EMERGENCY MEDICAL SERVICES

Considerations for "Toward Zero Deaths:

A National Strategy on Highway Safety"

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INTRODUCTION

Injury resulting from motor vehicle collisions is the leading cause of death for US citizens age 1 through 34. This includes victims who were the driver or occupant of a motor vehicle or struck by a motor vehicle. Trauma to motor vehicle occupants during crashes is the fourth leading cause of non fatal injuries treated in emergency departments (ED) nationally, with annual ED visits totaling over 2.6 million patients. Unpublished reviews of death certificates indicate that less than half of all fatal crash victims die at the scene; those who die later are potentially preventable. Until “zero crashes” is a reality on the nation’s roadways, effective emergency medical services and trauma care remain the only mechanism to approach “zero deaths”.

Since congressional enactment of the Highway Safety Act of 1966 and the approval of the Highway Safety Guideline on "Emergency Medical Services," the US Department of Transportation (US DOT) has vigorously pursued the implementation of a comprehensive Emergency Medical Services (EMS) system nationwide. The leadership for this effort is housed in the Office of EMS under Traffic Injury Control in NHTSA. The objectives of the NHTSA Office of EMS have been to reduce mortality and morbidity among the sick and injured through the promotion of standards enabling effective 9-1-1 systems, well educated and prepared EMS systems, the provision of medical interventions and care at the scene of trauma and medical emergencies, transportation of patients to definitive care at hospitals, interfacility transfers to specialty care facilities such as trauma centers and rehabilitation of survivors of trauma to return them to as productive a life as possible.

Unlike other modes regulated by US DOT, NHTSA has no direct authority over the provision of EMS. The states and territories regulate and support the estimated 15,000 local EMS agencies (most of which are ambulance services) and 757,000 EMS personnel. Licensure of local EMS agencies and personnel is the predominant mechanism used by states to protect the public and promote safe and effective EMS response. In four out of five states, the state EMS office is housed within the state health department. In many states, EMS regulatory authority also includes trauma center designation and trauma system development responsibilities. In late 2009, the Centers for Disease Control and Prevention (CDC) announced a research conclusion that a severely injured victim who received care at a “Level I” trauma center within one hour had a 25% reduction in risk of death.

Preventable deaths and disability from motor vehicle related incidents has long been a concern of the medical community. Recent and pending publications and initiatives also indicate that the public health community recognizes the importance of treating this epidemic, as evidenced by the following:

- The American Public Health Association published “The Hidden Health Costs of Transportation” in February 2010
- The Association of State and Territorial Health Officials Presidential Challenge, launched in the spring of 2010, calls for reducing “the burden of preventable injuries and death”, including traumatic brain injury, from motor vehicle related incidents

- The National Association of County & City Health Officials offered a “State and National Policies to Promote Motor Vehicle Safety” webinar in collaboration with the Safe States Alliance in April of 2010

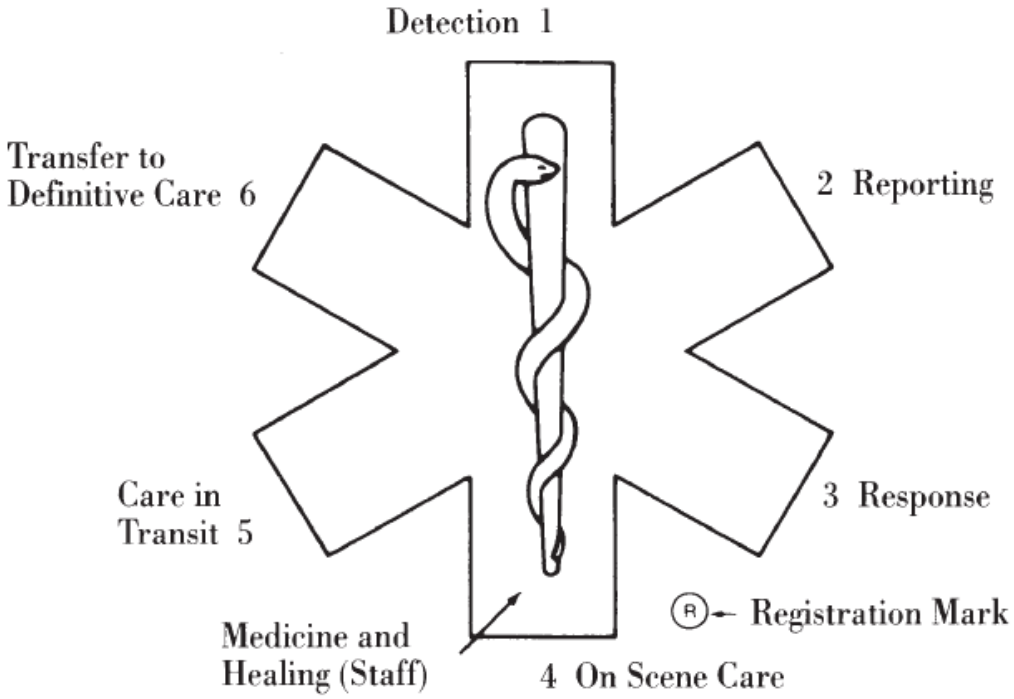
Despite these efforts to date, there is no evidence that EMS, public health, and trauma systems have exhausted all means of reducing highway death and disability in the post-crash phase. Proven practices related to triage and highway mass casualty management are not in universal use; patient care and transportation practices such as those associated with trauma systems vary by state and are still absent in some states. Technologies evolving in the private sector (e.g., telematics) and for the commercial vehicle industry (e.g., driver and vehicle monitoring systems) are not widespread throughout the EMS industry.

