



**Trauma System Consultation
State of Colorado
Denver, Colorado**

May 17th-20th, 2009

**American College of Surgeons
Committee on Trauma**

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Executive Summary

American College of Surgeons Colorado Trauma System Consultation Visit

Overview

Colorado is the 8th largest state geographically, encompassing 103,730 square miles, divided into 64 counties. Eighty-one percent of the state's total population (approximately 4.9 million, 2007 Population Estimates, Colorado State Demographers Office) is concentrated in the Denver metropolitan area and Front Range regions (11 counties), and eighty-six percent is classified as living in the 17 total "urban counties" some of which are only adjacent to metro areas and are actually quite remote. This leaves 14% of the population (approximately 690,000) widely distributed across the rest of the state. This largely rural and frontier state possess approximately 190 ground ambulance services, 17 air transport agencies, and approximately 245 non-transporting agencies (e.g., fire departments, ski patrols, search and rescue teams). Sixty percent of Colorado's ground agencies provide emergency care and transportation in rural and frontier areas of the state.

Colorado has 77 acute care hospitals across the state; however, 18 (28%) counties have no hospital. Sixty-five (84%) hospitals are designated as trauma centers at levels I – V. Importantly, five of the undesignated facilities serve rural and frontier communities as the sole provider, and they are located at considerable distances from the nearest trauma center. In an effort to ensure greater patient access to trauma care in rural and frontier areas, Colorado allows facilities licensed as community clinics with emergency centers (CCECs) to become designated trauma centers.

Trauma is the leading cause of death for Coloradans in the 1 to 44 year age range. Trauma is the third leading cause of death overall, behind heart disease and cancer, and results in approximately 3,000 deaths per year. In addition to motor vehicle crashes and other injury mechanisms, suicide is a leading cause of trauma mortality. Colorado's suicide mortality rate traditionally ranks in the top ten of all states, often at a rate 1.5 times higher than the national average. Falls are the leading cause of injury hospitalizations.

The evolution of Colorado's trauma response efforts began in the late 1980s and early 1990's concurrent with trauma system development across the nation. Legislation to create a state-regulated voluntary inclusive trauma system, with the Colorado Department of Public Health and Environment as the lead state agency, was passed in 1995. The notion of an inclusive trauma system was visionary in 1995, enabling the state to address the needs of less severely injured patients and patients needing services in rural areas. However, this statute does not permit the lead agency to limit the level of facility participation to match patient

needs within a geographic location. This has resulted in a large number of high level, costly and competing trauma centers along the Front Range.

The appropriate matching of the level of participation based on patient needs should not in any way diminish the exemplary commitment, of people and facilities, across the entire state to do their part in caring for injured patients – all should be encouraged to continue to do so in the spirit of a truly inclusive trauma system. This is particularly critical in the rural and frontier areas of the state.

The EMS and Trauma Advisory Committees were merged in 2000 in an effort to integrate EMS and trauma services. However, the trauma system needs appear to have been de-emphasized in the current State Emergency Medical and Trauma Services Advisory Council (SEMTAC), especially since there is no trauma subcommittee. This same unbalanced advisory and planning structure exists in many of the eleven Regional Emergency Medical and Trauma Advisory Councils (RETACs) as well.

Colorado has a long history of data collection with more than ten years of legacy data in the Colorado Trauma Registry. The addition of prehospital data beginning in 2006 through the State developed MATRIX software system adds another data source for potential performance improvement processes at the local, regional, and state level. Unfortunately, these and several other data sources have been primarily used for epidemiologic descriptions of the injury problem, and little information has been used to evaluate the system or for performance improvement. The lack of absolute protection/confidentiality of data for multi-disciplinary, multi-institutional/provider performance improvement at all levels is another major hindrance to trauma system development in Colorado.

The Emergency Medical and Trauma System (EMTS) Section has seen a resurgence of quality leadership in the past several years. That leadership is well respected and appreciated by trauma system leaders throughout the state. However, until the recent passage of SB09-002, signed by Governor Ritter on May 19, 2009, the EMTS was understaffed, particularly as it pertains to trauma system development, monitoring, and improvement. The likely addition of one staff member to assist with these processes should provide an opportunity for thoughtful improvement of the trauma system.

Despite the challenges posed by urban, rural, and frontier trauma care, the Colorado trauma system has the potential to become one of the premier systems in the United States with the addition of new resources and the utilization of recommendations in this report. However, strong leadership by both the EMTS Section and the medical community will be required. Even though Colorado's motto is *Nil Sine Numine*, it is clear that in addition to divine guidance, the attainment of a high quality trauma system in Colorado will also require the dedicated work of a host of mere mortals to do the heavy lifting. We wish you the best of luck in that endeavor and stand by ready, and willing, to assist.

Assets and Advantages

- The EMTS Section has broad authority for the trauma system.

- The EMTS Section has gained the respect of the trauma community.
- EMS and trauma are integrated.
- A large group of interested stakeholders exist for the trauma system and injury prevention.
- Rule 500 defines the duties of EMS medical directors and the scope of practice for EMTs and paramedics.
- Air medical agencies and EMS training programs are all accredited.
- A new infusion of funding is available to support the trauma and EMS system.
- Prehospital trauma triage and transfer guideline rules exist.
- Excellent acute care facility commitment to the trauma system is evident from the large number of designated trauma centers.
- Colorado has national leaders in the research and delivery of leading edge trauma care.
- Colorado has a pediatric regional trauma referral center.
- Extensive epidemiologic data resources are available.

Challenges, Vulnerabilities, and Opportunities

- No rules exist to protect data confidentiality for system continuous quality improvement (CQI) or protection of the peer review process at the regional level.
- The current advisory committee structure has no focused trauma advisory group.
- The state does not have a full time medical director for the trauma and EMS system.
- Regulation of the trauma and EMS system is shared by the Colorado Department of Public Health and Environment, the Board of Medical Examiners, the Department of Public Safety, and the county commissioners.
- A lack of collaboration between trauma centers was noted by the site visit team.
- No trauma system plan has been developed.
- No trauma system needs assessment has been conducted.
- Prehospital trauma triage and transfer guidelines are not monitored for compliance.
- No central communication system exists to coordinate interfacility transfer and transport.
- The trauma center designation process is variable with both a state designation and ACS verification process for level I and II trauma centers.
- The trauma system is information poor as the existing data are not well utilized to assess, monitor, and evaluate the system.
- All acute care facilities do not submit trauma registry data.

- The definition of an “inclusive trauma system” within the State should be evaluated and refined if necessary.

Priority Recommendations

Statutory Authority and Administrative Rules

- Revise the statute to authorize limits on level and location of trauma centers commensurate with patient needs.
- Assure the protection of the data and the trauma quality improvement process at local, regional, and state levels.
 - The EMTS Section should establish administrative rules or take any other necessary action.
 - Seize the opportunity to incorporate protection for the multidisciplinary performance improvement peer review process during the review of the sunseting Medical Practice Act.
- Consolidate all regulatory oversight of emergency medical services (EMS) and trauma system functions within the Colorado Department of Public Health and Environment through the EMTS Section.
 - This includes responsibilities and authorities currently assigned to the Board of Medical Examiners, Department of Public Safety, and Colorado counties.

