MODEL TRAUMA CARE SYSTEM PLAN

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PREFACE

In November of 1990 the Congress passed the Trauma Care Systems Planning and Development Act (P.L. 101-590), which amended the Public Health Service Act by adding Title XII -Trauma Programs. This legislation specifically requires development of a Model Trauma Care Systems Plan that States may use as a guide in the development of a comprehensive trauma plan as part of their statewide Emergency Medical Services plan.

To accomplish this work, the Bureau of Health Resources Development (BHRD), Health Resources and Services Administration, U.S. Public Health Service assembled a group of expert consultants experienced in trauma care systems and the delivery of trauma services to develop the first draft of this model plan. The following individuals were instrumental in the development and revision of the original draft of the Model Trauma Care Systems Plan:

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The draft plan was distributed to State Emergency Medical Services Directors and a variety of professional health care organizations for review and comment. The revision process incorporated comments received in writing and points highlighted by participants at a Model Trauma Care System Plan Development meeting (Appendix B). This final draft will be submitted to the Advisory Council on Trauma Care Systems (to be established by the Secretary of Health and Human Services) for final review and approval of the document.

We sincerely appreciate the assistance of every individual who contributed to the creation of a comprehensive Model Trauma Care System Plan.

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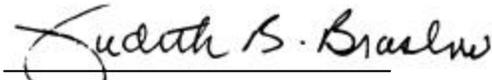
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INTRODUCTION

Trauma is a serious public health problem. Traumatic injury, both accidental and intentional, is the leading cause of death in the first four decades of life. Trauma has no respect for age, and frequently causes profound loss of function for the persons involved. Each year, more than 140,000 Americans die and approximately 80,000 sustain long term disability as a result of injury (1). Despite this magnitude, most injuries are not accidental; trauma is largely predictable and preventable. Trauma typically involves young adults and results in the loss of more productive work years than both cancer and heart disease combined. Health care costs, in addition to the loss of productivity, accounts for 100 billion dollars annually. The emotional costs are immeasurable.
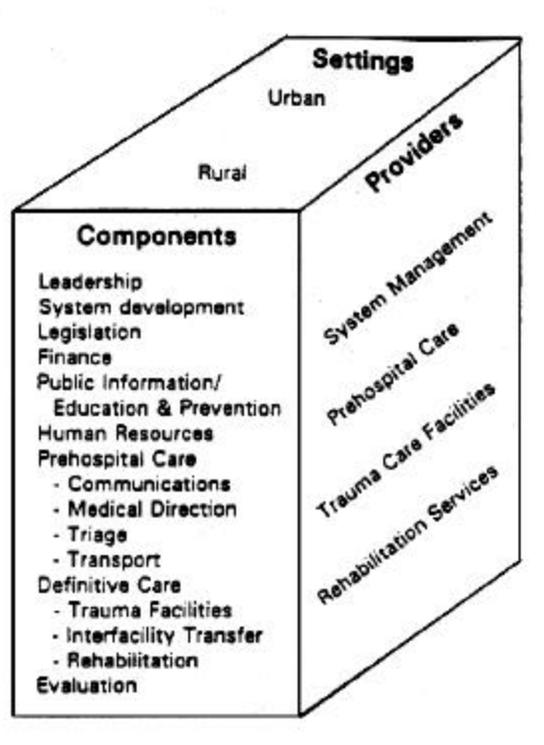
Injury was one of man's earliest recognized afflictions, and yet as civilization has progressed, systems of care for the injured have not kept pace in terms of mortality, morbidity and lost productivity. The efficacy of trauma systems in reducing preventable deaths and improving patient outcomes has been clearly established (2-8). However, in many regions of the country the growth of trauma systems is slow, or non-existent. Equally frustrating, in the face of continued evidence supporting trauma system effectiveness, many existing trauma centers have closed due to a myriad of political and economic factors (9).

In an effort to revitalize trauma system development efforts and abate the erosion of existing systems, Congress passed the Trauma Care Systems Planning and Development Act of 1990 (10). This Act amended the Public Health Service Act by adding a Title XII - Trauma Programs. This legislation underscores the recognition of injury as a public health problem and specifically requires the development of a Model Trauma Care System Plan which States may use as a reference guide in the development of a comprehensive trauma care system plan as part of the statewide Emergency Medical Services (EMS) plan.

The Model Trauma Care System Plan that follows provides a framework for States to use as a template; it supports the development of a plan that will be tailored to meet the unique needs of the individual State or territory. This plan identifies the mandatory components of a system that is designed to meet the needs of <u>all</u> injured patients who require care in an acute care facility (Figure 1). Implementation of a trauma care system plan that includes these components must incorporate all levels of providers as well as the unique aspects of the setting in which the components are established.

The Model Trauma Care System Plan reflects the concept of an inclusive trauma care system in which every health care provider or facility with resources to care for the injured patient is incorporated. Input from each of the key participants at each stage of trauma system decision making is essential to establishing a workable system. Effective trauma systems require clear integration of all components in each phase of care and draw upon the capacity of health care providers to reduce mortality and disability regardless of the severity of the injury involved.

FIGURE 1

Settings
Urban
Rural

Providers

Components

Leadership
System development
Legislation
Finance
Public Information/
  Education & Prevention
Human Resources
Prehospital Care
  - Communications
  - Medical Direction
  - Triage
  - Transport
Definitive Care
  - Trauma Facilities
  - Interfacility Transfer
  - Rehabilitation
Evaluation

System Management
Prehospital Care
Trauma Care Facilities
Rehabilitation Services

This model was adapted from the American College of Emergency
Physicians, "Guidelines for Trauma Care Systems"

Most of the existing regional trauma systems are "exclusive" in nature; they are driven by the major (severely injured) trauma patient who requires immediate treatment at a designated trauma center. An inclusive trauma care system will not only incorporate provisions for designated trauma centers to care for the most severely injured patients, but also recognizes the importance of other acute care facilities within a trauma system in caring for the majority of less severely injured. The range of injury severity risk and extent of actual injury occurs along a spectrum of minor to severe injury, and the resources needed to provide optimal care for these patients must also exist along the same spectrum (Figure 2). The goal of an inclusive trauma care system is to match each trauma care facility's (or provider's) resources to the needs of injured patients so that every patient receives optimal care from the initial recognition of the injury through return to the community.

FIGURE 2

SCOPE OF TRAUMA CARE SYSTEM
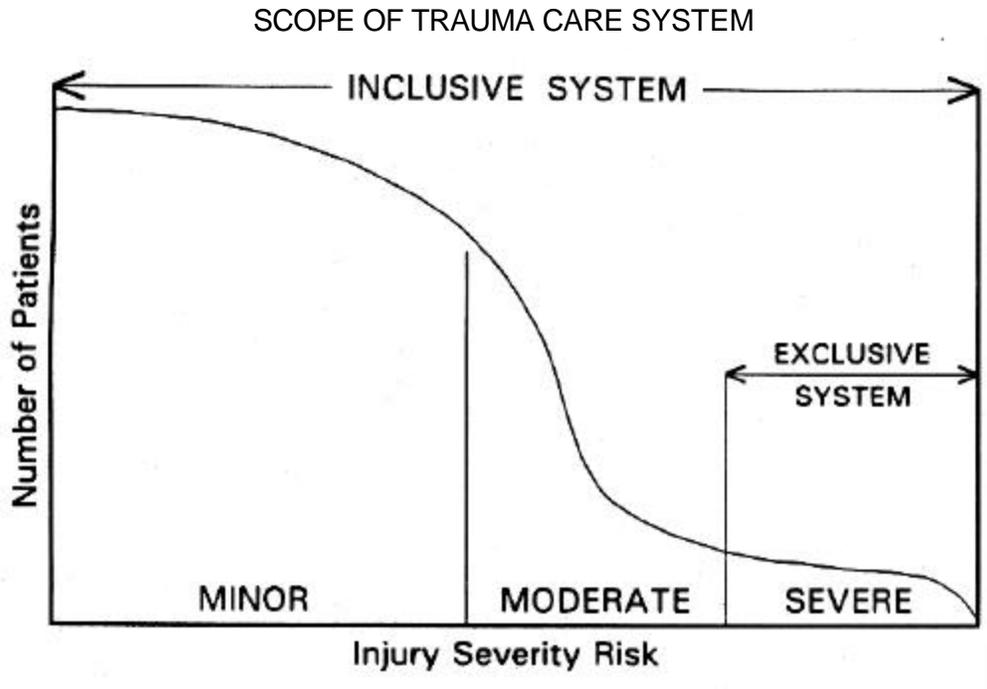
Each section of the Model Trauma Care System Plan highlights a component of a trauma care system that by design either provides or facilitates the delivery of optimal trauma patient care. At the "central core" of any trauma system are clinical or operational components which must be established in order to provide direct patient care once an injury has occurred (central area, Figure 3). A regional trauma system consists of hospitals, personnel and public service agencies that have a pre-planned response to caring for injured patients. This requires the use of coordinated communication mechanisms, accurate identification of the level of care needed by an injured patient, rapid transport to the appropriate care facility and integration of support and rehabilitative services designed to return the patient in a productive way back to the community.

The inner ring of a trauma system represents those components which facilitate direct patient care including prevention, training and evaluation. Prevention activities are geared at reducing the actual incidence or severity of injury itself, and ultimately remain the most cost effective activities within this realm. Once an injury occurs, optimal care necessitates that adequate numbers of

FIGURE 3

COMPONENTS OF AN INCLUSIVE TRAUMA CARE SYSTEM
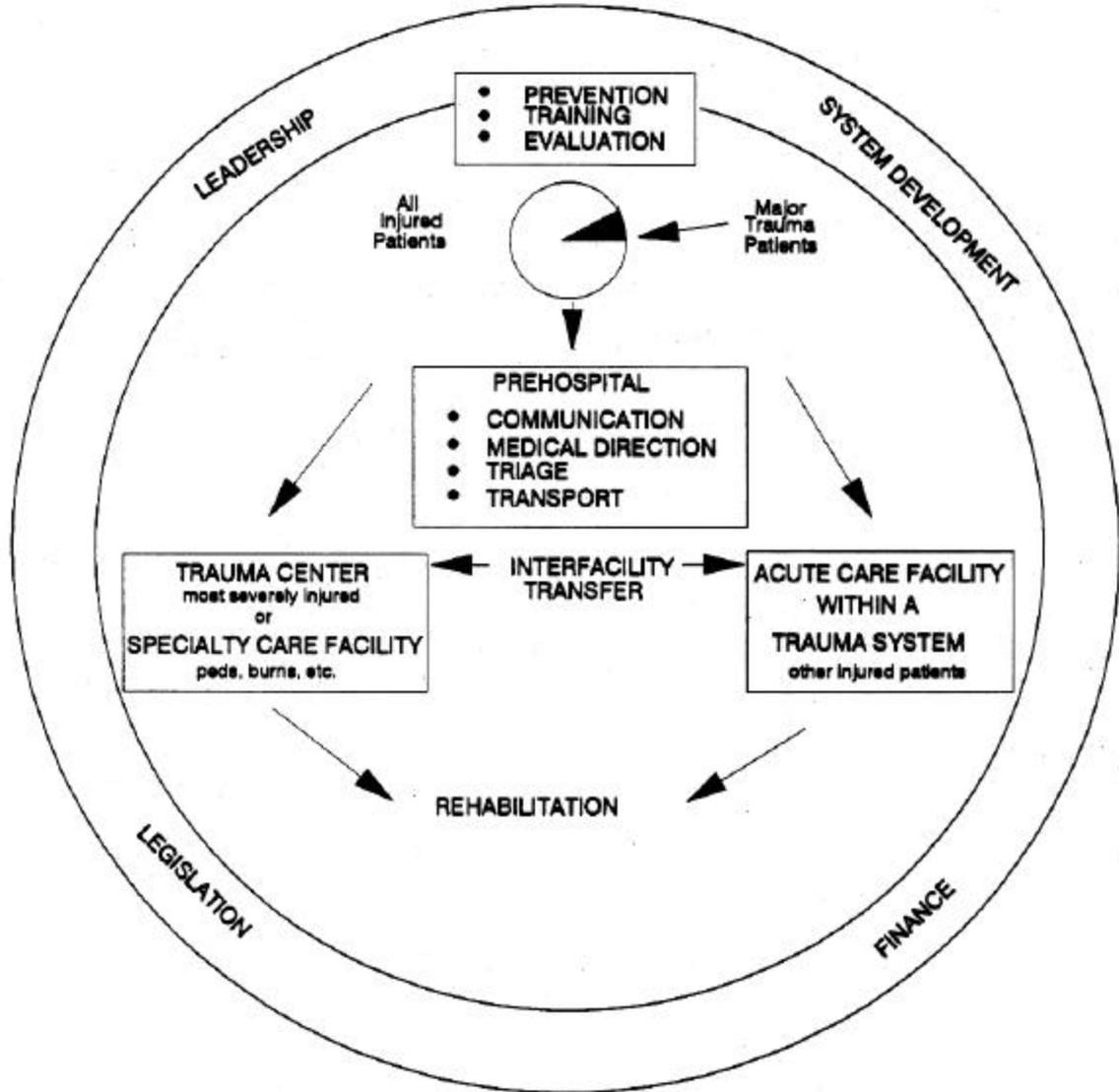
*   The components in this model are based on the components
    described in several trauma care resources (11-17). The model
    was adapted from Trauma Care Systems, a position paper from
    the Third National Injury Control Conference, "Setting the
    National Agenda for Injury Control in the 1990's", pg. 388.

specially trained trauma care personnel are available to provide care from access of the system to the delivery of rehabilitative services. Evaluation procedures are critical to identify ways to continuously improve the care given to trauma patients as well as the system in which care is delivered.