EMS providers are at greater risk of death on the job than their police and firefighter counterparts, with 74% of EMS fatalities being transportation related. The estimated fatality rate for EMS personnel is more than twice the national average. In contrast to the likely public perception, a growing body of evidence suggests that ambulances are actually very dangerous vehicles as well. For instance, the estimated crash rates of ambulances are 7 to 10 times greater than heavy trucks, and as many as 9,000 crashes per year among 50,000 vehicles. Equally troubling is Fatality Analysis Reporting System (FARS) data that reveals that two out of three fatalities associated with ambulance collisions were either occupants of other vehicles or pedestrians. Conventional practices related to “running hot” (i.e., using lights and sirens) are being increasingly challenged and proven practices have not yet emerged.

The state and territorial EMS offices do not have a roadmap for how best to move towards unified and effective practices related first to the safety of EMS personnel responding to, operating at the scene of, or transporting patients from roadway incidents and secondly to the critical difference that can be made in patient outcomes when an emergency care system functions in an optimal manner. A national strategic highway safety plan will provide an important opportunity to partner within and between states and nationally across disciplines in an unprecedented way.

THE STAR OF LIFE and EMS STRATEGIES

NHTSA was responsible for the blue "Star of Life" emergency medical care symbol, adopted and registered as a certification mark in accordance with the Office of the Secretary of Transportation’s Memorandum of September 26, 1972. NHTSA has continued to maintain this certification mark, and states and territories use this symbol to make ambulances, EMS personnel, and other EMS system components visible and recognizable to the public. Each of the phases represented by the six bars of the Star of Life continues to provide an effective framework for organizing strategies to reduce motor vehicle collision traumatic death and disability.



DETECTION SYSTEMS

The first people on the scene, usually untrained civilians or those involved in the incident, observe the scene, understand the problem, identify the dangers to themselves and the others, and take appropriate measures to ensure their safety on the scene (environmental, electricity, chemicals, radiation, etc.). Automated systems for crash detection and notification are also emerging as detection resources.

Telematics Data Definitions and Transmission Standards. OnStar, ATX, and other manufacturer and service delivery organizations have made it possible to electronically transmit data describing the crash severity to emergency call centers. No standard data dictionary and .xml schema for use by telematics devices manufacturers exists, hampering the transmission of crash specific severity indicators to and through 9-1-1 centers in a seamless fashion.

Advanced Automatic Collision Notification. The urgency algorithm calculates the probability of severe injury using vehicle telematics data. This information can be augmented after voice contact with vehicle occupants is established, allowing for even greater precision. In 2008, CDC published *Expert Panel Recommendations: Advanced Automatic Collision Notification and Triage of the Injured Patient*. While CDC and NHTSA continue to collaborate on the Advanced Automatic Collision Notification (AACN) refinements, real-time communications of AACN information to emergency medical personnel, EDs, and trauma centers processed through a consistent nationwide algorithm to yield probability of severe injury predictions is not in place throughout the

United States. There is an opportunity to develop a consistent national AACN algorithm, to develop methods of communicating the information in a user-friendly fashion to and through Public Safety Answering Points, and to provide pertinent education of PSAP, emergency medical, rescue and medical personnel.

AACN Predictors for the Need for Vehicle Extrication. Vehicle extrication (the use of motor-driven hydraulic tools to cut cars away from patients) is not always provided by the ambulance that will transport the patient, and may not be automatically dispatched to vehicle crashes where that skill and tool set is needed. An opportunity exists to determine which current and potential future telematics data offer reliable indicators for the need for extrication capabilities at the scene.