System Leadership

- Create a Multidisciplinary Trauma Advisory Committee (MTAC) of State Emergency Medical and Trauma Advisory Committee (SEMTAC) to assist SEMTAC in addressing trauma system issues.

Lead Agency

- Employ a 1.0 FTE physician state medical director to oversee the clinical aspects of the trauma and EMS system.
 - This position will require expertise in both trauma and EMS clinical care.

Trauma System Plan

- Perform a *patient-focused* in-depth statewide *needs assessment study* to determine the appropriate level and geographic location of trauma centers for the state.
- Develop a plan for statewide trauma system implementation based on the needs assessment study, using the authority of the existing enabling legislation.
 - Use the Health Resources and Services Administration’s Model Trauma System Planning and Evaluation document as a guideline for system development.

- Evaluate and consider refining Colorado’s definition of an “inclusive system.”
 - Modify rules and regulations to assure optimal patient outcomes and a model of value-based medical care

Definitive Care Facilities

- Perform a *patient-focused* in-depth statewide *needs assessment study* to determine the appropriate level, number, and geographic location of trauma centers for the state.

System Coordination and Patient Flow

- Establish a statewide central communications system to coordinate and secure expeditious transports and interfacility transfers with one call.

System-wide Evaluation and Quality Assurance

- Develop a statewide trauma system performance improvement plan (PI) in collaboration with trauma system constituents within the next 12 months.
 - Consider using a contractor for development of the plan
 - Query other states for a template.

Trauma Management Information Systems

- Collect trauma registry data from all hospitals in order to conduct a complete and comprehensive assessment of trauma care in Colorado.
 - Select a minimum dataset for trauma participating facilities at lower level designations or without designation in addition to the dataset already collected from hospital discharge.
 - Continue development of a web-based portal for data entry.

Trauma System Assessment

Injury Epidemiology

Purpose and Rationale

Injury epidemiology is concerned with the evaluation of the frequency, rates, and pattern of injury events in a population. Injury pattern refers to the occurrence of injury-related events by time, place, and personal characteristics (for example, demographic factors such as age, race, and sex) and behavior and environmental exposures, and, thus, it provides a relatively simple form of risk-factor assessment.

The descriptive epidemiology of injury among the whole jurisdictional population (geographic area served) within a trauma system should be studied and reported. Injury epidemiology provides the data for public health action and becomes an important link between injury prevention and control and trauma system design and development. Within the trauma system, injury epidemiology has an integral role in describing the root causes of injury and identifying patterns of injury so that public health policy and programs can be implemented. Knowledge of a region's injury epidemiology enables the identification of priorities for directing better allocation of resources, the nature and distribution of injury prevention activities, financing of the system, and health policy initiatives.

The epidemiology of injury is obtained by analyzing data from multiple sources. These sources might include vital statistics, hospital administrative discharge databases, and data from emergency medical services (EMS), emergency departments (EDs), and trauma registries. Motor-vehicle crash data might also prove useful, as would data from the criminal justice system focusing on interpersonal conflict. It is important to assess the burden of injury across specific population groups (for example, children, elderly people and ethnic groups) to ensure that specific needs or risk factors are identified. It is critical to assess rates of injury appropriately and, thus, to identify the appropriate denominator (for example, admissions per 100,000 population). Without such a measure, it becomes difficult to provide valid comparisons across geographic regions and over time.

To establish injury policy and develop an injury prevention and control plan, the trauma system, in conjunction with the state or regional epidemiologist, should complete a risk assessment and gap analysis using all available data. These data allow for an assessment of the "injury health" of the population (community, state, or region) and will allow for the assessment of whether injury prevention programs are available, accessible, effective, and efficient.

An ongoing part of injury epidemiology is public health surveillance. In the case of injury surveillance, the trauma system provides routine and systematic data collection and, along with its partners in public health, uses the data to complete injury analysis, interpretation, and dissemination of the injury information. Public health officials and trauma leaders should use injury surveillance data to describe and monitor injury events and emerging injury trends in their jurisdictions; to identify emerging threats that will call for a reassessment of priorities

and/or reallocation of resources; and to assist in the planning, implementation, and evaluation of public health interventions and programs.

OPTIMAL ELEMENTS

I. There is a thorough description of the epidemiology of injury in the system jurisdiction using population-based data and clinical databases. **(B-101)**

- a. There is a thorough description of the epidemiology of injury mortality in the system jurisdiction using population-based data. **(I-101.1)**
- b. There is a description of injuries within the trauma system jurisdiction, including the distribution by geographic area, high-risk populations (pediatric, elderly, distinct cultural/ethnic, rural, and others), incidence, prevalence, mechanism, manner, intent, mortality, contributing factors, determinants, morbidity, injury severity (including death), and patient distribution using any or all the following: vital statistics, ED data, EMS data, hospital discharge data, state police data (data from law enforcement agencies), medical examiner data, trauma registry, and other data sources. The description is updated at regular intervals. **(I-101.2)**

Note: Injury severity should be determined through the consistent and system-wide application of one of the existing injury scoring methods, for example, Injury Severity Score (ISS).

- c. There is comparison of injury mortality using local, regional, statewide, and national data. **(I-101.3)**
- d. Collaboration exists among EMS, public health officials, and trauma system leaders to complete injury risk assessments. **(I-101.4)**
- e. The trauma system works with EMS and public health agencies to identify special at-risk populations. **(I-101.7)**

II. Collected data are used to evaluate system performance and to develop public policy. **(B-205)**

- a. Injury prevention programs use trauma management information system data to develop intervention strategies. **(I-205.4)**

III. The trauma, public health, and emergency preparedness systems are closely linked. **(B-208)**

- a. The trauma system and the public health system have established linkages, including programs with an emphasis on population based public health surveillance and evaluation for acute and chronic traumatic injury and injury prevention. **(I-208.1)**

IV. The jurisdictional lead agency, in cooperation with the other agencies and organizations, uses analytic tools to monitor the performance of population based prevention and trauma care services. **(B-304)**

- a. The lead agency, along with partner organizations, prepares annual reports on the status on injury prevention and trauma care in the state, regional, or local areas. **(I-304.1)**
- b. The trauma system management information system database is available for routine public health surveillance. There is concurrent access to the databases (ED, trauma, prehospital, medical examiner, and public health epidemiology) for the purpose of routine surveillance and monitoring of health status that occurs regularly and is a shared responsibility. **(I-304.2)**

CURRENT STATUS

The data and data sources available for injury epidemiology in Colorado are extensive. Additionally, the Emergency Medical Trauma System (EMTS) Section has a full-time injury epidemiologist, and some of her time is dedicated to injury data analysis. The epidemiologist has long standing relationships with several agencies, enabling her to gain access to their databases for injury surveillance.

The Colorado Department of Public Health and Environment (CDPHE) has established an injury epidemiology web-based data query system, the Colorado Health Information Dataset. This population-based dataset, including vital statistics and hospital discharge (UB04) data, allows stakeholders and consumers to easily obtain county- and region-specific injury data. *Injury in Colorado*, published in 2005 provides an extensive description of injury for all the major mechanisms of injury, including: motor vehicle, other transportation, falls, unintentional poisoning, fire and burn, drowning, unintentional injury, suicide, and homicides and assault. This report along with several additional updated injury epidemiology reports, are available to the trauma and injury prevention community on the state web site.