Finally, the administrative components of a trauma system comprise the framework within which care is given and which also promote continual development of the system. These components consist of the leadership authority responsible for system oversight, the mechanism of continual planning and development of the system, the legislation that establishes a system and authorizes both responsibility and funding, and the quantification of trauma system finances. These components form an outer sphere of stability that is vital for the continuation of activities directly related to patient care.

A trauma care system <u>must</u> be distinctly integrated into the overall EMS system, and a trauma care system plan must incorporate the use of existing EMS resources, including those for special populations (18-22). Integration prevents duplication of services and resources, maximizes efficiency and hence should reduce overall costs. Inherently, there is a great need for cooperation between States/regions that supersedes geographic boundaries in order to meet the needs of any injured patient regardless of where the injury occurred. Joint powers, or similar agreements with various geopolitical districts are desirable, especially near State boundaries. Special effort or initiatives may be required to provide access to trauma care services for groups such as Native American Indians, Alaska Natives, religious communities or farm workers. The trauma care system plan must be flexible enough to incorporate the unique needs of each region and its population. Although issues raised during trauma care system implementation are often political in nature, all parties can easily form an alliance towards a common goal: to provide the optimal level of care for injured persons in a community.

A trauma care system plan must also include provisions for the diverse needs of the population in regards to the type of environment served as well as any special patient populations. Rural trauma care environments pose logistical problems for care with long distances, difficult access and limited financial as well as professional resources. In contrast, urban care environments are shaped by large population densities within limited geographic spaces and providers are confronted with a volume of trauma patients that can often overwhelm the prehospital and hospital resources committed to delivering care. Each component of a trauma system plan <u>must</u> contain specific provisions for the care of specialty patient populations. The needs of specialty patient populations such as pediatric patients or burn patients must be considered in order to facilitate the use of concentrated resources and expertise in centers devoted to meet the unique assessment and treatment needs of these special groups. For example, development of a trauma care system plan should reflect collaborative input from centers of excellence in pediatric trauma care (e.g. EMS-C programs) and burn care (e.g. regional burn centers) where these are available.

USE OF THE MODEL TRAUMA CARE SYSTEM PLAN

The Model Trauma Care System Plan is divided into sections that reflect the essential components of an inclusive trauma care system. Each section highlights a single component or related set of components, and the objectives to be met in creating a trauma care system plan. Essential elements of each component are displayed in tabular format so that the reader can quickly review this information. The discussion segment offers detailed information related to implementing these objectives and identifies issues to be addressed in developing a trauma care system plan. Key concepts or activities are underlined in the discussion text to underscore their importance and summarize essential material. Appendix A consolidates the tabular components of each section for easy reference in the identification of necessary objectives in a trauma care system plan.

As each State trauma care system plan must reflect the dynamic nature of traumatic injury with deliberate plans for continual revision and adaptation, so must the Model Trauma Care System Plan be considered in itself a fluid document which will be continually revised as new components, or criteria need to be incorporated. The success of any trauma plan and resultant system depends on the ability to ensure that each injured patient will receive timely access to resources and optimal care which will enable the patient to expeditiously return to the community as a productive member.

ADMINISTRATIVE COMPONENTS

I.   LEADERSHIP

By State, Regional and/or Local Area[1]:

Lead Agency
- Define and describe role and responsibility of the authority that will take a leadership role in trauma system development (cite statutory, regulatory or policy provisions of authority)
- Provide organizational chart, with short narrative description of duties within the authority and showing relationship to other EMS agency components
- Identify medical and other health care leaders from public and private sectors to assist with trauma system development
- Develop a plan for linkage between trauma system components and the local organ procurement organization

Trauma System Committee
- Define and describe the composition, role, responsibility, and authority for Trauma System Committee
- Display in organizational chart

Interdisciplinary Medical Review Committee
- Define and describe role, responsibility, and authority for the Medical Director and Interdisciplinary Medical Review Committee
- Display in organizational chart

DISCUSSION

The development of a trauma system is best accomplished through the designation of a lead agency to organize the development of the system, coordinate both EMS and trauma resources, seek input from key participants at each stage of development and negotiate workable policies. The lead agency must integrate prehospital, hospital and all other system components while being responsive to the

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[1]As appropriate to individual States, the trauma care system plan should include provisions for each level of organization within the system.

needs of both the providers and the public. This lead agency is usually placed within a governmental entity, such as the State EMS agency or another existing health agency within the State, and must possess the authority, responsibility and resources required by this broad role. The organization of trauma care activities within a given State government has a number of implications, not the least of which is how the EMS regulatory process relates to that of the overall health care system. Special efforts should be made to ensure consistency in policy as conflicts resulting from lack of coordination and understanding of responsibilities can undermine the implementation of a trauma care system.

The State lead agency, working with medical and professional societies, is ultimately responsible for coordinating system design, as well as establishing the minimum standards for system performance and patient care. Implementation of the trauma care system plan may take place in particular areas under the direction of a regional or local lead agency; in these cases the minimum standards established by the State lead agency must be met or exceeded. The State lead agency is also responsible for integrating the trauma system and the EMS system (23), and ensuring cooperation between contiguous State or regional level agencies to fully meet public health needs in spite of geographic boundaries.

Regulatory authority may be needed to establish some components of the trauma system and the lead agency must possess, or have access to the legal authority to implement the system. The establishment of authority for the lead agency often requires that enabling legislation precede or be developed concurrently with trauma system planning (see Legislative components, p 11). Through legislation, the lead agency may also be granted the authority to regionalize care, and to designate trauma centers. In States where the designation authority and planning responsibility reside in the same agency, the development process is often simplified.

Medical and surgical participation is critical to trauma system planning and key physician groups should participate in trauma system planning to ensure that the final system reflects the availability of specialty physicians and the hospitals best prepared for the care of injured patients. These groups must assess the impact of trauma system implementation on the existing levels of professional resources within the community, and plan for future resource development. Communities with limited physician specialists (such as neurosurgeons or orthopedic surgeons) must develop creative solutions to ensure the continual availability of these resources in that community.

The lead agency should work closely with Level I facilities to ensure integration of system leadership activities. The role of the lead agency is to coordinate input from all affected parties in establishing a framework for trauma system development to ensure that the system is responsive to the needs of all injured persons and to establish realistic timeframes for system planning and implementation. The lead agency can also be charged with adopting trauma standards, implementing triage guidelines, designating trauma facilities, determining the number and location of designated trauma centers, establishing data collection systems, and evaluating system performance. The lead agency should also ensure that linkages are established between the trauma care system and the local

organ procurement organization. Protocols should be developed to maximize integration of trauma system components with the organ procurement organization, transplant centers, and donor hospitals.

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The key to successful administration will be the ability of the lead agency to build a trauma system based on available resources, provider and community commitment, and ongoing evaluation. Consideration should be given to how existing resources can be incorporated into the system and what modifications will improve their usefulness. It is critical to actively involve stakeholders in the planning process. The lead agency should organize a Trauma System Committee, composed of prehospital and hospital providers from all levels of trauma care system participants, to guide system planning activities. The Trauma System Committee is best composed of a multidisciplinary group of providers and consumers (including previous trauma patients and their families where possible) whose interest and expertise can facilitate the development of the statewide trauma system. This committee will assist in defining system criteria, establishing system standards and reviewing system performance.

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Incorporated into the lead agency function is the identification of a Medical Director to ensure medical accountability, act as a trauma system advocate, and provide for medical credibility throughout system development. The EMS Medical Director (see EMS Medical Direction component, p 24) can fulfill this role, or an additional position may be established with specific responsibilities for the trauma care system. This director should be assisted by an Interdisciplinary Medical Review Committee that links medical, nursing and other health care provider protocols to the needs of the injured and changes in technology, ensures integration of the trauma patient care policies and the EMS system, evaluates the trauma system and recommends changes. The composition of the Interdisciplinary Medical Review Committee should include representation from all medical and nursing specialties, and all categories of hospitals in the system that provide services for injured patients along the spectrum of trauma care.

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II.   SYSTEM DEVELOPMENT

By State, Regional and/or Local area:

Trauma System Planning
- Describe the process for needs assessment and identification of appropriate resources
- Describe the process for development and implementation of the trauma care plan, and the systematic review of the plan
- Describe how professional and consumer groups will participate in the trauma system planning process
- Describe the format for trauma plan implementation and approval: objectives, proposed action plan and implementation schedule
- Describe the process for establishing and implementing guidelines and standards for trauma care

Trauma System Operations
- Describe how the trauma system components are integrated with the EMS system components
- Describe the process for establishing, implementing and maintaining policies, procedures, and protocols for trauma care within the EMS system
- Describe how the trauma system components are integrated with other systems such as regional or Federal agencies (e.g. National Park Service, military bases), Native American Indian lands and contiguous States

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DISCUSSION

The planning process for trauma system development often begins with a comprehensive needs assessment to: a) determine the magnitude of "injury" as a problem within the State/community; b) document the levels of current resources; and c) determine those resources needed for optimal system performance.

The establishment of a complete and accurate trauma patient data base is essential for future planning. Analysis of such data often includes aggregating the percentage of the population involved in moderate, major or fatal injury incidents, analyzing distribution patterns of injury incident sites, studying the number of deaths due to injury measured against those determined to be preventable or potentially preventable, and estimating the impact of traumatic injuries on long term disability for survivors and their use of community resources.

Resource assessment involves collection of statewide data to identify the current capabilities, levels of distribution and utilization of resources such as communication systems, ground and air ambulances, acute care and specialty care facilities, as well as both prehospital and hospital personnel. An assessment of the current status of trauma care, including resources and personnel, enables system planners to identify areas of potential deficiency and determine possible resolutions to be included in the statewide trauma care system plan. The volume and distribution of the injured can then be matched with the appropriate resources.

Overall development of a trauma care system plan involves setting realistic timeframes for implementation of each component, as well as establishing an orderly system for review of the planning process itself. Steps in the implementation process include: system design, development of policies for EMS system integration, adoption of current guidelines and standards for trauma care, solicitation of proposals from facilities seeking designation, and establishment of data collection processes necessary for effective system evaluation. <u>The sequence of plan development must reflect the unique needs of the region and more emphasis may be placed on specific components of the plan as directed by the initial needs assessment</u>.

The lead agency will manage the planning process but successful implementation depends on involving all trauma system participants in this process. Trauma systems have the greatest potential to succeed if the environment is a cooperative one in which there is a partnership among all providers. It is important to build a constituency of hospital, medical, nursing and other health professionals to identify ways that the health care community can support trauma system development, participate in prevention activities and facilitate community awareness of injury. Another asset to the planning process is the establishment of a community coalition of consumer groups and networks already in place (such as Mothers Against Drunk Driving and the American Red Cross) that can assist in the support and development of the trauma system. This coalition can improve community understanding of injury, support legislative initiatives, assist with fund raising efforts, promote injury prevention and encourage trauma research.

Adoption or development of appropriate trauma care guidelines and system standards is essential to an effective trauma care system. Nationally recognized trauma care guidelines and standards can provide a reference from which to begin planning a system and can help define criteria for individual components of the trauma system (16,17,24-28).

<u>The effectiveness of the trauma care system depends on its integration with the EMS system, and any relevant subcomponents (i.e. EMS-C systems where they have been developed). Often times, the development of the trauma system will serve as a catalyst for growth within an EMS system itself</u>. Planning for trauma system implementation requires consideration of the additional responsibilities the trauma care system will place on the existing EMS components such as prehospital personnel, communication networks and referral hospitals. Special agreements may be necessary to ensure a consistent level of trauma care services for persons who are injured on territories or areas outside State jurisdiction.

III.   LEGISLATION

By State, Regional and/or Local area:

Legislative Activities
- Establish authority for lead agency
- Identify key provisions to be included in trauma system legislation
- Ensure authorization for allocation of sufficient resources to cover cost of trauma system administration and operations
- Identify potential funding sources for unreimbursed trauma care

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DISCUSSION

Trauma system development often begins with comprehensive legislation which addresses at a minimum the responsibility and authority necessary for implementation of the trauma system. System planning may take place without formal authority; however effective implementation and regulation may be impossible to achieve in this instance. Legislation should establish the public lead agency as the organization with the responsibility to plan, develop, implement and maintain an effective trauma care system. This legislation should reflect an inclusive system model which incorporates the needs of all injured patients that require care in acute care facilities and provides for a continuum of services. The statutes (or administrative rule) created by trauma legislation should be broad based and allow the regulatory process to further refine and develop trauma care system specifics.