9-1-1 ACCESS AND CAPABILITIES

The call for professional help is made, ideally with the first device the caller attempts to use, and a 9-1-1 dispatcher is connected with the victims.

Enhanced 9-1-1 and Phase II Compliance. Enhanced 9-1-1 allows a dispatcher to identify the address of a caller when the 9-1-1 call is placed using a conventional wireline telephone. Of greater relevance to a mobile and wireless society is FCC Phase II compliance which allows the 9-1-1 center to narrow down a caller's geographic location to within 300 meters. Adequate wireless coverage and Phase II compliance in all 9-1-1 centers is crucial to the ability for motor vehicle crash victims and passersby to be able to notify authorities that a crash has occurred.

Next Generation 9-1-1. The ability to receive, process, and manage information through a 9-1-1 center that originates from other than a wireline or wireless telephone audio connection (such as text messages) and data that can be transmitted across wireless or internet-based systems (images, videos, etc.) does not exist in 9-1-1 centers today. In addition to the technology solutions necessary to equip those centers to handle this information, policy issues abound that must be resolved in order to best utilize these data and turn them into actionable information for emergency response personnel.

EMS RESPONSE AND CAPACITY

Most states regulate local EMS agencies to assure that minimum requirements are met or exceeded. These regulatory standards commonly address patient care equipment carried, radio communications capabilities, medical director requirements, etc. The requirements for educational preparation of EMS personnel are also governed by states.

National EMS Scope of Practice Model and National EMS Education Standards. NHTSA has historically published the educational curricula used to prepare EMS personnel, including emergency medical technicians and paramedics, for use by states and educational institutions. The construct has changed in recent years where the scope of practice (skill sets, delineating devices, medications, and medical interventions) is separated from the National EMS Education Standards. States are in varying stages of adoption of these new standards. Widespread adoption in a manner

consistent with the national standards is necessary for the delivery of contemporary clinical practice in the prehospital setting.

Vehicle Extrication Education and Competency Standards. Beginning in 1994, the National Standard Curriculum for emergency medical technicians no longer included a module on vehicle extrication. As a result, course content, length, devices used and psychomotor skill content has evolved differently as the private sector and discipline specific sectors moved to fill the void left by the removal of this national standard.

Regionalization of Emergency Care. The Institute of Medicine of the National Academies in its report "The Future of Emergency Care in the US Health System" has called for regionalization of emergency care. A regionalized approach to deployment and integration of EMS personnel, equipment, agencies, and the hospitals to which they transport patients is expected to benefit trauma victims through the most expeditious and effective use of resources, transportation, and destination decision making.

Integrated Ambulance-Based Safety Systems. In what would be a crosscutting strategy if ambulances were regulated like large trucks, the availability of collision avoidance and other safety systems is critical. Crash avoidance and means of reducing crash severity can mitigate the hazard that ambulances pose on the rest of the traveling public. Currently the use of such systems is limited and the installation and use of driver monitoring and feedback systems in ambulances has to date been mandated by only one state.

IntelliDrive for Emergency Response Vehicles. Currently only century-old "vehicle to human" means of an ambulance or other emergency medical vehicle communicating its presence and operation in an emergency mode is in place today through flashing lights and sirens. "Vehicle to vehicle" (V2V) interaction would assist drivers of other vehicles in the vicinity of an ambulance seeking priority access to and use of lanes. One example of "Vehicle to infrastructure" (V2I) in use for EMS systems is signal priority, but other benefits of V2I could be realized for the EMS agency and patients.

Evidence-based Emergency Vehicle Operations Standards. Training and operational standards for emergency vehicle driving are not consistent across the nation. NHTSA first developed an Emergency Vehicle Operations Course in 1978 but has not been updated since 1995. Other programs are in use, often the result of local or discipline-specific (e.g., fire department) development and implementation. In addition to the absence of contemporary standardized training, no evidence-based model exists for what "mode" of operation (lights and sirens) should be used by ambulances and other EMS vehicles when dispatched and responding to a scene or when transporting patients to a helicopter landing zone or hospital.

ON SCENE MEDICAL CARE

Rescuers provide emergency medical care and stabilization in accordance with the scope of practice sanctioned by their state and medical director under a license to practice issued by the state or territory.

Field Triage Decision Scheme: The National Trauma Triage Protocol. Protocols are a common method used by EMS systems to convey the expectations of the system medical director and standardize practices to conform to best medical science. Despite publication by the Centers for Disease Control and Prevention, the National Trauma Triage Protocol has not been universally adopted. Some states lack the authority to impose mandatory protocols on local systems.