While the epidemiologist in the EMTS Section is a significant resource for the trauma system, the demands for, and interest in, having more data analysis from the trauma and EMS community cannot be met with existing personnel. The EMTS Section has recommended the addition of a data analyst to support the Colorado trauma registry and EMS Ambulance Trip Report Information Exchange (MATRIX) as a priority for the new funding.

Trauma center directors stated a desire for more statewide data about patients treated. For example, routine trauma outcome specific reports generated from the data currently submitted to the trauma registry do not occur at the state level. Explanations regarding the limited focus on the analysis of such data were reported by the injury epidemiologist to be the following:

- lack of guidance from the trauma center directors and trauma managers on issues to investigate,
- competing priorities for the injury epidemiologist's time,
- customization of registries in trauma centers was reported that may result in an inconsistent application of trauma data element definitions by individual trauma centers, and

- all trauma participating facilities do not contribute data (only level I, II, and III trauma centers contribute data to the state trauma registry, so the state trauma registry data are not population-based).

A new school of public health was recently launched in the state. This school could become a significant resource for injury epidemiology if a relationship is established and projects for graduate students were identified.

The state has experience with probabilistic data linkage, but injury databases, the trauma registry, and MATRIX are not currently linked. The lack of a common patient identifier is viewed as a significant barrier for data linkage. It was reported that the Department of Transportation will soon launch a major initiative to link traffic safety databases, and a request for linkage with the trauma registry and MATRIX is forthcoming.

The report that 19% of injury deaths occurred in the hospital was of concern to the TSC team; it was thus assumed that 81% of injury deaths occurred out of hospital. Information provided subsequent to the visit helped clarify this issue. In fact, 30.6% die in the emergency department and hospital, and approximately 64% die at the scene or are dead on arrival. This figure is similar to other states when poisoning and drowning is included in the count of trauma deaths. The state may wish to modify how trauma deaths are reported to exclude poisoning and drowning so that the death rate corresponds to the patients cared for by trauma centers.

RECOMMENDATIONS

- Develop a relationship with the new school of public health and identify injury epidemiology projects for graduate students to increase the depth and breadth of injury data that can be analyzed.
- Actively recruit other agencies, academic centers, institutions, the Colorado Injury Control Research Center, the Rocky Mountain injury institute, etc. to expand the injury epidemiology capabilities.
- Continue the partnership with the Department of Transportation and share the trauma registry and MATRIX data so that data linkage with other important databases occurs routinely.
- Move toward development of trauma datasets (trauma registry and MATRIX) that are population-based.
- Expand the focus of the trauma system's injury epidemiology to report on trauma patient outcomes for selected priority injury mechanisms in the state's injury strategic plan.
 - Relate these patient outcomes to the functioning of the trauma system

- Modify the definition of trauma deaths for monitoring and reporting to exclude poisonings and drowning so that findings correspond to the patients treated by trauma centers.

Indicators as a Tool for System Assessment

Purpose and Rationale

In the absence of validated national benchmarks, or norms, the benchmarks, indicators and scoring (BIS) process included in the Health Resources and Services Administration's *Model Trauma System Planning and Evaluation* document provides a tool for each trauma system to define its system-specific health status benchmarks and performance indicators and to use a variety of community health and public health interventions to improve the community's health status. The tool also addresses reducing the burden of injury as a community-wide public health problem, not strictly as a trauma patient care issue.

This BIS tool provides the instrument and process for a relatively objective state and sub-state (regional) trauma system self-assessment. The BIS process allows for the use of state, regional, and local data and assets to drive consensus responses to the BIS. It is essential that the BIS process be completed by a multidisciplinary stakeholder group, most often the equivalent of a state trauma advisory committee. The BIS process can help focus the discussion on various system strengths and weaknesses, can be used to set goals or benchmarks, and provides the opportunity to target often limited resources and energies to the areas identified as most critical during the consensus process. The BIS process is useful to develop a snapshot of any given system at a moment in time. However, its true usefulness is in repeated assessments that reveal progress toward achieving various benchmarks identified in the previous application of the BIS. This process further permits the trauma system to refine goals to be attained before future reassessments using the tool.

OPTIMAL ELEMENT

- I. Assurance to constituents that services necessary to achieve agreed-on goals are provided by encouraging actions of others (public or private), requiring action through regulation, or providing services directly. **(B-300)**

CURRENT STATUS

A representative group of stakeholders completed assessment of the select group of 16 indicators from the federal Health Resources and Services Administration (HRSA) Model Trauma System Planning and Evaluation (MTSPE) document. Additionally, a broader number of stakeholders convened at locations throughout the state and provided feedback on the strengths and weaknesses of the current trauma system. These comments were captured in an open-ended format and without structured qualitative analysis, thus they will not be useful in the ongoing evaluation of the system. This limitation does not diminish the utility of the comments in the identification of current system challenges and opportunities.

The EMTS Section has indicated a desire to complete the entire BIS to establish a baseline for repeated measures that could be used to monitor system evolution. A formalized BIS assessment conducted by a facilitator would provide an opportunity to engage a specific

trauma stakeholder constituency group in the process. A facilitator could assist the stakeholder group to use the BIS indicator findings and identify priorities for trauma system development or enhancement to be addressed in the trauma system plan. Results from the BIS will be useful as a benchmark for evaluation of progress in implementing the plan.

RECOMMENDATIONS

- Convene a group of 30-40 key stakeholders identified from trauma directors, trauma managers, rehabilitation personnel, prehospital personnel, select Regional Emergency Medical and Trauma Advisory Committee (RETAC) representatives, public health, public safety, emergency preparedness, and others and conduct a facilitated BIS evaluation.
- Incorporate the findings of the benchmarks, indicators and scoring (BIS) assessment into the formal trauma system plan.
 - Identify trauma system priorities and establish targets for change in key indicators, based upon the initial BIS scoring.
- Conduct repeated measures of key indicators to mark trauma system development progress over time.
- Report progress to the trauma community, media, and legislators.

Trauma System Policy Development

Statutory Authority and Administrative Rules

Purpose and Rationale

Reducing morbidity and mortality due to injury is the measure of success of a trauma system. A key element to this success is having the legal authority necessary to improve and enhance care of injured people through comprehensive legislation and through implementing regulations and administrative code, including the ability to regularly update laws, policies, procedures, and protocols. In the context of the trauma system, comprehensive legislation means the statutes, regulations, or administrative codes necessary to meet or exceed a prescribed set of standards of care. It also refers to the operating procedures necessary to continually improve the care of injured patients from injury prevention and control programs through post-injury rehabilitation. The ability to enforce laws and rules guides the care and treatment of injured patients throughout the continuum of care.