Key provisions outlined in trauma system legislation may include: development of a comprehensive trauma system plan, integration of trauma and EMS systems, development of a comprehensive prevention program, establishment or adoption of standards for trauma care, organization of data collection and system evaluation, protection of access to confidential quality management program activities and authorization for dedicated sources of trauma funding (29).

To accomplish the goals of administering the system, the lead agency will need substantial support. It is important to recognize that each component of system development will require the identification of manpower and resources specifically assigned to trauma system functions. Sufficient administrative funding is a critical component of the planning process and must be considered in legislative mandates.

Legislation that authorizes dedicated trauma funds should direct placement of monies in a special account where funds are not co-mingled with other general purpose revenues, where spending is restricted to the EMS or trauma program and where interest accrues to the account. Means to acquire dedicated funds include general user fees such as telephone surcharges, taxes on cigarettes or alcohol, surcharges on motor vehicle registrations or traffic violation penalties, taxes on sales of

weapons or use permits, development of preferential payment systems for trauma patients or a trauma financing pool to reimburse designated centers for documented uncompensated care (9). Legislation should be enacted that encourages fiscal support at all levels of the system. Examples of such incentives include tort reform, reimbursement reform laws guaranteeing trauma system providers adequate reimbursement levels to cover costs and upgrade the system as needed, adjusting to optimum levels worker's compensation reimbursement for State designated trauma centers, and creating financial incentives for interfacility transfer of major trauma patients and specialty patients.

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IV.   FINANCE

By State, Regional and/or Local area:

Trauma System Administrative Costs
- Document costs associated with trauma system administration and development
  1. Management (lead agency and support committees)
  2. Data collection systems

Trauma System Provider and Facility Costs
- Develop a mechanism for documenting costs, in particular unreimbursed costs, associated with trauma system operations:
  1. Prehospital
  2. Hospital (all levels of trauma care facilities)
  3. Physician
  4. Undercompensated and Uncompensated Care

Trauma System Funding
- Identify potential funding sources to support system administration and the care provided in all levels of trauma care facilities

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DISCUSSION

An important challenge in the management of trauma systems is the documentation of the costs and benefits of a regionalized approach to trauma care. Trauma system expenses must be linked to the ultimate cost effectiveness of trauma care and demonstrated benefit to society, such as lives saved and injured persons returned to productive lifestyles. As components of the trauma system are identified and implemented, the cost may rise but the savings gained from decreasing death and disability should rise as an outcome. Constituencies must understand and accept the powerful relationship between ongoing system costs and ultimate saving to society. The lead agency that successfully demonstrates a positive cost-benefit analysis (in terms of lives saved and years productivity) can secure participant support, consumer satisfaction and, ultimately, sustain funding.

After initiation of the trauma care system plan, there will be a period of cost escalation and a need for increased operational funding which may occur before improved patient outcomes can be documented. Trauma system implementation costs include supporting the process of regional planning, designation of hospitals, managing data collection and system analysis, regulatory activities and prevention programs. To retain community support during this period it may be important to utilize related outcome studies from other trauma systems and to demonstrate careful monitoring of the incremental costs directly associated with trauma system development.

Administrative and implementation costs include supporting the process of regional planning, designation (and subsequent redesignation/de-designation) of hospitals, monitoring compliance with standards, and the aggregation and analysis of data for trauma system evaluation. Trauma system costs are often integral parts of the fiscal structure of the larger EMS system for the state, making it difficult to document those costs that truly reflect trauma system implementation. For example, communication systems and supplies may already exist in an organized EMS system; however the proposed trauma care system plan could not be implemented without this basic component.

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The provision of comprehensive trauma care requires a significant financial commitment by all trauma care providers. Prehospital costs include not only the direct expenses, but also the participant's time involved in ongoing training and continuing education necessary for trauma system implementation. The additional equipment and numbers of prehospital providers devoted to trauma care should be quantified, as well as any additional communication system enhancements necessary to fully implement the trauma plan. Regionalization often increases the use of advanced life support units and air medical services, and the increased costs may be considered part of implementation activities.

The establishment of hospital services to meet the needs of patients with multiple injuries requires a significant investment in personnel and facility resources. Trauma care facilities commit substantial resources to ensure priority access for injured patients, regardless of their ability to pay. Direct costs include dedicated medical, nursing and ancillary staff, trauma service personnel (trauma medical director, trauma nurse coordinator and support staff), specialized equipment for trauma resuscitation and exclusive trauma patient needs, dedicated operating suite time, training and continuing education requirements for all involved personnel (including physicians), trauma registry or data collection systems and quality management program activities. The costs are fully dependent on the unique physical and psychosocial needs of the trauma patient population, the requirements of the trauma system plan, and the level of trauma care that the facility intends to provide. Some programs support physician involvement in the trauma system, including trauma surgeons and/or subspecialty clinicians, by providing daily on-call fees or assuring a percentage of collections, which must also be considered when documenting total system costs.

Trauma care often represents a significant portion of the total unreimbursed care for all providers. Three major factors responsible for uncompensated costs are: (a) the high costs of trauma care, (b) the high percentage of uninsured trauma patients and (c) declining levels of reimbursement (30-32). It is estimated that the cost of admission for a trauma patient is three or more times greater than that for the average acutely ill patient. The majority of trauma patients are young, at high risk for injury, and have little or no health care insurance. Major hospital reimbursement methods such as government sponsored funding (Medicare, Medicaid) do not provide adequate coverage for the costs of delivering care to patients with multiple injuries. Trauma centers located in urban areas (usually Level I trauma centers) receive a disproportionate number of trauma patients with lower socio-economic backgrounds, decreased insurance rates, and increased unemployment rates. Drug related

violence produces a higher acuity of injury, which requires a longer hospital stay and contributes significantly to the problem for urban trauma centers.

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The State plan must include a mechanism to identify potential sources of funding and to promote legislative efforts to secure this funding. The lead agency and trauma system participants should actively support joint studies or large scale analysis of trauma care finances wherever possible. Funding for a comprehensive trauma system must be dedicated to and sufficient to cover its development, implementation, delivery of care and evaluation. Legislation should authorize dedicated revenue sources to support the EMS/trauma system (see Legislative components, p 11). Funding allocation should be a flexible process that is continually updated with changes in both the amount and distribution of funding. <u>To allow for a consensus of funding priorities by all system participants, funding distribution should be closely linked to the needs assessment and priorities set by the lead agency as it works in conjunction with the Trauma System Committee</u>. It is essential that a portion of the dedicated funds be identified for: assessing the level of support needed to sustain a trauma care system, including designated facilities; assisting the hospitals in revising their information systems to accommodate new trauma care reporting requirements; systemwide data collection and analysis, with special attention placed on documenting the cost effectiveness of the trauma system, measuring patient outcomes and supporting quality improvement of each system component.

As initial implementation costs plateau and prevention programs provide an impact that decreases the overall incidence of injury, trauma system costs continue at a rate necessary to support the continual commitment for trauma care delivery. Legislators and consumers must understand that an effective trauma care system relies heavily upon maintaining trauma care services and facilities in a constant state of readiness, thus requiring long term financial and community support.

OPERATIONAL AND CLINICAL COMPONENTS

V.   PUBLIC INFORMATION/EDUCATION AND PREVENTION

By State, Regional and/or Local Area:

Public Information And Education
- Develop a plan to heighten public awareness of injury as a public health problem, to promote injury as an entity amenable to injury control countermeasures, to explain the need for a trauma care system, to describe how the trauma care system operates and how the system can be accessed
- Establish a trauma constituency to promote trauma system awareness and prevention activities
- Develop a plan to educate elected officials and staff about trauma system issues

Prevention
- Evaluate current injury surveillance information and activities
- Assess current trauma prevention programs
- Identify additional prevention strategies needed to target high risk groups (e.g. trauma patients with alcohol or substance abuse disorders, violence prevention for youths)
- Develop a plan for implementation of comprehensive prevention activities, including provider based interventions

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DISCUSSION

Injury is a preventable public health problem and a well-planned community public information/education and prevention program is an integral part of an effective trauma system. The ultimate goal of an organized trauma system is to prevent injuries, just as the ultimate goal of medicine is to prevent disease. The trauma system lead agency and care professionals should organize a program to educate the public about the nature of injury, the typical profile of trauma patients, the <u>need</u> for a trauma system, and current trauma system development. The public information/education and prevention program should also address the need for educating the public about how to safely approach an injury scene, how to access the trauma care system, and how to provide assistance to the injured until professional help arrives. Many communities have also provided this type of information in the preface of telephone books for reference purposes.

The public information/education program should include support for and interaction with the programs implemented by organ procurement organizations intended to increase public awareness about organ and tissue donation.

The establishment of a broad based community task force with members from public and private sectors interested in trauma prevention activities can be useful in creating a systematic approach that will reduce fragmentation and intensify community efforts. Membership of the community prevention constituency includes representatives from fire and police agencies, highway safety and motor vehicle agencies, auto and health insurance agencies, State health department injury control programs, State alcohol and drug abuse agencies, youth groups, school officials, local church and civic groups, children's service agencies, professional health care organizations and acute health care facilities.

Information about injury, prevention and the need for a trauma system and trauma system development must also be shared with elected officials and legislators to gain support for trauma system regulatory activities and promote the passage of legislation aimed at reducing injury.

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Injury prevention programs should be based on a solid foundation of data related to injuries and their prevention. Existing data sources include State motor vehicle data, law enforcement accident reports, EMS data, vital statistic mortality files, medical examiner s reports, and hospital discharge data. The lead agency should also evaluate the need for a plan to strengthen injury surveillance data collection, and how the trauma system data base can be linked to other existing data sources. Hospital discharge data represent an important (and usually the only) source of population based data on serious, non-fatal injuries. Many States, however, do not require uniform hospital discharge data reporting. A trauma care system plan should support mandatory systematic reporting of E-codes (International Classification of Diseases, External Cause of Injury) in these databases, with data fields separate from those available for recording diagnoses, pre-existing medical conditions and complications. This model would provide essential information for monitoring trends and patterns of injury, for defining subgroups of the population at high risk of injury and for developing and evaluating injury prevention programs.

Information gathered during the needs assessment will provide the basis for supporting legislative efforts, documenting the need for preventative efforts, setting prevention program goals and assist in identifying resources. An assessment of current community injury prevention projects is an essential part of the planning process to ensure the coordination of community resources. The trauma system prevention plan should communicate key trauma prevention strategies, describe mechanisms to link existing programs and use outcome information from existing programs, highlight high risk groups that are not currently addressed by existing prevention programs, and organize an implementation schedule for additional prevention programs.

Three general strategies are most commonly used in injury prevention: a) persuasion programs designed to alter behavior or guide decision making for increased self protection (e.g. drunk driving campaigns, seatbelt education, water safety classes, smoke detector education, gun safety programs); b) legislation or enforcement of policies which require individuals to follow protective guidelines (e.g. motorcycle helmet law, seatbelt policy, clothing safety requirements, poison prevention packaging information, swimming pool barriers, fire and building codes, gun registration); and c) providing automatic protection by altering products or the environment (e.g. air bags, child proof packaging, smoke alarms, bullet resistant windows, bathroom grab bars, reflective clothing). Trauma system participants and community groups can collaborate to support public education, strengthen the interventions that prove effective, increase adoption and enforcement of safety legislation or policies and contribute to injury research. Trauma system consumers, or former trauma patients and their families, can offer a personalized approach in advocating for trauma prevention activities.

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Substance abuse, particularly that involving alcohol, has long been linked to being injured and causing injury, as well as subsequent injury episodes. Post-injury interventions to prevent repeated injury for this high risk group include routinely obtained blood alcohol concentrations and toxicology tests for other drugs of abuse to identify patients with substance abuse disorders and initiate treatment for the same. The epidemic of youth violence has prompted interest in prevention programs which focus on modification of those factors known to place youth at risk for injuries due to violence. These factors include destructive ways of coping with anger and solving interpersonal conflicts, access to weapons, abuse of alcohol and illicit drugs, and participation in illicit drug trade. Primary prevention programs are aimed at teaching children and youth conflict resolution and violence prevention techniques.

The trauma care system plan should also include a mechanism to educate health care professionals about methods for injury control and provider based interventions. Injury prevention should be incorporated into the practice of medicine, nursing and other health care professionals similar to that presently used for other groups of patients. For example, patients with heart disease, hypertension and other disease processes are routinely screened for risk factors and given instructions on behavior modification, precipitating factors and protective countermeasures. Ultimately, the support of an injury prevention oriented care system will support constant monitoring of populations for high risk groups and problem injuries, coalition based development of injury control countermeasures and the evaluation of previously implemented injury prevention strategies.

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VI. HUMAN RESOURCES

By State, Regional and/or Local area:

Workforce Resources
- Define, describe, and estimate the current available numbers, and certification and education levels, of all prehospital personnel
- Define, describe and estimate the current hospital personnel resources (physician, nurse and other health care professionals) and education levels of personnel required to care for all injured persons
- Document the additional prehospital and hospital resources necessary to meet trauma patients' needs
- Develop strategies for securing needed personnel

Trauma Educational Preparation
- Describe current trauma education programs/resources
- Estimate number of personnel, by care giver type, needing basic trauma education and those needing supplemental trauma education to augment current level of knowledge/skills
- Describe mechanisms in place for continuing education in trauma care

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DISCUSSION

The trauma system cannot provide optimal care for seriously injured patients unless necessary trauma care personnel are adequately educated and available in sufficient numbers throughout the State and in all areas of the system. The trauma care system plan should address basic educational preparation, continuing education, recruitment and retention of qualified personnel across the spectrum of trauma care professionals. A well-planned needs assessment that identifies current resource levels and availability is an essential prerequisite to developing further educational activities.