The National Unified Goal for Traffic Incident Management. Emergency response at motor vehicle crash scenes are by definition multidisciplinary. A serious single vehicle crash may be attended to by as many as six organizations: law enforcement, fire suppression, one or more EMS agencies, rescue or vehicle extrication organizations (if not provided by EMS, police or fire), roadway maintenance, and towing. An organized approach among and between these organizations for crucial practices related to scene safety, crime scene prevention, interagency communications, and the necessary training to assure competency is not in place throughout the nation. An organized and safe scene enhances the expediency of patient stabilization and transportation.

PATIENT TRANSPORTATION PARADIGMS

The EMS personnel make a decision about how to transport the patient to a hospital (usually via an ambulance or helicopter) for specialized care. EMS personnel continue to provide medical care during transportation.

Engineering and Design Standards for Ambulances. The patient care compartment, which is the large “box” on the chassis of an ambulance, is a design that has evolved over time with little or no benefit from automotive design engineers and without any scientific safety standards to reduced death and severe injury in the event of a crash. The only compartment of an ambulance subject to the Federal Motor Vehicle Safety Standards is the “cab”, where the driver and a front seat passenger ride. Concerns have mounted nationally over the frequency and severity of crashes involving ambulances, and the design has been called into question by leading authorities, including the establishment of a TRB subcommittee on ambulance safety.

Helicopter EMS Utilization Criteria. Like protocol and scene management scenarios mentioned previously, helicopter utilization for the rapid transportation of seriously injured patients is a widespread but non-standardized practice throughout the country. Decision criteria vary based on local medical director’s preferences, helicopter EMS agency policy, closest receiving facility prohibitions, and the degree to which the state regulates the decision to use helicopter EMS, either in statewide protocols or other rules. The frequency of helicopter crashes associated with EMS response and patient transportation is also a major concern.

Ground Ambulance Access to Intelligent Transportation Systems (ITS) Infrastructure. The evolution of road condition reporting, remote weather information systems, dynamic message signs, and other ITS applications has not been exploited for EMS agency and specifically transporting ambulances' use. Ambulances with patients as cargo regularly cross county and other geopolitical boundaries, often taking them out of the range of their home 9-1-1 system. This leaves the ambulance crew vulnerable to the absence of information about road hazards or closures, worsening or improving weather conditions that may drive rendezvous or helicopter use decisions, and other information that could contribute to the crew and patient's safety and judicious route planning and resource utilization.

DEFINITIVE CARE: HOSPITAL AND SPECIALITY CARE INFRASTRUCTURE

Common practices include selection of the closest appropriate hospital based on the patient's clinical needs. Many states have implemented trauma systems, including facility designation, to stratify the hospital capabilities and routing of patients based on those capabilities.

Trauma Systems. Trauma systems are not in place throughout the United States, and maps published by the CDC indicate that only 8% of the land and nearly 57% of the population of the United States is within a one hour drive of a Level I or Level II trauma center. While these figures increase to nearly 29% and 83% when helicopter availability is assumed, there are still thousands of miles of roadways outside of this range, leaving patients at risk for delay reaching definitive care and risking preventable death. A comprehensive and state regulated trauma system minimizes these risks by organizing resources and providing standards for care and transportation, including interfacility transports, to help assure optimal patient outcomes.

Prehospital and Interfacility Telemedicine Applications. With the advent of paramedics in the United States in the 1970s, radio communications with a physician in the receiving hospital was determined to be a critical system capability. Many of these original systems are still in place, as well as other devices (e.g., wireless telephones) making communications possible to enable physician guidance to prehospital EMS providers about patient care, transportation, and destination determination. A limited number of devices are now commercially available to facilitate more dynamic information exchange between the field and the hospital, especially those that monitor and transmit patient vital signs, and those that transmit video images to the receiving hospital. Promising practices have been implemented in southern Arizona through a "telepresence and teletrauma" allowing for video/audio and file image exchange between rural hospitals and a trauma center. In addition to facilitating clinically appropriate transfer decisions, this type of system also allows for more robust consultation between a traumatologist and a physician of any specialty working in a rural emergency department.