There must be sufficient legal authority to establish a lead trauma agency and to plan, develop, maintain, and evaluate the trauma system during all phases of care. In addition, it is essential that as the development of the trauma system progresses, included in the legislative mandate are provisions for collaboration, coordination, and integration with other entities also engaged in providing care, treatment, or surveillance activities related to injured people. A broad approach to policy development should include the building of system infrastructure that can ensure system oversight and future development, enforcement, and routine monitoring of system performance; the updating of laws, regulations or rules, and policies and procedures; and the establishment of best practices across all phases of intervention. The success of the system in reducing morbidity and mortality due to traumatic injury improves when all service providers and system participants consistently comply with the rules, have the ability to evaluate performance in a confidential manner, and work together to improve and enhance the trauma system through defined policies.

OPTIMAL ELEMENTS

I. Comprehensive state statutory authority and administrative rules support trauma system leaders and maintain trauma system infrastructure, planning, oversight, and future development. **(B-201)**

- a. The legislative authority states that all the trauma system components, emergency medical services (EMS), injury control, incident management, and planning documents work together for the effective implementation of the trauma system (infrastructure is in place). **(I-201.2)**
- b. Administrative rules and regulations direct the development of operational policies and procedures at the state, regional, and local levels. **(I-201.3)**

II. The lead agency acts to protect the public welfare by enforcing various laws, rules, and regulations as they pertain to the trauma system. **(B-311)**

- a. Laws, rules, and regulations are routinely reviewed and revised to continually strengthen and improve the trauma system. **(I-311.4)**

CURRENT STATUS

The Emergency Medical and Trauma Services Act, C.R.S. § 25-3.5-101, was amended in 1995 with revisions to the sections providing for the statewide trauma care system. The law includes comprehensive authority for CDPHE to function as the lead agency for emergency medical services (EMS) and trauma system development activities. The CDPHE assigned the EMTS Section to manage the trauma system. Included in the existing statute are abilities for the CDPHE to:

- Designate and de-designate trauma centers as Level I through V, nondesignated, or regional pediatric trauma centers
- Collect data from facilities treating trauma patients and from ground and air transport agencies
- Certify emergency medical technicians
- License air ambulances
- Receive funds from the Highway Users Tax Fund and allocate them for several different purposes, including trauma system development through the EMTS grant program
- Establish trauma system rules through the Colorado Board of Health
- Protect confidential patient data and maintain the confidentiality of a statewide quality improvement system

Despite the broad authority existing in the current law, Colorado is facing a number of issues related to statutory authority and administrative rules. No specific funding mechanism is dedicated for trauma system development or for operations. The recently expanded EMS account within the Highway Users Tax Fund represents a substantial new resource that can be used for trauma system purposes. As a practical matter, these funds have not historically been applied to this purpose. Within the State Emergency Medical and Trauma Services Advisory Committee (SEMTAC), the use of available State grant funds for trauma system purposes has not been previously explored.

Colorado has an established process for designating trauma centers that is voluntary. Hospitals not only decide to seek designation, but they choose their preferred trauma center level when submitting an application. Funding for the designation process comes from application fees. With this voluntary approach, the participation of hospitals in the designation process is surprisingly high. Designation is based upon State-specific criteria and some facilities also participate in a trauma center verification process by the American College of Surgeons. Hospital re-designation is conducted every 3 years.

A waiver process exists for requirements in the State's designation criteria. It was reported by participants that some facilities do not actually meet the State's established requirements for designation. A parallel problem is that some hospitals are functional at a level higher than their designation and are informally functioning at that higher level. The designation process is not based on an assessment of the needs of trauma patients in a particular geographic area. The use of waivers for level I, II, III, IV and V trauma centers should be eliminated unless they are time limited and follow-up is conducted to ensure that compliance has been achieved. The state's lack of ability to limit the number and level of trauma centers based on patient need is a significant problem that needs to be addressed.

Quality improvement (QI) programs have not been implemented at a regional level due to concerns about the ability to protect the process. The explanation provided by participants was that, while the law contains statutory provisions for protection of a QI process, rules to implement the protections have never been created. The State has protection for a state level QI process, but no on-going activity has been initiated. The State's Medical Practice Act is scheduled to "sunset" in the near future. As this act is being reviewed, an opportunity may exist to insert assurance that the trauma and EMS QI process as well as the data used are protected at all levels.

Criteria exist in rule for the triage and transfer of patients. Despite this relatively formalized status, variability and local interpretation of the criteria were reported at the regional level. The effect of this variability is erosion of the consistency and predictability of the system of trauma care. The lack of an ongoing State and regional QI review makes it impossible to measure the compliance with, and the effectiveness of, triage and transfer criteria.

The regulation of EMS is a shared function between the EMTS Section, the Department of Public Safety (DPS), the counties, and the State Board of Medical Examiners. While the EMTS Section establishes the minimum standards that counties apply when granting ambulance service licenses, it is not known how consistently these standards are applied or enforced. Dividing EMS regulation between four different agencies invites inconsistencies and does not appear to serve either the public or the EMS agencies and personnel being regulated. A strong history of "home rule" partly explains how this regulatory model evolved. If Colorado is to have a true EMS and trauma system, assuring the consistency of regulation under a central lead agency is an essential step.

The CDPHE, through the EMTS Section, has authority in statute to regulate the collection of data from ambulance services, trauma centers, and non-designated hospitals. While the data reporting by level I, II, and III trauma centers was reported as highly reliable, ambulance data collection is less so. Trauma registry data are not collected from level IV and V trauma centers or non-designated facilities. The number and type of data elements currently captured in the MATRIX data system at the state level reflect only the National Elements subset of the federal National Emergency Medical Services Information System (NEMSIS) dataset. A more complete prehospital dataset that includes patient care elements is necessary in future efforts to link trauma care data and to monitor the performance of the trauma system.

RECOMMENDATIONS

- **Revise the statute to authorize limits on level and location of trauma centers commensurate with patient needs.**
- **Assure the protection of the data and the trauma quality improvement process at local, regional, and state levels.**
 - **The EMTS Section should establish administrative rules or take any other necessary action.**
 - **Seize the opportunity to incorporate protection for the multidisciplinary performance improvement peer review process during the review of the sunseting Medical Practice Act.**
- **Consolidate all regulatory oversight of emergency medical services (EMS) and trauma system functions within the Colorado Department of Public Health and Environment through the EMTS Section.**
 - **This includes responsibilities and authorities currently assigned to the Board of Medical Examiners, Department of Public Safety, and Colorado counties.**
- Enforce 100% submission of EMS data by EMS agencies to the EMTS data collection system.
 - Promote collaboration between the EMTS Section and counties to achieve compliance.
- Dedicate a portion of the new grant funds for trauma system development.
 - Priority focus areas include a statewide needs assessment, development of a trauma system plan, a quality improvement process, and a preventable mortality study.
- Assure all hospitals being designated as trauma centers at levels I, II, and III meet the established criteria without waivers.
- Assure compliance with the triage and transfer criteria for trauma patients on a continual basis and adjust the rule as necessary.