Standard curricula and prehospital education standards should be adopted, or established to promote consistent standards of care, to facilitate mutual aid efforts and to ease the movement of personnel between systems. For example, the minimum standard might be education of all transporting prehospital personnel to the EMT-Basic level. The trauma care system plan should address methods to provide the required education, and the process for State certification, recertification and decertification. Recertification of prehospital personnel is critical to ensure skill retention and to provide new or updated information. Quality management programs for monitoring courses and instructor certification/recertification should be established.

The trauma care system plan should designate the number of hospital personnel to be available to care for trauma patients in all areas of the hospital and the minimum credentials necessary to ensure optimal trauma patient care. These standards should refer to all health care personnel, including trauma and specialty care physicians, nurses and other health care professionals, and may be based upon State licensing and/or national guidelines (16,17,24,25). Designation of trauma centers often establishes the need for a trauma coordinator to monitor and coordinate all trauma services and system elements (24). The trauma coordinator is usually a registered nurse with demonstrated expertise in trauma care who has administrative, clinical, educational, research and quality management responsibilities within each trauma care facility. The trauma coordinator should also serve as a liaison to organ procurement organizations and transplant centers to facilitate the identification of potential organ and tissue donors. Additional training should be provided in conjunction with local organ procurement organizations to educate trauma care staff about issues such as presenting the option of organ donation to families of potential donors.

Examples of specialized trauma programs available for prehospital and hospital personnel include (but are not limited to): Advanced Trauma Life Support, Prehospital Trauma Life Support, Basic Trauma Life Support, Trauma Nursing Core Course, Pediatric Advanced Life Support and Advanced Pediatric Life Support. These courses offer excellent opportunities to augment basic training with special emphasis on trauma and specialty care. It is essential that trauma system education standards be focussed on the health care provider's area of expertise and area of practice, and that continual assessment of these requirements is based upon trauma patient outcome analysis. Formal mechanisms to provide continuing education credit can assist in meeting mandatory licensing requirements and may be an incentive to many participants. Educational programs may be particularly important in facilities that do not receive a high volume of trauma patients. Because relatively few pediatric trauma patients are seen in one institution, pediatric education may be of particular importance. Where appropriate, continuing education programs should be tied to quality management activities.

Innovative and concerted efforts are needed in the recruitment, retention and education of qualified personnel throughout the trauma care system, especially for rural providers. Programs such as mobile trauma training units, continuing education via satellite or interactive computer programs can reach providers in more remote areas. Another approach is to rotate rural providers through an urban system, in either the prehospital or hospital environment, and vice versa.

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VII.   PREHOSPITAL CARE

Prehospital care is a vital component of trauma systems; what happens in this setting often directly impacts both initial treatment and eventual outcome. The prehospital components of trauma care system should provide easy access, prompt response by qualified professional responsible for assessment, stabilization, triage and transport to the nearest appropriate trauma care facility.

A.   COMMUNICATION

By State, Regional and/or Local Area:

Public Access
- Describe the current public access communication system(s) (e.g. 9-1-1/enhanced 9-1-1)
- Identify alternative/backup communication systems
- Identify and assess the strengths and weaknesses of the current system(s)

Dispatch Priorities
- Describe current dispatch system(s), training, and standards for dispatch personnel
- Identify the strengths and weaknesses of the current system(s)
- Describe provisions for bystander care based upon Emergency Medical
- Dispatcher provided instructions

Communication System Integration
- Describe ambulance to dispatch and ambulance to ambulance communication network
- Describe the ambulance to hospital, and hospital to hospital communication network
- Describe multiple public/private agency scene communication (e.g. police to fire to ambulance)
- Identify and describe how these systems interrelate during single patient, multiple patient, mass casualty and disaster incidents

Quality Management
- Identify the process for review and strategies for upgrading the current communication system(s)
- Describe the process for evaluating communication system providers and dispatch activities

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DISCUSSION

Communication systems provide essential coordination among the components of the EMS and trauma care system. An effective communications plan provides statewide coverage and coordination of EMS communications, as well as appropriate linkages across State lines. Signal interference problems and "blackout areas" should be minimized. The communication component of the trauma care system plan should address system access, EMS dispatch, dispatcher assistance to on-scene persons, general EMS communications linkages and quality management program activities.

Rapid detection and discovery of a crash or other injury event requires planning and implementation of appropriate methods, such as crash and injury surveillance technology (e.g., remote transmitter in vehicles), and awareness programs for the public on accessing the EMS system. Easy access to the system, through a single coordinated system such as a 9-1-1, or enhanced 9-1-1 telephone system which permits automatic caller locations, should be available in all locales. All 9-1-1 calls should be free of charge and include provisions for non-English speaking citizens as needed. An emergency highway call box system should be considered.

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Dispatch of prehospital personnel should be organized in each region to facilitate system-wide emergency response coordination. Dispatchers should have emergency medical dispatcher education courses to prepare them to provide the most appropriate EMS response (34). The dispatch center should provide call screening and structured questioning, to determine the best utilization of personnel, equipment and hospitals. The injured person's needs should be matched with existing EMS resources. Pre-arrival instructions should also be offered to callers according to established protocols. Special protocols should be developed to address response to single or multiple patient encounters as well as mass casualty incidents. The EMS dispatch system should be physician directed, and incorporate regular medical peer review as well as continuous quality improvement. Where possible, the system should incorporate the best possible technology, including computer aided dispatch.

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The trauma care system plan should incorporate communications among the prehospital provider, the medical direction physician or designee, and personnel at the receiving trauma care facility. Appropriate linkages must include dispatch to ambulance, ambulance to ambulance, ambulance to hospital, and hospital to hospital, as well as ease of communication with police and fire agencies at the scene. Current technology and equipment are available to provide effective online communication in most areas. Special funding may be needed to upgrade current radio systems in order to maximize communication system integration.

There should be a quality management program for all communication equipment which may include utilization monitors to measure system demand, peer review of staff performance, preventative maintenance and new equipment checks, and incident control monitors. Periodic revision of communication policies and procedures should be performed as needed to maintain system compatibility and a quality communication network.

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B.   EMS MEDICAL DIRECTION

By State, Regional and/or Local Area:

EMS Medical Direction
- Describe the current system for off-line medical direction of prehospital/interfacility personnel
  1. Medical Director qualifications and responsibilities
  2. Policies, procedures, protocols for training, triage, treatment, transport and operations
- Describe the current system for on-line medical direction for prehospital/interfacility personnel
  1. On-line physician advisor or designee qualifications and responsibilities
  2. Policies, procedures, protocols for training, triage, treatment, transport and operations
- Describe the mix of health care professionals currently designated to provide patient care services under medical direction
- Identify strategies to strengthen or improve the current on-line and off-line medical direction system

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DISCUSSION

All aspects of the organization and provision of emergency medical services require the active involvement and participation of physicians. <u>Medical direction provides the operational framework for field personnel and seeks to assure appropriateness of all medical aspects of the prehospital program with the same professional accountability as medical care in the more traditional settings</u> (35).

The EMS system Medical Director is a physician who is knowledgeable in trauma system planning and who must either assume total responsibility for, or appoint an appropriate person to assume responsibility for trauma planning activities, including coordination with State or regional EMS Medical Directors from adjacent systems (36). The medical director must be involved in the design, implementation, continual revision, and operation of the trauma system from earliest prehospital contact through delivery to definitive care. The EMS Medical Director is responsible for developing clinical standards and subsequent policies and procedures that assure that these standards of care are observed. The medical director must have a well-defined position with respect to the other components of the trauma system, and the authority to develop necessary medical policies and procedures.

Physician direction of prehospital trauma care is accomplished through off-line (prospective and retrospective) and on-line (concurrent) medical functions. Off-line medical direction is the administrative promulgation and enforcement of accepted standards of prehospital care as established by the State EMS Medical Director. The off-line EMS medical director of a trauma system must possess the proper credentials, commitment and authority to provide prehospital medical direction. When possible, this individual should complete a medical director training course. Prospective medical direction may include training, testing and certification of providers, protocol development, operational policy and procedure development, and legislative activities. Off-line direction is translated in the form of protocols for training, triage, treatment, transport and operations guiding hands-on care. These protocols should provide medical direction for the scope of prehospital interventions, and authorize the range of procedures as well as the amount of on-line direction needed. Within an EMS system, several regional/areawide medical directors may be delegated authority to carry out these activities. Statewide treatment and operational protocols should be developed with the assistance of individual regional/local EMS medical directors in order to support continuity.

Retrospective quality management activities include medical audit and review of care. Various aspects of prospective and retrospective medical direction can be handled by committees functioning under the medical director with representation from appropriate EMS, medical, nursing and other health care personnel. The trauma care system plan should also include concurrent and retrospective mechanisms for quality review of medical direction and clinical management of trauma patients. Methods include: concurrent case review at the on-line agency (medical director or designee), monthly case review conferences, in-house experiences for prehospital personnel, periodic review of competency and certification records for all physicians, nurses and prehospital personnel, and routine monitoring of field performance by direct observation. System evaluation can include review of morbidity and mortality rates, and monitoring of process and outcome criteria for trends. Specific case review can be performed to monitor appropriateness of assessment, compliance with treatment protocols, adequacy of medical supervision and improvement in patient status.

On-line medical direction is the medical direction given to prehospital personnel by direct communication with an on-line physician advisor or designee, either on-scene or by direct voice communication. The trauma care system plan must also consider requirements for education, certification and evaluation of any physician designees. Responsibility for the structure of concurrent medical direction rests with the medical director, which includes collaborative input from other health care personnel.

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C.   TRIAGE

By State, Regional and/or Local Area:

Trauma Patient Identification
- Define the major trauma patient
- Describe the triage system for identifying the major trauma patient, and the appropriate destination for all injured patients

Hospital Categorization
- Develop triage guidelines and transport protocols based on hospital resources
- Describe how patient needs and hospital resources are to be integrated; specify capabilities for specialty needs (e.g. pediatrics, burns, spinal cord injury)

DISCUSSION

Triage is the process of sorting injured patients by actual, or perceived degree, or risk, of injury and assigning them to the most appropriate regional care resources. The key is to provide optimal care with maximum efficiency and minimal cost in terms of lives, disability, and dollars. Resources must be organized using a systems approach to plan for the rapid decisions required during initial treatment of trauma patients.

Triage may be imprecise due to a patient's variable physiological response to trauma. A resource mismatch occurs when a patient triaged to a trauma center does not require that specialized degree of care (overtriage). This results in unnecessary use of sophisticated resources and the potential to overwhelm trauma center capabilities with patients not needing that level of care. Another mismatch occurs when seriously injured patients are triaged to facilities unable to provide an adequate level of care and may result in unnecessary morbidity and mortality (undertriage). The goal of triage criteria is to closely match patients' needs to the appropriate resources.

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Identification of the major trauma patient is fundamental to trauma system design because it describes the patient who will benefit the most from regionalized care, and indirectly determines the level and intensity of resources needed to provide definitive care.

Major trauma patient triage criteria should consider categories such as:

- patients with multisystem blunt or penetrating trauma with unstable vital signs;
- patients with known or suspected severe anatomic injury;
- patients involved in a high energy event with a probability of serious injury despite stable or normal vital signs (mechanism of injury).

Once identified, patients in these categories should activate an appropriate systems response. Triage guidelines have been recommended by specialty organizations, and should be considered in establishing statewide or regional triage protocols (16, 17).

Triage can occur in the field and at the hospital. Field triage decisions occur during the first evaluation of the injured patient at the scene. An ideal triage tool is one that can be applied quickly under field conditions with consistent application between providers, and has a high rate of accuracy. The tendency to develop complex triage scoring systems must be balanced with the need for simplicity of triage criteria to be used by prehospital personnel. Field triage identifies those patients needing transport to the most appropriate designated trauma center rather than the nearest hospital. Field triage also identifies the type of transport needed. In addition, field triage criteria should allow for activation of the trauma system from the field including an appropriate response from designated trauma centers. Field personnel should always seek guidance from on-line medical direction if there is any doubt regarding delivery decisions or system activation.

Both the available level of hospital resources and time/distance factors are considered in making triage and destination decisions. Level III/IV (see Definitive Care component, pg 33) hospital triage should serve to identify those patients who require initial stabilization and rapid transfer to the next highest level of care, and those patients that can be safely held in a Level III/IV center for further evaluation and serial observations. Level I/Il hospital triage identifies those patients who require a full trauma team approach as well as those who can be initially evaluated by identified members of the trauma team with subsequent consultation by either a trauma surgeon or the appropriate subspecialist.