CROSSCUTTING STRATEGY:
EMS Data, Registries, and Records Linkage

National EMS Information System

The National Emergency Medical Services Information System (NEMSIS) is the national recognized EMS data repository that will be used to store EMS data from every state in the nation. Since the 1970s, the need for EMS information systems and databases has been well established through state EMS office regulation, and many statewide data systems have been created. However, these legacy EMS systems vary in their ability to collect patient and systems data and allow analysis at a local, state, and national level. The NEMSIS database currently includes fully compliant data from 25 contributing states with 7.6 million records of EMS events, including motor vehicle crash victims and pedestrians struck by motor vehicles. This number will increase substantially as seven additional states provide data by the end of 2010.

The NEMSIS 2008 Public Research Dataset was provided to NHTSA in July 2009. The data aggregation process ensures that the National EMS Database is rebuilt with every submission of data and ready for release to the National Center for Statistics and Analysis (NCSA) at their request. Currently, the database could be transferred to NCSA with only a few days notice.

NEMSIS Version 2.2.1 compliance testing for EMS software products was completed in November 2009 and at the end of 2009, 49 EMS software programs have passed compliance testing as gold products (i.e., containing all NHTSA 2.2.1 variables) and a 42 software programs are now certified as NHTSA 2.2.1 compliant at the silver level (i.e., containing at least the National NHTSA 2.2.1 variables). Thus, a total of 81 products have been evaluated and listed as complaint with the NHTSA 2.2.1 standard. The next version of the NEMSIS data standard, Version 3, is being finalized. In addition to resolving limitations in the version 2.2.1 standard, Version 3 introduces several aggressive efforts to improve the consistency of EMS data systems, including a standard web services specification for transmitting data between systems, a technology for encoding business rules, and inclusion of NEMSIS into the HL7 family of health data standards.

The NEMSIS EMS dataset and standards were developed to help states collect more standardized elements and eventually submit the data to a national EMS database. The development of the NEMSIS EMS Data Collection Standard focuses on achieving the following goals:

- Evaluating patient and EMS system outcomes
- Facilitating research efforts
- Developing nationwide EMS training curricula
- Determining national fee schedules and reimbursement rates for EMS
- Addressing resources for disaster and domestic preparedness

- Providing a standardized and uniform EMS dataset and file structure for data linkage with other EMS related data sets such as trauma registries
- Providing valuable information on other issues or areas of need related to EMS care

States, local agencies, and software vendors will work on implementing the NEMSIS Version 3 Standard over the next several years. Standardized data can be shared and analyzed at the local, regional, state and national levels to ensure EMS and other stakeholders have information and quality data to continue to evaluate the EMS system responses to roadway crashes and continued to move "Toward Zero Deaths".

Trauma Registries as a Reliable Source for Severe Injury Data

Methods for measuring "severe injury" exist and are widely accepted in the medical community. Peer-reviewed research has further established a correlation between patients' injury severity scores, multiple organ failure, and death, and evaluate outcomes based on injury severity. Currently, over 75% of states have a system in place to gather trauma-related data in trauma registries. Most states have already adopted or are presently refining the data collection efforts of their registries to become compliant with the National Trauma Data Standard (NTDS) as defined by the American College of Surgeons Committee on Trauma. The benefit of standardized data collection allows for improved analysis of trauma procedures and patient care, as well as comparison of data across state boundaries as data is aggregated into the National Trauma Data Bank (NTDB). Analysis of trauma registry data allows for data driven decision making, establishment of outcome measures, and the monitoring of trauma system performance.

Several states have utilized their trauma registry data to conduct 'preventable mortality' studies. Preventable mortality studies are different than injury prevention activities in that they assess the care provided by medical staff in the field and hospital setting to the injured patient. Preventable mortality studies are valuable for assessing emergency medical services resource utilization and identifying opportunities for improvement in care within the emergency medical services system.

Records Linkage

States maintain disparate systems that collect crash, law enforcement, injury, ambulance, and hospital data. In many states the records contained in those systems have not been linked or integrated. As EMS data collection systems continue to standardized datasets and file exchange formats, using the data for linkage with other healthcare datasets such as trauma registries, hospital inpatient discharge data (HIDD), other sources of hospital outcome data and Crash Outcome Data Evaluation Systems (CODES) will continue to progress.

Currently no national standard variables have been established to enable linkage of crash related records. Standard linkage variables would assist with the design of state level linkage protocols. Having deterministic linkage capabilities would serve as one means for complete evaluation of numerous "Toward Zero Deaths" strategies. The

systems contain a wealth of information that could be used to reduce traffic-related deaths, but the lack of integration makes it difficult to see all aspects of a traffic crash in a single picture. The outcome information contained in the medical records is especially critical for evaluating the effectiveness of highway death prevention efforts. A number of states are using Highway Safety Section 408 funding to work on linking records across databases.

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