System Leadership

Purpose and Rationale

In addition to lead agency staff and consultants (for example, trauma system medical director), there are other significant leadership roles essential to developing mature trauma systems. A broad constituency of trauma leaders includes trauma center medical directors and nurse coordinators, prehospital personnel, injury prevention advocates, and others. This broad group of trauma leaders works with the lead agency to inform and educate others about the trauma system, implements trauma prevention programs, and assists in trauma system evaluation and research to ensure that the right patient, right hospital, and right time goals are met. There is a strong role for the trauma system leadership in conveying trauma system messages, building communication pathways, building coalitions, and collaborating with relevant individuals and groups. The marketing communication component of trauma system development and maintenance begins with a consensus-built public information and education plan. The plan should emphasize the need for close collaboration between coalitions and constituency groups and increased public awareness of trauma as a disease. The plan should be part of the ongoing and regular assessment of the trauma system and be updated as frequently as necessary to meet the changing environment of the trauma system.

When there are challenges to providing the optimal care to trauma patients within the system, the leadership needs to effect change to produce the desired results. Broad system improvements require the ability to identify challenges and the resources and authority to make changes to improve system performance. However, system evaluation is a shared responsibility. Although the leadership will have a key role in the acquisition and analysis of system performance data, the multidisciplinary trauma oversight committee will share the responsibility of interpreting those data from a broad systems perspective to help determine the efficiency and effectiveness of the system in meeting its stated performance goals and benchmarks. All stakeholders have the responsibility of identifying opportunities for system improvement and bringing them to the attention of the multidisciplinary committee or the lead agency. Often, subtle changes in system performance are noticed by clinical care providers long before they become apparent through more formal evaluation processes.

Perhaps the biggest challenge facing the lead agency is to synergize the diversity, complexity, and uniqueness of individuals and organizations into a finely tuned system for prevention of injury and for the provision of quality care for injured patients. To meet this challenge, leaders in all phases of trauma care must demonstrate a strong desire to work together to improve care provided to injured victims.

OPTIMAL ELEMENTS

- I. Trauma system leaders (lead agency, trauma center personnel, and other stakeholders) use a process to establish, maintain, and constantly evaluate and

improve a comprehensive trauma system in cooperation with medical, professional, governmental, and other citizen organizations. **(B-202)**

- II. Collected data are used to evaluate system performance and to develop public policy. **(B-205)**
- III. Trauma system leaders, including a trauma-specific statewide multidisciplinary, multiagency advisory committee, regularly review system performance reports. **(B-206)**
- IV. The lead agency informs and educates state, regional, and local constituencies and policy makers to foster collaboration and cooperation for system enhancement and injury control. **(B-207)**

CURRENT STATUS

A critical component of any trauma system is to have a designated lead agency. The CDPHE was designated as the lead agency in the 1995 enabling legislation.

The state's medical community has, historically, been a driving force for the development of a statewide trauma system. This strength benefited the state with the passage of legislation in 1995 to establish a formal trauma system regulated by the state. This early commitment by the statewide medical community continues today, as evidenced by the representation from all regions of the state during the trauma system consultation (TSC) site visit. The passion and commitment of these individuals was apparent in the open, honest, and highly informed discussions that took place.

The Chief of the EMTS Section assumed his position in 2004 and has been rebuilding this office. He has engendered the trust of the stakeholders from across the state, from urban, rural, and frontier areas. This trust will be valuable as the next steps are taken in statewide trauma system development. Evidence of his leadership was found in the passage of the legislation to increase the Highway User's Tax fund allocation to the EMTS Section. This EMS/trauma funding bill was signed into law by Governor Ritter on May 19, 2009.

A challenge that Colorado faces in moving the statewide trauma system forward is establishing a more appropriate balance between emphasis and resources dedicated to emergency medical services (EMS) versus trauma. To date, the emphasis and resources have been heavily weighted for EMS, as was evident in the deliberations and actions of the SEMTAC, which has an important advisory role for the EMTS Section. The presence and participation of the SEMTAC chairperson during the consultation visit was extremely positive. He demonstrated an interest and commitment to the development of a statewide trauma system plan that integrates EMS and trauma components.

Information from participants indicated that the RETACs are also generally focused more on EMS than clinical trauma issues. However, it was apparent to the site visitors that commitment and expertise exists in various RETACs to address both the EMS and trauma issues. This will be particularly valuable when an appropriate infrastructure for statewide

collaboration exists between the RETACs with differing areas of interest and expertise (e.g., urban, rural, and frontier).

The RETACs appear to function relatively independently with little guidance from the SEMTAC or the EMTS Section. Contracts between the EMTS Section and RETACs require the regular submission of reports, but little in the way of specific activities or priority projects to address during the contract period. RETAC representatives reportedly attend SEMTAC meetings, but RETACs are not seen as vehicles for implementation of SEMTAC initiatives. Contracts with the RETACs that include specific priorities or activities in support of EMS and trauma system development could be a good vehicle for a more unified approach to system development.

In terms of leadership, the SEMTAC plays an important advisory role for EMTS and this role will be strengthened by the creation of a Multidisciplinary Trauma Advisory Committee (MTAC). Such a committee, composed of trauma stakeholders, will provide much needed trauma leadership and expertise for trauma system statewide planning and implementation. The MTAC would also be helpful in assisting the EMTS Section to design and implement such critical trauma system elements as a system-wide quality improvement process.

RECOMMENDATIONS

- **Create a Multidisciplinary Trauma Advisory Committee (MTAC) of State Emergency Medical and Trauma Advisory Committee (SEMTAC) to assist SEMTAC in addressing trauma system issues.**
- Task the MTAC to oversee all clinical components of the trauma system, including quality improvement and compliance with clinical care guidelines (e.g., trauma triage, interfacility transfer).
- Assure that SEMTAC supports the Lead agency's efforts in dealing with trauma system issues (e.g. monitoring each phase of trauma care, the trauma center designation process, etc.)
- Provide guidance to the Regional Emergency Medical and Trauma Advisory Committees (RETACs), through the SEMTAC, regarding priority trauma system issues or projects.
- Specify priority tasks in the RETAC contract in support of state trauma system development and hold them accountable for the accomplishment of those priorities.
- Establish an infrastructure for RETACs to collaborate and regularly communicate with each other for exchange of programmatic issues, best clinical practices, prevention programs etc.

Fulfill the state mandate for system-wide quality improvement and positively influence public policy, through a collaborative effort involving the lead agency, with support of SEMTAC, and in concert with RETACs and other community leaders.

Coalition Building and Community Support

Purpose and Rationale

Coalition building is a continuous process of cultivating and maintaining relationships with constituents (interested citizens) in a state or region who agree to collaborate on injury control and trauma system development. Key constituents include health professionals, trauma center administrators, prehospital care providers, health insurers and payers, data experts, consumers and advocates, policy makers, and media representatives. The coalition of key constituents comprises the trauma system's stakeholders. The involvement of these key constituents is important for the following:

- Trauma system plan development
- Regionalization: promoting collaboration rather than competition between trauma centers
- System integration
- State policy development: authorizing legislation and regulations
- Financing initiatives
- Disaster preparedness

The coalition should be effectively organized through the formation of multidisciplinary state and regional advisory groups to coordinate trauma system planning and implementation efforts. Constituents also communicate with elected officials and policy leaders regarding the development and sustainability of the trauma system. Information and education are needed by constituents to be effective partners in policy development for trauma system planning. Regular communication about the status of the trauma system helps these key partners to recognize needs and progress made with trauma system implementation.