Triage criteria should provide a basis for the establishment of protocols for patient identification, delivery decisions, and appropriate response at acute care facilities for all trauma patients in an inclusive care system. They should recognize the requirements of individual trauma systems as well as the importance of clinical judgment. Patients can then be delivered depending on degree of injury as well as time and distance from site of injury to definitive care. Both off-line (prospective and retrospective) medical direction and on-line (concurrent) medical advice for individualized patient care is essential.

It is imperative for all trauma systems, through medical direction and quality management activities, to individualize triage protocols to provide high quality and cost effective care. Local and regional guidelines should establish the appropriate level of response for all components of the system. The inclusive trauma system triage model (Figure 4) allows a trauma system to establish triage criteria as broad or narrow as the system desires. These criteria will determine the field categorization of the "major trauma patient" which requires the resources of and transport to the most appropriate designated trauma center. The vertical (field triage) line will move right or left depending on the unique requirements of individual trauma systems.

FIGURE 4

TRIAGE IN TRAUMA CARE SYSTEM
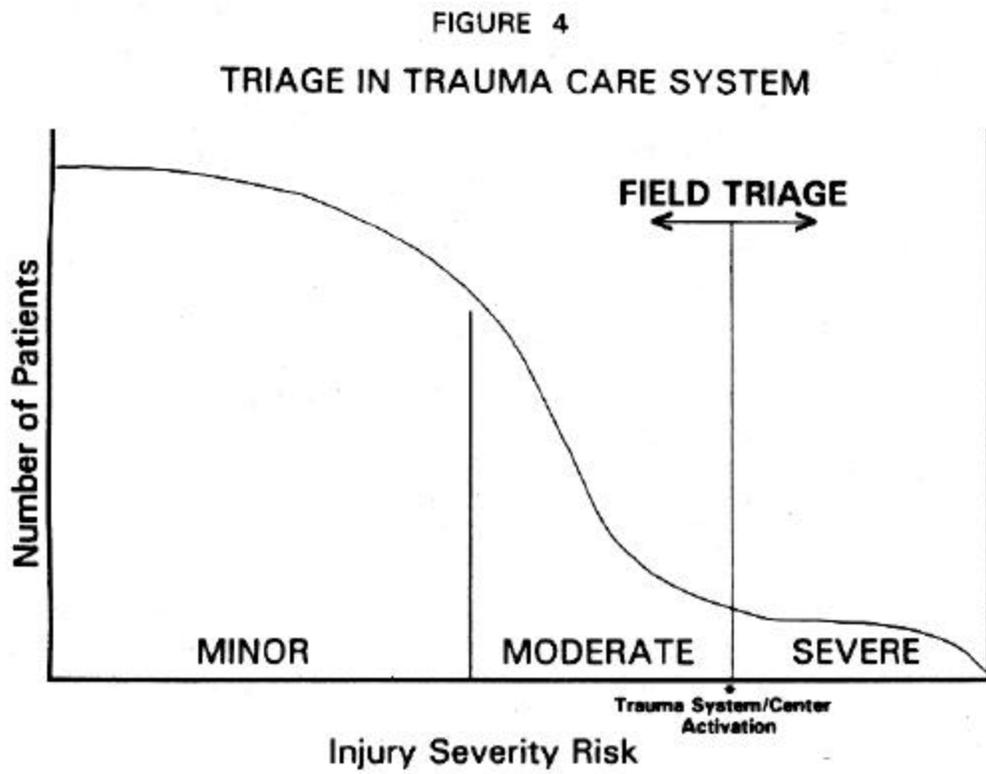
There will be, in any trauma care system, a subset of moderately injured patients who will not be identified or appropriately triaged in the field. These patients will be transported to non-designated acute care facilities, but in retrospect will be found to have major injury, or risk of injury which requires the resources of a trauma center. There must be transfer protocols and written agreements to ensure the prompt transfer of such patients to the nearest appropriate trauma center. Similarly, there will be patients transferred to designated trauma centers, who in retrospect do not require such resources and can be transferred back to their community hospital when appropriate.

Since field triage determines delivery decisions for patients in an inclusive system, it should consider the subset of patients with moderate injury severity risk. Appropriate response for these patients may well entail gradations of response within both the trauma center and the trauma care system, depending on time, distance and available resources. The definition of unstable vital signs, significant anatomical injuries, and what constitutes a high energy event are best made by individual trauma systems. Outcome studies may be used to add, delete, upgrade or downgrade certain anatomical injuries or high energy events. Deviations from established protocols based on clinical judgement should be allowed, but should also become an automatic filter for individual case review.

Two additional triage circumstances exist. These are mass casualty triage and "back" or "down" triage. Mass casualty triage is necessary when the number of casualties exceeds the resources of any component of the system. Each medical treatment facility, city, county, or region must have a mass casualty plan that addresses multiple mass casualty occurrences which may overwhelm local resources (37). Provisions must be made to test these plans, evaluate them, and make improvements based on this evaluation.

Reassessment, i.e. "back or down triage", occurs when designated trauma facilities have determined that an individual patient no longer requires that level of care and may safely be transferred to another facility. Ideally, these transfers should not occur before the patient has been completely evaluated and observed for at least 24 hours to minimize the incidence of missed injuries (38-39). These referrals to community support facilities should occur in order to provide the best use of system resources, however current reimbursement patterns often preclude the efficient movement of patients between facilities. Patients with moderate injury severity are often triaged to a trauma center to give them the full benefit of expert trauma care. Third party payors need to understand that significant injury is often subtle in its presentation and that patients with moderate to severe risk for injury are best served by triage and evaluation at facilities with expertise and experience in trauma care.

By combining triage guidelines with a quality management program and research, optimal and cost-effective care can be provided. The end result should be triage protocols with the sensitivity to identify severe injury or moderate to severe injury severity risk, yet specific enough not to overburden the designated trauma facilities while efficiently utilizing existing resources.

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D.   TRANSPORT

By State, Regional and/or Local area:

Current Demand and Nature of the System
- Describe the area to be served by the trauma system (urban, rural, remote, wilderness)
- Describe the population to be served by the trauma system in terms of demography and clinical needs

Ground And Air Ambulances
- Identify the transportation resources and describe their current configuration, staffing and service level
- Describe the process for regulation of transport vehicles, equipment and resources
- Describe the current ambulance deployment methodology(s)
- Describe current transportation/destination policies

System Integration
- Identify current licensed acute care facilities and current service area for each facility
- Document commitment of acute care facilities to participate in the trauma system
- Identify strategies to strengthen the existing ambulance to hospital transportation system and ongoing mechanism for evaluation

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DISCUSSION

Trauma patients should be delivered in a timely fashion to appropriate designated facilities utilizing the most expedient and appropriate means of transport. Elapsed time between injury and receipt of definitive care is dependent upon: 1) public recognition of the event; 2) access to the EMS system (i.e. 9-1-1); 3) response time performance of the EMS system; 4) level of training and performance on-scene; and 5) distance to appropriate definitive care. The failure of any individual element or coordination between elements can result in significant delays to the detriment of the patient.

A well planned and coordinated trauma care system is designed to eliminate the problems which increase this time interval and subsequently may increase morbidity and mortality. Included in the trauma care system plan are State or regional regulations for personnel and equipment, and protocols for triage criteria which match patient severity to facility capability and determine transport decisions.

Important factors that need to be considered in the development of triage and transport protocols include population density, geography and topography, ambulance resources available (ground/air), and hospital capabilities, commitment and location within a given region. The size of the population and the geographic area must be considered when developing transport systems. A large population located within a relatively small urban area may result in a large number of trauma related runs, with short time intervals between injury and definitive care Alternatively, the same population over a much larger geographic region may result in similar numbers of trauma related EMS runs; however, these incidents will result in markedly increased times to definitive care. Increased prehospital time may increase the consumption and hence decrease the availability of EMS resources.

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Planning should be based upon an initial assessment of the numbers and types of vehicles, equipment and personnel needed, accessibility to transport and the characteristics of services offered. The need for ground ambulance resources is based on a number of variables, including response time requirements, geography, call density, response time restraints (e.g. weather, inaccessible location), availability of mutual aid resources, traffic patterns, and actual system demand. The configuration of an EMS system can make a large difference in response times and patient outcome. Ideally, a balance is reached between the economics of EMS availability and utilization, actual demand, and patient care requirements.

EMS systems may utilize a systematic approach to ambulance deployment by analyzing historical call demand and location patterns, combined with geographic variables and seasonal analysis. The deployment system should continually adjust itself to provide an appropriate and timely response to all patients, after first meeting response time criteria and utilization criteria for rural areas.

The availability of air ambulances can greatly enhance the response of an EMS system and guidelines for appropriate utilization of air medical scene response are available (40-41). Particularly in rural systems, the time to definitive care can be reduced by bringing higher skill level resources directly to the patient, decreasing transport time and surmounting geographic barriers. Air ambulances are frequently used within the urban environment for cases where transport time to definitive care is excessive due to external or environmental factors, or in cases where the patient would be compromised by long ground transport times. The patient's condition may warrant evaluation and treatment by more highly trained air medical personnel such as in multicasualty events or when unstable patients require increased extrication time.

The choice of transport mode should be made on the basis of the most expedient way of getting the trauma patient to definitive care. Prospective and concurrent coordination of ground and air transport is essential for optimal system functions. Factors to be considered include available resources as well as time and distance from site of injury, coupled with assessment of the patient's condition to assure rapid transport to definitive care. Triage criteria should exist that will activate the trauma system from the scene (see Triage component, p 26). This allows for air transport directly from the scene or

a coordinated rendezvous at a predetermined site. Field response by air medical agencies must be organized so that the time on scene and to definitive care is documented to diminish time compared to ground transport. In some areas of the country other means of transport, such as by water, must be considered. Mutual aid agreements between ambulance providers are essential in providing for multiple mass casualty incidents, or equipment failure.

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Criteria for distribution of patients requires judicious medical direction in balancing the concerns for appropriate prehospital times against the need for adequate trauma service volume. The ultimate decision for triage guidelines and transport protocols must be based on the capability of the system to minimize morbidity and mortality. Bypass, or directing patients past a closer medical facility in order to receive optimal care at a facility that is farther away should be explicitly stated in protocols, as determined by the EMS medical director. Trauma system design must consider hospital resource availability such as medical specialists, emergency department beds, critical care beds, operating room suites, computerized tomography (CT) scanners and specialized services for pediatrics, spinal cord injury, eye injury, limb replantation and burns to ensure that destination plans are well developed and meet the needs of all injured persons. The trauma system plan should incorporate a mechanism for communicating the divert status of trauma centers and acute care facilities within a trauma system that are temporarily unable to provide the expected level of services, to ensure rapid decision making and smooth delivery of trauma patients to another appropriate facility.

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The plan should include mechanisms to evaluate transport processes including utilization of ambulance services, actual response times, response accuracy, scene times, delivery times in relation to standards, communication with medical direction and compliance with operational protocols. The data collection system must support routine analysis of utilization of services and performance of EMS elements in response to patients' needs.

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VIII.   DEFINITIVE CARE FACILITIES

It is imperative that injured patients are delivered in a timely manner to the closest appropriate facility. Regionalization of trauma care involves the participation of hospitals with the resources necessary to provide optimal care for injured patients and the identification of the specific capabilities of each facility. Each facility has a role in providing a tiered response to meet the needs of injured patients, and regional configuration should reflect the individual needs of the community it serves.

A.   TRAUMA CARE FACILITIES

By State, Regional and/or Local area:

Trauma Centers
- Identify designation standards for trauma centers including required resources and equipment
- Establish the numbers and severity types of patients for each center

Other Trauma Care Facilities
- Describe the role and responsibility of other acute care facilities within the trauma system
- Describe the role and responsibility of specialty care centers (pediatrics, burn, spinal cord injury)

Designation Process
- Describe the process for selecting and designating trauma centers
- Describe the process for monitoring designated centers and subsequent redesignation/de-designation

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DISCUSSION

An essential part of the trauma care system plan is the regionalization of care or designation of definitive trauma care facilities and system integration. Effective trauma systems are the result of a successful public-private partnership between definitive care facilities and a coordinating governmental agency, and requires a high degree of functional interdependence. The trauma care system plan should integrate all facilities into an inclusive system or network of definitive care facilities in order to provide a spectrum of care for all injured patients.

The trauma care system plan should establish trauma facility standards, or adopt those currently available. Trauma facility standards can be outlined in numeric or descriptive terms. Numeric

guidelines similar to those established by the American College of Surgeons remain the most often utilized as a basis for defining and implementing statewide/regional trauma centers (17). Trauma center guidelines should identify those resources required to function effectively as a trauma center in the following areas: hospital organization; specific facilities and equipment; quality assurance; outreach; public education; research; training programs; and qualifications for trauma center personnel.

Level I

The Level I facility is a tertiary care hospital that maintains a distinct leadership role in system development, optimal care delivery, evaluation, training and research. It is the regional resource trauma center in a system and has the capability of providing total care for every aspect of injury from prevention through rehabilitation. Examples of <u>dedicated</u> (24 hour availability solely for use by trauma patients) resources to support the spectrum of injury include trauma trained surgical specialists, comprehensive medical/surgical subspecialty support, trauma nursing staff and other health care professionals, resuscitation space and equipment, diagnostic equipment such as computerized tomography and angiography, operating suites and intensive care beds. Level I centers develop a comprehensive medical rehabilitation plan for every patient admitted to the trauma center. Level I centers are usually university based teaching hospitals because of the large personnel and equipment resources necessary to sustain the required teaching and research commitments.

