medical response to a mass casualty incident.*
- *Because of this lack of federal oversight and regulation, there is no logical integration of EMS and trauma functions at the state, county, and local levels.*

### **B. Lack of Uniform Data Reporting**

- *There is no uniform data set that exists from one EMS/trauma care jurisdiction to another, or even across the EMS, trauma care, and public health systems within a single jurisdiction, making uniform data analysis all but impossible.*
- *This lack of uniformity in data collection has led to a research gap.*
- *The lack of standardized trauma care system research has made it impossible to identify best practices.*

### **C. Lack of Coordination Between Public Safety, Trauma Care Systems, and Public Health**

In spite of recent terrorist events and the preparation they have prompted, there is still little coordination between public safety, the trauma care system, and public health.

- *Data and communications systems are not designed to standards that allow interoperability—different departments and agencies use radios and communication devices that cannot be accessed by other emergency agencies.*
- *Even if Interoperability standards were to be implemented, person-to-person communications between different emergency response disciplines is unpracticed and inadequate. Public safety personnel (e.g., police and fire), EMS and trauma personnel, and public health personnel are said to speak “different languages,” but need to be able to come together using one common vernacular when responding to a disaster or other public health emergency.*

#### **D. Cross-Knowledge of the Public Health and Trauma Care Systems**

Strides have been made, including the development of this linkages position paper, to close the gap between public health and trauma care systems. While this has been a good start, this message is not yet widely understood in trauma care and public health systems across the country.

- *There is no broad-based opportunity for EMS, trauma, or public health practitioners to learn about the roles and responsibilities of the other, especially in a disaster situation.*

#### **E. Funding**

The Department of Homeland Security (DHS) is responsible for *preventing* terrorist attacks on the United States; the trauma care and public health systems, on the other hand, are responsible for *responding* to any such attacks, or other disasters, should they occur. While DHS receives billions of dollars annually for their efforts, the trauma care and public health infrastructures in any parts of the country are decaying, largely because their funding comes primarily from state, county, and local jurisdictions, most of which are in fiscal crisis themselves.

- *Trauma care systems are unevenly developed across the country. This will deeply impact their capacity to respond with emergency medical services should a disaster occur.*
- *The public health infrastructure in many parts of the country is in serious disrepair, seriously impacting the government's capacity to reach millions of Americans in a disaster. Just as military and law enforcement "boots on the ground" are important in the fight to prevent terrorism, public health "boots on the ground" will be critical in successfully responding to an attack on the public's health.*

## VI. RECOMMENDATIONS

- 1) Congress and the administration should consider enacting federal oversight authority for EMS and trauma care systems throughout the United States. This authority should include funding capacity to enable the development of a uniform set of EMS and trauma care standards and capacities across the country. This would facilitate the collection of uniform data from each state and jurisdiction, thereby prompting research into best practices. Further, it would eliminate (or at least minimize) the lack of trauma care coordination across states and the lack of integration within states.
- 2) Research on EMS and trauma best practices should be undertaken immediately—even with the uneven data currently available.
- 3) Technological interoperability problems continue to plague emergency response. Efforts must continue to make communications and data systems compatible with each other.
- 4) “Human interoperability” problems also exist. Efforts must also be made to develop the capacity for emergency personnel from different agencies in a single jurisdiction—public safety, public health, and the trauma care system—to get to know each other, to be at the same table in preparing for disaster response, and to know how to find key people from other agencies in the event of a disaster. These person-to-person linkages must be made before a disaster occurs in order to be effective.
- 5) A model curriculum on public health and its role in disaster response should be developed for physicians and EMTs. This could be developed as a CME/CEU eligible course and/or as a part of the core medical school/EMT curricula.
- 6) The Linkages Working Group strongly suggests that Congress and the Administration consider increasing funding to trauma care and public health systems across the country in order to fully develop the capacity of these agencies to respond to a disaster and/or a public health emergency anywhere in the United States of America.

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