One of the most effective ways to educate elected officials and the public is through an organized public information and education effort that may involve a media campaign about the burden of injury in the state and the need for trauma system development. Information and education are important to reduce the incidence of injury in all age groups and to demonstrate the value of an effective trauma system when a serious injury occurs.

OPTIMAL ELEMENT

- I. The lead agency informs and educates state, regional, and local constituencies and policy makers to foster collaboration and cooperation for system enhancement and injury control. **(B-207)**

CURRENT STATUS

Colorado is blessed with the number of individuals participating and interested in the trauma system. The large representation of these individuals at the TSC site visit is commendable, both to the EMTS Section that encouraged their participation and to the stakeholders who attended. The trauma managers and trauma registrars have formed the Colorado Trauma

Network, and they meet quarterly. Past meeting minutes reflect discussions related to trauma registry definitions, training for data coding, and improvements for the network's website. In addition to the trauma and EMS stakeholders, the state also has a large coalition of injury prevention stakeholders who address a significant component of the trauma system.

The interest of stakeholders in the EMS and trauma system was further apparent by their ability to mobilize and reach the state legislators to seek passage of the Highway User's Tax Fund bill that increased funding for the EMS and trauma system. Two legislators were identified as current champions for the EMS and trauma system, but it was also reported that state legislators have term limits, so recruitment of new legislative champions is a continuing need.

Despite the large number of stakeholders and interest in trauma and injury prevention, stakeholders are not well integrated into the planning and implementation process for a trauma system. No forum exists to easily bring trauma stakeholders together to foster collaboration for trauma system development. While the concept of the SEMTAC is good for promoting the integration of EMS and trauma system development, the most recent reorganization of the SEMTAC committees discontinued a trauma system specific committee. Thus, no group of trauma stakeholders exists to develop and make recommendations to the SEMTAC for comprehensive trauma system development. Despite the representation of trauma stakeholders on SEMTAC, other trauma stakeholders may feel disengaged and undervalued in the trauma system development process. Additionally, the state's American College of Surgeons (ACS) Committee on Trauma has no designated role on either the SEMTAC or in supporting the State's trauma system development. While the trauma managers and trauma registrars meet regularly through the Colorado Trauma Network, it is not clear that this organization has any direct relationship with the SEMTAC. This has resulted in a lack of collaboration between key stakeholders for trauma system planning and development.

Many important stakeholders have not been identified or recruited for trauma system development, including consumers, representatives from mental health, social work, traumatic brain injury (TBI), and rehabilitation, elected officials, and the print and broadcast media.

No public education is provided to inform state citizens about the importance of the trauma system and challenges it faces.

RECOMMENDATIONS

- Ensure the involvement of the State American College of Surgeons Committee on Trauma and trauma center leadership in the Multidisciplinary Trauma Advisory Committee functions and activities.
- Encourage trauma stakeholders to continue outreach to elected officials to increase the number of legislative champions.

- Expand the trauma stakeholders to include representation from mental health, rehabilitation, community organizations, the media, and the public.

Lead Agency and Human Resources Within the Lead Agency

Purpose and Rationale

Each trauma system (state, regional, local, as defined in state statute) should have a lead agency with a strong program manager who is responsible for leading the trauma system. The lead agency, usually a government agency, should have the authority, responsibility, and resources to lead the planning, development, operations, and evaluation of the trauma system throughout the continuum of care. The lead agency, empowered through legislation, ensures system integrity and provides for program integration with other health care and community-based entities, namely, public health, EMS, disaster preparedness, emergency management, law enforcement, social services, and other community-based organizations.

The lead agency works through a variety of groups to accomplish the goals of trauma system planning, implementation, and evaluation. The ability to bring multidisciplinary, multi-agency advisory groups together to accomplish trauma system goals is essential in developing and maintaining the trauma system and is part of providing leadership to evolving and mature systems.

The lead agency's trauma system program manager coordinates trauma system design, the adoption of minimum standards (prehospital and in-hospital), and provides for overall system evaluation through performance indicator assessment and assurance. In addition to a trauma program manager, the lead agency must be sufficiently staffed to actively participate in each phase of development and in maintaining the system through a clearly defined structure for decision making (policies and procedures) and through proactive surveillance and evaluation. *Minimum* staffing usually consists of a trauma system program manager, data entry and analysis personnel, and monitoring and compliance personnel. Additional staff resources include administrative support and a part-time commitment from the public health epidemiology service to provide system evaluation and research support.

Within the leadership and governance structure of the trauma system, there is a role for strong physician leadership. This role is usually fulfilled by a full- or part-time trauma medical director within the lead agency.

OPTIMAL ELEMENTS

- I. Comprehensive state statutory authority and administrative rules support trauma system leaders and maintain trauma system infrastructure, planning, oversight, and future development. **(B-201)**
 - a. The legislative authority (statutes and regulations) plans, develops, implements, manages, and evaluates the trauma system and its component parts, including the identification of the lead agency and the designation of trauma facilities. **(I-201.1)**

b. The lead agency has adopted clearly defined trauma system standards (for example, facility standards, triage and transfer guidelines, and data collection standards) and has sufficient legal authority to ensure and enforce compliance. **(I-201.4).**

II. Sufficient resources, including financial and infrastructure-related to support system planning, implementation, and maintenance. **(B-204)**

CURRENT STATUS

Since 1995, the lead agency for trauma system development in Colorado has been the CDPHE. In 2003, the EMTS Section was added to the Health Facilities and EMS Division. The EMTS Section is responsible for the statutory responsibilities of C.R.S. § 25-3.5-101 relating to oversight and support of the state's trauma and EMS system.

The EMTS Section works with the SEMTAC, a governor-appointed advisory committee with 25 voting and 7 ex-officio members. This group has five specific functions:

- Make recommendations to the CDPHE about trauma center designations
- Distribute grants from the EMTS grant fund
- Review the biennial plans from the eleven RETACS
- Review and approve EMS and trauma system rules for promulgation by the Colorado Board of Health
- Provide advice to the CDPHE regarding matters pertaining to the state's EMS and trauma system(s)

A tangible example of the quality of the relationships that currently exists between system stakeholders and the lead agency is the recent passage of legislation that will increase EMS and trauma system funding by 4 to 5 million dollars. Successfully obtaining this level of increased funding typically requires every participant in the system to deliver a clear and consistent message to the state legislators.

Despite a significant staffing turnover within the EMTS Section several years ago, both the EMTS Section staff and other system participants agree that personnel in their current positions have successfully learned their jobs and are functioning at effective levels.

The EMTS Section has made limited progress in developing Colorado's trauma system due to staffing limitations. At present, only 2.0 full time equivalents (FTEs) are formally dedicated to trauma designation and other system activities. It is recognized that other staff in the EMTS Section contribute to the trauma system activities, e.g. the EMTS Section Chief, the Deputy EMTS Section Chief, and the EMTS Data Program Manager who manages the state trauma registry. However, it is important to recognize that additional dedicated staff are needed to complete trauma system development. The recently passed funding legislation will provide a modest expansion of three staff to the EMTS Section. These new personnel will include a trauma nurse coordinator, a statistical analyst, and a grants specialist. The trauma nurse coordinator will be dedicated to trauma system activities and the development of a QI program, and the statistical analyst will help with data analysis of the state trauma registry.