In addition to acute care responsibilities, the mission of a Level I trauma facility includes commitment to education, research and system leadership. Level I facilities typically provide extensive public outreach and prevention programs. Medical education programs include postgraduate training for trauma and other specialties, as well as programs for other system participants including prehospital providers, trauma nursing staff and community physicians. Research at either the clinical or basic science level is essential for a Level I Trauma Center and system integration allows dissemination of state of the art clinical information to all participants in the trauma system from Level I research activities. These facilities often take the lead in planning, implementing and evaluating systemwide clinical research projects.

Level II

The Level II Trauma Center is a hospital which is also expected to provide definitive trauma care to injured patients. However, depending upon geographic location, patient volume and trauma center experience, a Level II Trauma Center may not provide the same comprehensive care as a Level I Trauma Center and so in certain instances it may be necessary to transfer patients with more devastating injuries to a Level I Trauma Center (e.g. patients with severe, complex, multiple system injuries; patients with certain severe single system injuries; and patients that might require complex, coordinated surgical critical care.) Level II Trauma Centers may be the most prevalent facilities in the community, handling the majority of trauma patients.

The Level II Trauma Center can be an academic facility, public or private community facility and be located in urban, suburban or rural areas. Educational outreach and prevention programs are similar to the Level I Trauma Center requirements; however the professional graduate education and research commitments are not primary objectives.

Level III

The Level III Trauma Center services communities that do not have the resources associated with a Level I or II institution, but can provide prompt assessment, resuscitation, emergency surgery and stabilization while arranging for transfer to a facility that can provide definitive surgical care. Guidelines for Level III facilities should specify the need for 24 hour per day access to an on-duty trauma physician or nurse. A Level III Trauma Center reflects a maximum commitment to trauma care commensurate with its local resources. Planning for care of injured patients in these hospitals requires transfer agreements and standardized protocols.

Level IV

Level IV trauma facilities provide the initial care to severely injured patients despite very limited resources. These facilities provide the opportunity to develop trauma care access points throughout less populated areas. The development of Level IV facilities extends regionalized trauma care to even the most remote areas of the State or region. A Level IV facility may not be able to provide emergency surgical treatment on a consistent basis, but should provide access to an on-call trauma physician or nurse. As with the Level III Trauma Center, treatment protocols for initial stabilization and transfer agreements are essential.

The rural model for definitive trauma care in more remote facilities requires a unique approach. The attempt to impose urban standards may be detrimental. Establishing realistic standards based on available resources is essential to the development of a rural trauma system. Optimal care in rural areas can be provided by skillful use of existing professional and institutional resources supplemented by guidelines which result in enhanced education, resource allocation and appropriate designation for all levels of providers.

Since rural trauma facilities serve critically injured patients on an infrequent basis and with limited resources, a strong working relationship must be established between rural Level III or IV facilities and the nearest Level I or II Trauma Centers. It is essential to have a committed health care provider involved in the Level IV facilities, who can provide leadership and sustain this affiliation with other centers. An inclusive system should leave no facility isolated without direct linkage to a Level I or II Trauma Center.

This association should facilitate expeditious transfer of seriously injured patients who require a higher level of care. Exchange of medical personnel between Level I and II with Level III and IV

facilities may be an excellent way to develop this relationship. The Level I and II Trauma Centers have an obligation to extend their educational outreach to the rural areas in the form of professional education, consultation or community outreach. A mechanism should also be in place to deliver feedback to the referring hospital regarding individual patient care and outcome analysis.

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Acute Care Facilities Within a Trauma System

In the urban/suburban areas, many qualified acute care hospitals will not be designated trauma centers, and yet these hospitals will, in fact, provide care for the majority of the less severely injured patients. These hospitals are an integral part of the inclusive trauma care system and it is critical that these hospitals support the trauma care system by contributing to the trauma registry data base (see Data Collection, p 42) to facilitate the analysis of care for injured patients who require care in an acute care facility. In return, these hospitals must receive support from the trauma centers through assistance with quality management of trauma patients, trauma education and prevention programs.

Inherent to an inclusive system, these hospitals must be able to transfer patients rapidly and effectively to a trauma center when necessary, and accept the return of less critically injured patients from trauma centers as their conditions warrant. This process will free up beds from crowded trauma centers, encourage sharing of clinical expertise between hospitals and may place patients closer to their homes. Formal letters of agreement should be obtained attesting to the willingness of hospitals to facilitate the rapid, free and unobstructed transfer of patients as necessary and indicated.

Special Facilities

Regional trauma specialty facilities can improve patient care by concentrating expertise, maintaining skill competence, and limiting unnecessary duplication of specialized capital and personnel resources. Pediatric trauma care should be provided by personnel and facilities with a special interest and competence in care of the injured child (i.e. a pediatric hospital or an adult center with demonstrated competence and readily available pediatric facilities) (25, 27, 28*).* This may also be accomplished by integration of an EMS-C component into the existing EMS system (18-22). Although the volume of severe burn injuries in a given region may be low, resource utilization for such injuries is high and burn centers have been well established as specialty care centers in some EMS systems. Spinal cord injury, eye injury and limb replantation are other clinical problems that demand highly specialized care, facilities, training and organization of specialty teams, which may not be available in all Level I or II Trauma Centers. Effective transfer agreements and protocols must be developed for all specialized facilities.

Rehabilitation centers must also be integrated into the trauma system. This has historically been a neglected area of trauma care but is critical to the total care of the injured patient (see Rehabilitation components, p 40).

Designation

The trauma care system plan should include specific standards for staffing, ancillary services, equipment and patient volumes for each designated level of care facility. These standards should be routinely evaluated over time. Estimated volume requirements and facility guidelines have been established by several professional organizations (16, 17, 24, 25, 28).

The lead agency must have the authority to determine the number of trauma centers that are designated to minimize duplication and enable those hospitals that are most committed to maintain expertise. Geographic catchment area and facility distribution require consideration of population density, proposed injured patient volumes, transport resource capabilities, transport times and the number of facilities with the appropriate resources. Designation policies should minimize duplication and excessive services to enable those hospitals that are the most committed to maintain their expertise and volumes of patients necessary to support quality care, research and post-graduate education for physicians, nurses and other health care professionals. The quality management program should be used to evaluate whether trauma centers are receiving the appropriate volume of trauma patients to maintain expertise.

The process for designation should be clearly outlined in the trauma care system plan. Phases of the designation process usually include: creation of a request for proposal by the designating authority and submission of proposals by applicant hospitals, proposal review, independent expert site survey to validate the system and application, public hearings, recommendation of designated facilities and formal designation. The evaluation process for designated facilities should address routine medical care evaluations and provider compliance with contractual obligations. There should be a mechanism for periodic review of the designated centers, with a clear process for redesignation and "de"designation.

The trauma care system plan must establish the mechanism for trauma patient data retrieval from all facilities that participate in the trauma system. Each facility should also implement prospective transfer agreements with nearby trauma centers, specialty facilities and other acute care facilities within a trauma system to ensure the provision of comprehensive care for all injured patients. Written guidelines and policies should be established in collaboration with organ procurement organizations concerning the role and responsibilities of trauma facilities in organ procurement activities. Policies to be developed include those outlining responsibility for providing the opportunity for organ and tissue donation, for clearly defining the hospital protocol for determining brain death, and the protocol for communication between organ procurement organizations and donor hospitals.

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B.   INTERFACILITY TRANSFER

By State, Regional and/or Local area:

Transfer to Trauma Centers
- Describe the policy and procedure for the rapid interfacility transfer of major trauma patients to trauma centers
- Describe the communication linkages between and among the facilities treating injured patients

Transfer From Trauma Centers to Other Facilities
- Describe the process and procedure for transferring patients to their community hospital
- Describe the process and procedure for transferring trauma patients to other specialty care facilities

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DISCUSSION

An inclusive trauma system makes interfacility transfer more efficient, since theoretically all facilities are involved and committed to regionalized trauma care. A critical component of a trauma system is the establishment of transfer agreements that ensure the unobstructed transfer of trauma patients between hospitals when there is a need to do so. Transfer agreements will minimize the inherent problems of triage and provide consistent as well as efficient movement between facilities (26). Decisions to transfer patients should be based on objectively agreed upon criteria. Guidelines for use in identifying those patients who would benefit by interfacility transfer to a trauma center have been established (17, 28).

The trauma care system plan should establish standards for the type of personnel to accompany patients, documentation and methods for evaluating patient outcomes. There should also be a mechanism in place to establish feedback to the referring hospital.

Interfacility transfer is particularly important in the linkage between the urban and rural components of a trauma system. There will also be the need to transfer to appropriate specialty facilities injured patients with specialized problems such as pediatrics, burns, spinal cord injury or the need for further rehabilitation. Preplanning will assure expeditious and appropriate transfers.

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Interfacility transfer also occurs when trauma centers have determined that an individual patient no longer requires trauma center level care and may safely be transferred to another facility. These transfers to other community facilities (such as hospitals affiliated with HMOs) should occur to provide efficiency and cost effectiveness in the system. It is essential that the transfer agreements include provisions required under the Consolidated Omnibus Budget Reconciliation Act (COBRA) and subsequent revisions of the Act (42).

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C.   MEDICAL REHABILITATION

By State, Regional and/or Local area:

Rehabilitation Services
- Describe the process and procedure for initiation and utilization of rehabilitation services

Rehabilitation Facilities
- Identify rehabilitation facilities for continuous care of severely injured or those requiring long term therapies
- Describe how these facilities have been integrated into the trauma care system

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DISCUSSION

The rehabilitation of the trauma patient and continual support of their family members is as important as any other system component. In many cases, rehabilitation is the longest phase and most difficult part for the trauma patient and family. Rehabilitation resources may be limited and reimbursement for the rehabilitation of the trauma patient varies considerably among insurance companies. Yet, proper and early use of rehabilitation resources ensures the most rapid return of the patient to family, community, work force and society.

A comprehensive rehabilitation program should be directed by a physiatrist knowledgeable in trauma rehabilitation and use a multidisciplinary team approach. Rehabilitation should be heavily integrated into all phases of acute and primary care, and should begin at the earliest stage possible after admission to the acute care hospital. Rehabilitative services are best provided along a continuum from admission to a trauma center to community reintegration, including social and vocational adaptation. Each trauma care facility should establish an identified mechanism to initiate rehabilitation services and/or consultation upon patient admission as well as policies regarding coordination of transfers between facilities.

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A complete rehabilitation facility guide, including rehabilitation facilities in contiguous States, should be created by the lead agency as part of the trauma system plan. This broader interstate approach to rehabilitation resource utilization may provide facilities closer to the patient's or the family's home community, or may provide availability to specialized rehabilitation resources when limited access exists within the State. Transfer agreements should exist between all acute care and rehabilitation hospitals and should also contain protocols to ensure periodic feedback of patient progress and outcome to the acute care facility as well as the system database. All rehabilitation facilities must collect and report a specific set of rehabilitation data to the trauma system data base.

Rehabilitation services can be provided in a designated unit within a trauma care facility or in a free standing rehabilitation center. Standards for comprehensive inpatient and outpatient programs have been established and may be used as criteria to identify trauma rehabilitation facilities (43). A trauma care system plan may include provisions for the formation of a trauma system peer support group for persons who have experienced injury to facilitate rehabilitation, psychosocial adaptation and integration of trauma survivors back into their communities.

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Research studies should be established to determine the effect of the rehabilitation process on improving or maintaining long term functional outcome of the severely injured. Rehabilitation patient data will provide an excellent view of the system's ability to re-integrate the injured back into society.

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IX. EVALUATION

a. Data Collection

System Data Requirements
- Describe the plan and system for collection and collation of trauma care data from throughout the State, and the population to be included in data collection
- Describe the role and responsibility for agencies and institutions for data collection
- Identify the timeline for implementation of a comprehensive data collection system
- Describe the process for evaluation of the quality of the data, and reporting process
- Develop the process for assuring appropriate patient and provider confidentiality

Data Collection Tools
- Describe the current trauma registry and/or data base system(s)
- Describe the system for linking all trauma related data:
  1. law enforcement accident reports
  2. prehospital run reports
  3. emergency department data
  4. hospital discharge data (including rehabilitation and specialty care facility data)
  5. medical examiner/coroner records
  6. death certificates
  7. insurance records

DISCUSSION

The patient population to be included in the trauma care data collection system is a subset of all injured patients; injured patients that require care in an acute care facility and all fatalities should be recorded in the data collection system. Data collection for each system component is the responsibility of all providers in a trauma system. Collating and recording these data are the combined responsibility of the individual provider institutions and the lead agency. To fully evaluate the trauma system the data must be obtained from all providers in the form of consistent data sets with minimum standards. Trauma registry data can augment a statewide injury surveillance system when combined with vital statistics, mortality data and other data sources.