The EMTS Section uses the SEMTAC and other outside consultants on a regular basis to solicit input or assistance about matters where stakeholder buy-in is important or where the EMTS Section may not have the technical expertise for the task at hand. The Pre-Review Questionnaire (PRQ) for this TSC site visit is an excellent example of a resource created by a qualified contractor with a strong background in delivering this type of product.

State medical direction is provided by a 0.5 FTE contracted physician. Given the complexity and size of the Colorado EMS and trauma system, this level of time commitment is inadequate to meet the needs for clinical leadership of local and regional EMS medical directors or to make substantial progress on further trauma system development.

The EMTS Section shares some roles traditionally found within a lead agency with other agencies or groups. The certification of first responders is assigned to the DPS. The licensure of ambulance services occurs at the County level based upon standards set by the EMTS Section. The logic for this arrangement reflects a strong tradition and history of local home rule. Similarly, the EMS personnel scopes of practice are determined by the Colorado Board of Medical Examiners (BME). While all of the participating agencies seem to understand their roles and duties, the effectiveness of this arrangement is not clear. The structure appears to be fragmented and less than efficient in assuring that the public is protected through regulation and oversight. If regulation of all EMS functions were consolidated within the EMTS Section, the lead agency's needs regarding resources and personnel to manage these additional functions were not assessed during this TSC. At present, the EMTS Section is not able to fulfill all of the optimal elements for trauma system development and operation including planning, oversight, and managing future development. The ability of the EMTS Section to enforce clearly defined trauma system standards (for example, facility standards, triage and transfer guidelines, and data collection standards) is not apparent. These deficiencies are the result of multiple factors including previous limitations in personnel and financial resources allocated to the EMTS Section.

RECOMMENDATIONS

- **Employ a 1.0 FTE physician state medical director to oversee the clinical aspects of the trauma and EMS system.**
 - **This position will require expertise in both trauma and EMS clinical care.**
- Consolidate all regulatory oversight of EMS and trauma system functions within the EMTS Section.
 - This includes responsibilities and authorities of the Board of Medical Examiners, Department of Public Safety, and Colorado counties.
- Enforce trauma system standards across the State in both hospital and prehospital phases of care.
- Reassess the roles and responsibilities of the EMTS Section personnel in light of the opportunity provided by the statewide trauma system needs assessment and planning initiative.

- Consider realigning the responsibilities of various positions to improve the coordination and management of new planning and implementation activities.

Trauma System Plan

Purpose and Rationale

Each trauma system, as defined in statute, should have a clearly articulated trauma system planning process resulting in a written trauma system plan. The plan should be built on a completed inventory of trauma system resources identifying gaps in services or resources and the location of assets. It should also include an assessment of population demographics, topography, or other access enhancements (location of hospital and prehospital resources) or barriers to access. It is important that the plan identify special populations (for example, pediatric, elderly, in need of burn care, ethnic groups, rural) within the geographic area served and address the needs of those populations within the planning process. A needs assessment (or other method of identifying injury patterns, patient care review/preventable death study) should also be completed for initial trauma system planning and updated periodically as needed to assess system changes over time.

The trauma system plan is developed by the lead trauma agency based on the results of a needs assessment and other data resources available for review. It describes the system design, integrated and inclusive, with adopted standards of care for prehospital and hospital personnel and a process to regularly review the plan over time. The plan is built on input from trauma advisory committees (or stakeholder groups) that assist in analyzing data, identifying resources, and developing system standards of care, including system policies and procedures and overall system design. Ideally, although every stakeholder group may not be satisfied with the plan or system design, the plan, to the extent possible, should be based on consensus of the advisory committees and stakeholder groups. These advisory groups should be able to review the plan before final adoption and approve the plan before it is submitted to the lead agency with authority for plan approval.

The trauma system plan is used to guide system development, implementation, and management. Each component of the trauma system (for example, prehospital, hospital, communications, and transportation) is clearly defined and an established service level identified (baseline) with goals for enhancement (benchmark). Within the plan are incorporated other planning documents used to ensure integration of similar services and build collaboration and cooperation with those services. Service plans for emergency preparedness, EMS, injury prevention and control, public health, social services, and mental health are examples of services for which the trauma system plan should include an interface between agencies and services.

OPTIMAL ELEMENT

I. The state lead agency has a comprehensive written trauma system plan based on national guidelines. The plan integrates the trauma system with EMS, public health, emergency preparedness, and incident management. The written trauma system plan is developed in collaboration with community partners and stakeholders. **(B-203)**

- a. The trauma system plan clearly describes the system design (including the components necessary to have an integrated and inclusive trauma system) and is used to guide system implementation and management. For example, the plan includes references to regulatory standards and documents and includes methods of data collection and analysis. **(I-203.4)**

CURRENT STATUS

The PRQ states “the absence of a current integrated emergency medical and trauma services system plan has long been recognized as a weakness in Colorado’s system development efforts.” The CDPHE and the EMTS Section have appropriately identified and acknowledged this major hurdle to advancing the care of the injured in Colorado.

The state’s trauma system planning began with a technical assessment by National Highway Traffic Safety Administration (NHTSA) in 1988, but this assessment, as well as an additional resource assessment in 1993, was predominantly EMS-focused. State legislation for development of a trauma system was passed in 1995, and a second NHTSA technical assessment occurred in 1997. In 1999, the EMS and trauma efforts were structurally integrated. The current structure for the EMTS Section was created in 2000 with 11 RETACs and the SEMTAC, which each have EMS and trauma system activities. A major stimulus for the TSC visit was the need for analysis of current trauma system development, and, through the recommendations generated by the TSC team, the development of a viable functional statewide trauma system plan.

While another 3-year statewide assessment of resources for EMS and trauma care has been initiated at each RETAC, a statewide assessment of the injured patient population’s needs has not been conducted. The recently initiated RETAC-wide assessment of EMS and trauma care resources may provide some information, but will not replace a trauma system needs assessment and gap analysis. Information does exist on all patients who were admitted or died from their injuries with regard to severity, basic demographics, and locale. However, at the time of the TSC, no data were reported relative to trauma system needs, e.g., what is the availability of interfacility transfer, are the correct levels of trauma centers located where there is significant need, and do trauma patients get to the correct level of care. If such data exist, they have not yet been fully utilized to match patient needs with trauma facility capabilities and locations.

An accurate and complete needs assessment and gap analysis is a critical initial step prior to development and implementation of a trauma system plan. A major concern is that virtually all assessments have been resource driven rather than patient focused. Without knowledge of the needs of the injured patient, it is not possible to develop a plan allocating and distributing the medical resources required for their care. Before effective planning can occur, the state must perform a needs assessment and gap analysis to determine what changes are needed to improve the system. This TSC visit was timely in relation to national health care reform. Changes in the health care system, driven in part by the economy, but also by the need to evaluate any initiative for efficiency and quality, is and will continue to be a force in the future. A plan based on a comprehensive needs assessment will enable the state to

match injured patient needs to resources in a manner that optimizes efficiency, minimizes costs, and leads to optimal outcomes and health care value for the trauma system.