Statewide reporting systems have much potential to provide information useful in modifying and improving trauma systems. If properly designed, registries can meet several key goals. In addition to evaluating the effectiveness of a trauma system in meeting a community's needs, aggregate data can assist in assessing the appropriateness of trauma standards, developing appropriate trauma prevention strategies, and in assessing the extent of resources needed to adequately support and sustain a State trauma care system.

Given that there are as many variations of hospital information systems as there are hospitals and that such systems are costly, complex and serve multiple purposes, input from each type of hospital (trauma centers, specialty care facilities and acute care facilities within a trauma system) is critical at each stage in the design of reporting mechanisms and systems. Reporting mechanisms should be designed to be compatible with hospital operations (e.g. confidentiality protocols) and existing information systems, and should not be financially or operationally onerous to implement.

States should establish a workgroup of hospital representatives to identify and negotiate data elements to be collected, the mechanism for collection, and confidentiality assurances. Special effort should be made to avoid unnecessary duplication of data collection. In determining the data elements to be collected, consideration should be given to the cost of collecting the data and ultimate utility.

The data to be collected includes prehospital data incorporating mechanism of injury, patient assessment, treatment, and transportation. A comprehensive data base must also be compiled for hospital care from arrival through discharge. Information from trauma centers, other acute care facilities within a trauma system, specialty care facilities and rehabilitation centers is essential for obtaining a complete data base. Additionally, outcome data must be recorded to include survival, disability, and the need for rehabilitation. In each phase of patient care, a chronology of resource use, treatment rendered and outcome of treatment should be identified, and recorded using a variety of collection tools (i.e. structure, process and outcome measurements). Finally, resources used in the care of each patient should be tabulated including hospital costs or charges.

The recording of these data are the responsibility of each individual providing care to the injured patient. The resulting trauma data base, including a minimum required set of data, may then be used to compare an individual trauma care facility to others, as well as to itself over time. A comprehensive data base will allow the system to review its operation at specified intervals, to highlight the system strengths as well as areas for improvement. Integration of institutional trauma registries into a system data base will then allow comparisons with other systems and quality management evaluations which should be shared with individual agencies and hospitals. Protection of portions of these data and of the confidentiality of those agencies and institutions submitting it, will aid in assuring the completion of the data.

The individual hospital should be responsible for analysis of its own data and the State should be responsible for interpretation of system data. It is imperative that these data bases be available for trauma research at each level. A system for channeling of requests should be developed that allows individuals and institutions interested in improving local, State, and national trauma care to have access to the data base. It is only through careful scrutiny of the data and reporting of the results that the full benefit of a data collection system may be realized. The trauma care system plan should include the feedback process for regular reporting of trauma system activities and outcomes to the population it serves.

Although there is now no formalized national trauma registry, it would be beneficial to develop a comprehensive minimal data set for the State that allows for flexibility in future regional and national data base endeavors. Most currently available trauma registry programs contain sufficient data points to serve as a minimum data set.

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b. Trauma System Evaluation

Evaluation of System Performance
- Describe the plan for evaluating individual trauma system components and system operations, including the responsibility for monitoring compliance with standards, maintaining confidentiality and periodic review of trauma facility standards
- Describe the plan for assessing the effectiveness of the system as it relates to meeting the needs of injured persons, availability of appropriate resources, and costs
- Describe the plan and process for patient care evaluations at the system level

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DISCUSSION

A trauma care system plan must include the ability of the system to monitor its own performance over time and to assess its impact on trauma morbidity and mortality. This requires continual assessment of system operations, demonstration that the system is meeting stated goals, and documentation of system performance. Essential to the system quality management is the ability to measure compliance to standards, document system effectiveness, and to identify quality improvement opportunities. To accomplish the goal of system review the trauma system quality management program should interface with and include the trauma center quality management program.

The lead agency is responsible for the system quality management (QM) program. To encourage participation in system review the lead agency must ensure system participants' confidentiality in reviewing trauma patient care. Therefore confidentiality must be a part of the trauma system legislation.

An important component of a system OM program is the ability to review the system as it relates to patient needs, system resources, medical care and costs. Each of these segments should be incorporated into a specific set of audit criteria that can identify areas for further study and enhance system efficiency and effectiveness. In this way trends in trauma care management can be identified and the appropriate system adjustments made.

A central medical audit committee, to provide medical guidance and system oversight to the lead agency, is an important adjunct to system review and quality management activities. Ensuring system data analysis and conducting regular on-going peer review of all disciplines encourages positive system changes, translates system deficiencies into corrective action and enhances overall system performance.

c. Trauma Center Evaluation

Trauma Center Quality Management
- Describe the plan for trauma center evaluation including:
  1. Establish the authority, responsibility and organizational structure for the quality management program
  2. Identify the process for documenting corrective action plans, problem re-evaluation and oversight
- Describe the process for monitoring quality of care including:
  1. establishment of standards of care
  2. mechanism for concurrent review
  3. systematic evaluation of audit filters for case review
  4. mechanism for multidisciplinary case review
  5. statistical overview and trending of patient related data including process and outcome indicators
  6. outcome review
- Describe the data collection system to support quality management activities
  1. trauma registry
  2. medical examiner's report

DISCUSSION

Quality management (QM) programs are necessary to ensure that the standard of care is met in caring for injured patients. A strong QM program will drive the standard of care in a trauma center. Ultimately, trauma center QM programs will mesh with trauma system QM programs to ensure the standard of care throughout the system. A program for quality management should be included as part of the hospital designation criteria. However evaluation at each trauma care facility will support the ability to do a comprehensive system analysis, and therefore warrants further specification in the Evaluation Component of the trauma care system plan.

The goal of the OM program is to monitor the process and outcome of trauma patient care and to document appropriate and timely provision of care according to established standards of care. There should be a mechanism for determining when variation from standards of care exist, the corrective action plan, and when changes in the standard of care need to be made.

Level I and II Trauma Centers should have a distinct trauma service and authority must be vested in the trauma service (general surgery or emergency medicine if no established trauma service) to monitor the quality of care for all trauma patients. This process will cut across medical specialty lines and involve all patient care personnel. A well-defined organizational structure must be established to carry out a concurrent and retrospective peer review process and a trauma registry is necessary to provide the data base for review. A multi-disciplinary trauma quality management

committee is also necessary to review hospital data on a regular basis and to examine and measure the trauma center's degree of compliance with pre-established standards.

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Analysis of this peer review data will identify trends in patient care; some trends may be positive and should be augmented into the standard of care, while adverse trends, whether physician specific or institutional, must be translated into corrective action. Follow-up studies are necessary to document desired improvement in quality of patient care. Audit filters (clinical indicators) are specific criteria that can be utilized to identify problems in patient care. A complete anatomical diagnosis of injury is essential for adequate patient outcome evaluation and a post mortem examination should be sought in all trauma related deaths.

Level III/IV centers should focus on indicators or aspects of care that are relevant to their setting such as time spent in resuscitation, time elapsed before decision to transfer, or the type of diagnostic studies performed in the initial evaluation of trauma patients. These centers should review the types of trauma patients triaged to their facilities and how decisions are being made to transfer patients to higher levels of care. Because of their remote location and small numbers of professional care providers, these facilities may need to combine individual case review with other regional/areawide programs to pool resources necessary for effective quality management.

The trauma center QM program can be utilized to evaluate the cost effectiveness of treatment programs. In this way the QM program of a trauma center becomes central to the evolution of standards of care.

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d. Research

Trauma Care Research
- Develop a plan for trauma research activities, including functional outcome research
- Incorporate research activities as part of the trauma system assessment and utilization review

Research Funding
- Describe the process to fund continued research activities within the trauma system

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DISCUSSION

Ongoing systems research is necessary to guarantee the perpetual study, redirection and improvement of trauma system design, and ultimately, trauma patient outcome. Research should be organized so that certain aspects of injury can be addressed by the system database including injury surveillance and epidemiology, prevention, prehospital treatment, definitive care and rehabilitation information, financial studies and system organization. In addition to the evaluation of medical, nursing and other health care services, a process can be established to evaluate the effectiveness of individual system components. Validation of individual trauma care system components is necessary to insure system efficiency and proficiency.

It is of utmost importance that research be used to validate the cost effectiveness of trauma care systems in all settings (urban and rural). Other areas of study that could be identified include reimbursement issues, and studies of the ethical, moral and legal dilemmas facing trauma care.

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Research funding for trauma system and component validation should be at a level to insure optimal use of the trauma system data base. Access should be assured to system providers for individual, regional or statewide projects that enhance trauma patient care.

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GLOSSARY

Advanced Pediatric Life Support - a course jointly developed and sponsored by the American College of Emergency Physicians and the American Academy of Pediatrics which covers the knowledge and skills necessary for the initial management of pediatric emergencies, including trauma

Advanced Trauma Life Support (ATLS) - a course developed and sponsored by the American College of Surgeons Committee on Trauma for physicians which covers trauma knowledge and skills

Basic Trauma Life Support (BTLS) - a course for prehospital care providers sponsored by the American College of Emergency Physicians

bypass transport of an EMS patient past a normally used EMS receiving facility to a designated medical facility for the purpose of accessing more readily available or appropriate medical care

citizen access - the act of requesting emergency assistance for a specific event

Consolidated Omnibus Budget Reconciliation Act (COBRA) - the federal Medicare law. A portion of this law commonly referred to as COBRA or OBRA details the requirements Medicare hospitals must meet in providing screening examinations for individuals presenting at the emergency department, and the requirements that must be met prior to transferring a patient in an unstable medical condition or who is pregnant and having contractions

communications system - a collection of individual communication networks, a transmission system, relay stations, and control and base stations capable of interconnection and interoperation that are designed to form an integral whole. The individual components must serve a common purpose, be technically compatible, employ common procedures, respond to control, and operate in unison.

designation - formal recognition of hospitals as providers of specialized services to meet the needs of the severely injured patient; usually involves a contractual relationship and is based on adherence to standards

disaster - any occurrence that causes damage, ecological destruction, loss of human lives, or deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community area

dispatch - coordination of emergency resources in response to a specific event

emergency medical services for children (EMS-C) - an arrangement of personnel, facilities and equipment for the effective and coordinated delivery of emergency health services to infants and children that is fully integrated within the emergency medical system of which it is a part

emergency medical services system (EMS) - a system that provides for the arrangement of personnel, facilities, and equipment for the effective and coordinated delivery of health care services in appropriate geographical areas under emergency conditions

field categorization (classification) - a medical emergency classification procedure for patients that is applicable under conditions encountered at the site of a medical emergency.

inclusive trauma care system - a trauma care system that incorporates every health care facility in a community in a system in order to provide a continuum of services for all injured persons who require care in an acute care facility; in such a system, the injured patient's needs are matched to the appropriate hospital resources

injury - the result of an act that damages, harms, or hurts; unintentional or intentional damage to the body resulting from acute exposure to thermal, mechanical, electrical or chemical energy or from the absence of such essentials as heat or oxygen

injury control - the scientific approach to injury that includes analysis, data acquisition, identification of problem injuries in high risk groups, option analysis and implementing and evaluating countermeasures

injury prevention - efforts to forestall or prevent events that might result in injuries

injury rate - a statistical measure describing the number of injuries expected to occur in a defined number of people (usually 100,000) within a defined period (usually 1 year). Used as an expression of the relative risk of different injuries or groups.

lead agency - an organization that serves as the focal point for program development on the local, regional or State level

major trauma - that subset of injuries that encompasses the patient with or at risk for the most severe or critical types of injury and therefore requires a systems approach in order to save life and limb

mechanism of injury - the source of forces that produce mechanical deformations and physiologic responses that cause an anatomic lesion or functional change in humans

medical control - physician direction over prehospital activities to ensure efficient and proficient trauma triage, transportation, and care, as well as ongoing quality management morbidity - the relative incidence of disease

mortality - the proportion of deaths to population

off-line medical direction - the establishment and monitoring of all medical components of an EMS system, including protocols, standing orders, education programs, and the quality and delivery of on-line control

on-line medical direction - immediate medical direction to prehospital personnel in remote locations (also know as direct medical control) provided by a physician or an authorized communications resource person under the direction of a physician

overtriage - directing patients to trauma centers when they do not need such specialized care. Overtriage occurs because of incorrect identification of patients as having severe injuries when retrospective analysis indicates minor injuries

Pediatric Advanced Life Support (PALS) - a course developed and sponsored by the American Heart Association and the American Academy of Pediatrics, for healthcare workers covering the application of advanced life support therapies to pediatric patients

Prehospital Trauma Life Support (PHTLS) - a verification course for prehospital care providers that teaches concepts of basic and advanced trauma life support. It is developed and sponsored by the National Association of Emergency Medical Technicians in cooperation with the American College of Surgeons Committee on Trauma

protocols - standards for EMS practice in a variety of situations within the EMS system

quality improvement - a method of evaluating and improving processes of patient care which emphasizes a multidisciplinary approach to problem solving, and focuses not on individuals, but systems of patient care which might be the cause of variations

quality management - a broad term which encompasses both quality assurance and quality improvement, describing a program of evaluating the quality of care using a variety of methodologies and techniques

regionalization - the identification of available resources within a given geographic area, and coordination of services to meet the needs of a specific group of patients

rehabilitation - services that seek to return a trauma patent to the fullest physical, psychological, social, vocational, and educational level of functioning of which he or she is capable, consistent with physiological or anatomical impairments and environmental limitations

response time - the time lapse between when an emergency response unit is dispatched and arrives at the scene of the emergency

risk factor - a characteristic that has been statistically demonstrated to be associated with (although not necessarily the direct cause of) a particular injury. Risk factors can be used for targeting preventative efforts at groups who may be particularly in danger of injury.

rural - those areas not designated as metropolitan statistical areas (MSAs)

service area (catchment area) - that geographic area defined by the local EMS agency in its trauma care system plan as the area served by a designated trauma center

specialty care facility - an acute care facility that provides specialized services and specially trained personnel to care for a specific portion of the injured population, such as pediatric, burn injury, or spinal cord injury patients

surveillance - the ongoing and systematic collection, analysis, and interpretation of health data in the process of describing and monitoring a health event

trauma - a term derived from the Greek for "wound"; it refers to any bodily injury (see injury)

trauma care system - an organized approach to treating patients with acute injuries; it provides dedicated (available 24 hours a day) personnel, facilities, and equipment for effective and coordinated trauma care in an appropriate geographical region

Trauma Care Systems Planning and Development Act of 1990 - The law that amended the Public Health Service Act to add Title XII - Trauma Programs. The purpose of the legislation is to assist State governments in developing, implementing and improving regional systems of trauma care, and to fund research and demonstration projects to improve rural EMS and trauma.

trauma center - a specialized hospital facility distinguished by the immediate availability of specialized surgeons, physician specialists, anesthesiologists, nurses, and resuscitation and life support equipment on a 24 hour basis to care for severely injured patients or those at risk for severe injury

Trauma Nursing Core Course (TNCC) - a verification course providing core-level trauma knowledge and psychomotor skills associated with the delivery of professional nursing care to trauma patient. Developed and sponsored by the Emergency Nurses Association.

trauma registry - a collection of data on patients who receive hospital care for certain types of injuries. Such data are primarily designed to ensure quality trauma care and outcomes in individual institutions and trauma systems, but have the secondary purpose of providing useful data for the surveillance of injury morbidity and mortality.

trauma team - the multidisciplinary group of professionals who have been designated to collectively render care for trauma patients at a designated trauma center

triage - the process of sorting injured patients on the basis of the actual or perceived degree of injury and assigning them to the most effective and efficient regional care resources, in order to insure optimal care and the best chance of survival

triage criteria - measures or methods of assessing the severity of a person's injuries that are used for patient evaluation, especially in the prehospital setting, and that use anatomic and physiologic considerations-and mechanism of injury

uncompensated care - care for which no reimbursement is made

undertriage - directing fewer patients to trauma centers than is warranted because of incorrect identification of patients as having minor injuries when retrospective analysis indicates severe injuries

9-1-1 - a three-digit telephone number to facilitate the reporting of an incident or situation requiring response by a public safety agency

enhanced 9-1-1 - a telephone system that includes automatic number identification, automatic location identification, and (optimally) selective routing, to facilitate appropriate public safety response

APPENDIX A

TRAUMA CARE SYSTEM PLAN COMPONENTS

<u>ADMINISTRATIVE COMPONENTS</u>

I. LEADERSHIP
By State, Regional and/or Local Area[1]:

Lead Agency
- Define and describe role and responsibility of the authority that will take a leadership role in trauma system development (cite statutory, regulatory or policy provisions of authority)
- Provide organizational chart, with short narrative description of duties within the authority and showing relationship to other EMS agency components
- Identify medical and other health care leaders from public and private sectors to assist with trauma system development
- Develop a plan for linkage between trauma system components and the local organ procurement organization

Trauma System Committee
- Define and describe the composition, role, responsibility, and authority for Trauma System committee.
- Display in organizational chart

Trauma Medical Review Committee
- Define and describe role, responsibility, and authority for the Medical Director and Interdisciplinary Medical Review committee
- Display in organizational chart

II. SYSTEM DEVELOPMENT

Trauma System Planning
- Describe the process for needs assessment and identification of appropriate resources
- Describe the process for development and implementation of the trauma care plan, and systematic review of the plan

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[1]As appropriate to individual States, the trauma care system plan should include provisions for each level of organization within the system.

- Describe how professional and consumer groups will participate in the trauma system planning process
- Describe the format for trauma plan implementation and approval: objectives, proposed action plan and implementation schedule
- Describe the process for establishing and implementing guidelines and standards for trauma care

Trauma System Operations
- Describe how the trauma system components are integrated with the EMS system components
- Describe the process for establishing, implementing and maintaining policies, procedures, and protocols for trauma care within the EMS system
- Describe how the trauma system components are integrated with other systems such as regional or Federal agencies (e.g. National Park Services, military bases), Native American Indian lands and contiguous States

III. LEGISLATION

Legislative Activities
- Establish authority for lead agency
- Identify key provisions to be included in trauma system legislation
- Ensure authorization for allocation of sufficient resources to cover the cost of trauma system administration and operations
- Identify potential funding sources for unreimbursed trauma care

IV. FINANCE

Trauma System Administrative Costs
- Document costs associated with trauma system administration and development
    1. Management (lead agency and support committees)
    2. Data collection systems

Trauma System Provider and Facility Costs
- Develop a mechanism for documenting costs, in particular unreimbursed costs, associated with trauma system operations:
  1. Prehospital
  2. Hospital (all levels of trauma care facilities)
  3. Physician
  4. Undercompensated and Uncompensated Care

Trauma System Funding
- Identify potential funding sources to support system administration and the care provided in all levels of trauma care facilities

OPERATIONAL AND CLINICAL COMPONENTS

V.   PUBLIC INFORMATION AND PREVENTION

Public Information and Education
- Develop a plan to heighten public awareness of injury as a public health problem, to promote injury as an entity amenable to injury control countermeasures, to explain the need for a trauma care system, to describe how the trauma system operates and how the system can be accessed
- Establish a trauma constituency to promote trauma system awareness and assist with prevention activities
- Develop a plan to educate elected officials and staff about trauma system issues

Prevention
- Evaluate current injury surveillance information and activities
- Assess current trauma prevention programs
- Identify additional prevention strategies needed to target high risk groups (e.g. trauma patients with alcohol or substance abuse disorders, violence prevention for youth)
- Develop a plan for implementation of comprehensive prevention activities, including provider based interventions

VI.   HUMAN RESOURCES

Workforce Resources
- Define, describe, and estimate the current available numbers, and certification and education levels, of all prehospital personnel
- Define, describe, and estimate the current hospital personnel resources (physician, nurse and other health care professionals) and education levels of personnel required to care for all injured persons
- Document the additional prehospital and hospital resources necessary to meet trauma patients' needs
- Develop strategies for securing necessary personnel

Trauma Training
- Describe current trauma education programs/resources
- Estimate number of personnel, by care giver type, needing basic trauma training and those needing supplemental trauma training to augment current level of training
- Describe mechanisms in place for continuing education in trauma care

VII. PREHOSPITAL

A. COMMUNICATION

Public Access
- Describe the current public access communication system(s) (e.g. 9-1-1/E9-1-1)
- Identify alternative/backup communication systems
- Identify and assess the strengths and weaknesses of the current system(s)

Dispatch Priorities
- Describe current dispatch system(s), training, and standards for dispatch personnel
- Identify and assess the strengths and weaknesses of the current system(s)
- Describe provisions for bystander care based upon Emergency Medical Dispatcher provided instructions

Communication System Integration
- Describe ambulance to dispatch and ambulance to ambulance communication network

- Describe the ambulance to hospital, and hospital to hospital communication network
- Describe multiple public/private agency scene communication (e.g. police to fire to ambulance)
- Identify and describe how these systems interrelate during single patient, multiple patient, mass casualty and disaster incidents

Quality Management
- Identify the process for review and strategies for upgrading the current communication system(s)
- Describe the process for evaluating communication system providers and dispatch activities

B.   MEDICAL DIRECTION

Off-Line and On-Line Medical Direction
- Describe the current system for off-line medical direction of prehospital/interfacility providers
    1. Medical Director qualifications and responsibilities
    2. Policies, procedures, protocols for training, triage, treatment, transport and operations
- Describe the current system for on-line medical direction for prehospital/interfacility providers
    1. On-line Physician Advisor or designee qualifications and responsibilities
    2. Pre-established policies, procedures, protocols for training, triage, treatment, transport and operations
- Describe the mix of health care professionals currently designated to provide patient care services under medical direction
- Identify strategies to strengthen or improve the current on-line and off-line medical direction system

C.   TRIAGE

Trauma Patient Identification
- Define the major trauma patient
- Describe the triage system for identifying the major trauma patient, and the appropriate destination for all injured patients

Hospital Categorization
- Develop triage guidelines and transport protocols based on hospital resources
- Describe how patient needs and hospital resources are to be integrated; specify capabilities for specialty needs (e.g. pediatrics, burns, spinal cord injury)

D. TRANSPORT

Current Demand and Nature of System
- Describe the area to be served by the trauma system (urban, rural, remote, wilderness)
- Describe the population to be served by the trauma system in terms of demography and clinical needs

Ground and Air Ambulances
- Identify the transportation resources and describe their current configuration, staffing and service level
- Describe the process for regulation of transport vehicles, equipment and resources
- Describe the current ambulance deployment methodology(s)
- Describe current transportation/destination policies

System Integration
- Identify current licensed acute care facilities and current service area for each facility
- Identify strategies to strengthen the existing ambulance to hospital transportation system and ongoing mechanism for evaluation

VIII. DEFINITIVE CARE

A. TRAUMA CARE FACILITIES

Trauma Centers
- Identify designation standards for trauma centers including required resources and equipment
- Establish the numbers and severity types of patients for each center

Other Trauma Facilities
- Describe the role and responsibility of other acute care facilities within a trauma system
- Describe the role and responsibility of specialty care facilities (pediatric, burn, spinal cord injury)

Designation Process
- Describe the process for selecting and designating trauma centers
- Describe the process for monitoring designated centers and subsequent redesignation/de-designation

B. INTERFACILITY TRANSFER

Transfer to Trauma Centers
- Describe the policy and procedure for the rapid interfacility transfer of major trauma patients to trauma centers
- Describe the communication linkages between and among the facilities treating injured patients

Transfer from Trauma Centers to Other Facilities
- Describe the process and procedure for transferring patients to their community hospital
- Describe the process and procedure for transferring trauma patients to other specialty care facilities

C. REHABILITATION

Rehabilitation Services
- Describe the process and procedure for initiation and utilization of rehabilitation services

Rehabilitation Facilities
- Identify rehabilitation facilities for continuous care of severely injured or those requiring long term therapies
- Describe how these facilities have been integrated into the trauma care system

IX.   EVALUATION

a. Data Collection

System Data Requirements
- Describe the plan and system for collection and collation of trauma care data from throughout the State, and the population to be included in data collection
- Describe the role and responsibility for agencies and institutions for data collection
- Identify the timeline for implementation of a comprehensive data collection system
- Describe the process for evaluation of the quality of the data, and reporting process
- Develop the process for assuring appropriate patient and provider confidentiality

Data Collection Tools
- Describe the current trauma registry and/or data base system(s)
- Describe the system for linking all trauma related data:
  1. law enforcement accident reports
  2. prehospital run reports
  3. emergency department data
  4. hospital discharge data (including rehabilitation and specialty care facility data)
  5. medical examiner/coroner records
  6. death certificates
  7. insurance records

b. Trauma System Evaluation

Evaluation of System Performance
- Describe the plan for evaluating individual trauma system components and systems operations, including the responsibility for monitoring compliance with standards, maintaining confidentiality and periodic review of trauma facility standards
- Describe the plan for assessing the effectiveness of the system as it relates to meeting the needs of injured persons, availability of appropriate resources, and costs
- Describe the plan and process for patient care evaluations at the system level

c. Trauma Center Evaluation

Trauma Center Quality Management
- Describe the plan for trauma center evaluation including:
    1. Establish the authority, responsibility and organizational structure for the quality management program
    2. Identify the process for documenting corrective action plans, problem re-evaluation and oversight
- Describe the process for monitoring quality of care including:
    1. establishment of standards of care
    2. mechanism for concurrent review
    3. systematic evaluation of audit filters for case review
    4. mechanism for multidisciplinary case review
    5. statistical overview and trending of patient related data including process and outcome indicators
    6. outcome review
- Describe the data collection system to support quality management activities
    1. trauma registry
    2. medical examiner's report

d. Research

Trauma Care Research
- Develop a plan for trauma research activities, including functional outcome research
- Incorporate research activities as part of the trauma system assessment and utilization review

Research Funding
- Describe the process to fund continued research activities within the trauma system

APPENDIX B
HEALTH RESOURCES AND SERVICES ADMINISTRATION
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HEALTH RESOURCES AND SERVICES ADMINISTRATION
Bureau of Health Resources Development
MODEL TRAUMA CARE SYSTEM PLAN
DEVELOPMENT MEETING
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