The development of an EMTS strategic plan was initiated in 1999; however, the nearly completed strategic plan was abandoned in 2004 due to a significant reorganization of the EMTS Section. This plan was focused on the national *EMS Agenda for the Future*, and the components were predominantly EMS-focused. The current evolution of the state's trauma system clearly demonstrates the lack of a trauma system plan. One problem may be the lack of a committee structure and membership to support the development of a trauma system plan.

When conducting the statewide needs assessment, a focus should also be included on identifying all resources for care available and their distribution. This will permit identification of the number, level, and distribution of facilities to designate and the bed capacity required. Upon completion of the needs assessment, a plan must be developed that describes how to monitor the functioning of the system (e.g., number of trauma centers needing correction plans to meet criteria for level of designation), and indicators of needed trauma system changes related to changes in trauma population (e.g., mechanism of injury, distribution), alterations in the resources available (e.g., fiscal and specialty care), and patient outcomes. Integrating such monitoring will permit a continual evolution and improvement in the trauma system plan.

A major strength of the current environment is the commitment of the medical community and the facilities at a grassroots level throughout the state. Colorado has a long-standing, very qualified trauma and EMS community. This should be a significant support base for development and implementation of the future trauma system plan. Critical key participants must have optimal involvement in the development of the trauma system plan. Essential participants include the EMS caregivers and trauma physicians along with other core members of the health care team, preferably representing their various specialty and academic societies.

"Inclusive trauma systems are the systems that include all acute health care facilities, to the extent that their resources and capabilities allow **and in which the patient's needs are matched** to hospital resources and capabilities" as defined in the *Regional Trauma Systems: Optimal Elements, Integration and Assessment, Systems Consultation Guide* (American College of Surgeons, 2007). The PRQ states "State law requires that all facilities receiving trauma patients by ambulance or other means shall follow the process for designation. In Colorado, this means that all facilities licensed as general acute care hospitals, critical access hospitals, or clinics licensed as 'community clinic with emergency centers' must participate in the system either by being designated or by signing a non-designation agreement with the department." The PRQ further indicates that the CDPHE has interpreted inclusive as a "...trauma system that accommodates the needs of large urban facilities as well as small frontier clinics. Ideally, the department would like all acute care and critical access hospitals as well as community clinics with emergency centers to participate in the trauma system." While it is admirable that the CDPHE is striving for 100% inclusion, it must be noted that the EMTS Section's interpretation of an inclusive trauma system does not address a system

based upon “patient needs.” In such an inclusive system facilities participate at a level commensurate with patient distribution, frequency of contact, and severity of injury.

The PRQ states that “currently, Colorado’s trauma system has few written policies, and those that exist focus on process issues ...rather than on the specifics of patient care.” As part of the statewide system plan implementation, standardized protocols should be developed by the appropriate experts on a multidisciplinary trauma advisory committee. Numerous studies have demonstrated an improvement in outcomes when consistent standardized care plans are utilized. This applies not only to direct patient care but also to triage and transfer criteria.

In addition, the EMTS Section and its predecessors have long recognized the need to collect data for assessments. The newly created MATRIX for prehospital data collection is an excellent move forward but should be expanded or changed to a system better able to collect more patient care data to assess the functioning of the prehospital system and needs for change. In addition, feedback to prehospital providers regarding provided care is essential, making the addition of patient-care data crucial. Several providers voiced concern over the lack of routine feedback on their submitted data.

While participants rapidly responded to specific queries of an epidemiologic nature, routine trauma outcome specific reports generated from the data currently submitted do not occur at the state level. The planned addition of personnel for data analysis will hopefully enable the EMTS Section to address concerns about lack of feedback. The development of standardized reports to assist providers in the assessment of their involvement in the system and impact on patient outcomes is highly desirable and has been beneficial to other trauma systems when working to achieve standardized care and improve overall patient outcomes.

Unfortunately, most of Colorado’s data has been collected without specific trauma system outcome questions in mind. Most analyses have focused largely on epidemiology. While compliance with rules and regulations is monitored, no questions have been defined for evaluating the impact of the number of trauma centers with correction plans on patient outcomes.

RECOMMENDATIONS

- **Perform a *patient-focused in-depth statewide needs assessment study* to determine the appropriate level and geographic location of trauma centers for the state.**
- **Develop a plan for statewide trauma system implementation based on the needs assessment study, using the authority of the existing enabling legislation.**
 - **Use the Health Resources and Services Administration’s Model Trauma System Planning and Evaluation document as a guideline for system development.**
- **Evaluate and consider refining Colorado’s definition of an “inclusive system.”**

- **Modify rules and regulations to assure optimal patient outcomes and a model of value-based medical care.**
- Utilize the Multidisciplinary Trauma Advisory Committee to complete a trauma system plan.
- Develop and enforce standardized protocols, triage, transfer guidelines and care plans.
- Set up monitoring and tracking data collection based on patient outcomes.
- Create incentives and establish goals to reduce the number of trauma centers that do not meet criteria at the time of the redesignation application.
- Set a timeline and deadline to implementation of the state trauma system plan.

System Integration

Purpose and Rationale

Trauma system integration is essential for the daily care of injured people and includes such services as mental health, social services, child protective services, and public safety. The trauma system should use the public health approach to injury prevention to contribute to reducing the entire burden of injury in a state or region. This approach enables the trauma system to address primary, secondary, and tertiary injury prevention through closer integration with community health programs and mobilizing community partnerships. The partnerships also include mental health, social services, child protection, and public safety services. Collaboration with the public health community also provides access to health data that can be used for system assessment, development of public policy, and informing and educating the community.

Integration with EMS is essential because this system is linked with the emergency response and communication infrastructure and transports severely injured patients to trauma centers. Triage protocols should exist for treatment and patient delivery decisions. Regulations and procedures should exist for online and offline medical direction. In the event of a disaster affecting local trauma centers, EMS would have a major role in evacuating patients from trauma centers to safety or to other facilities to make beds available for patients in greater need.

The trauma system is a significant state and regional resource for the response to mass casualty incidents (MCIs). The trauma system and its trauma centers are essential for the rapid mobilization of resources during MCIs. Preplanning and integration of the trauma system with related systems (public health, EMS, and emergency preparedness) are critical for rapid mobilization when a disaster or MCI occurs. The extensive impact of disasters and MCIs on the functioning of trauma centers and the EMS and public health systems within the affected region or state must be considered, and joint planning for optimal use of all resources must occur to enable a coordinated response to an MCI. Trauma system leaders need to be actively involved in emergency management planning to ensure that trauma centers are integrated into the local, regional, and state disaster response plans.

OPTIMAL ELEMENTS

- I. The state lead agency has a comprehensive written trauma system plan based on national guidelines. The plan integrates the trauma system with EMS, public health, emergency preparedness, and incident management. The written trauma system plan is developed in collaboration with community partners and stakeholders. **(B-203)**
 - a. The trauma system plan has established clearly defined methods of integrating the trauma system plan with the EMS, emergency, and public health preparedness plans. **(I-203.7)**

II. The trauma, public health, and emergency preparedness systems are closely linked.
(B-208)

CURRENT STATUS

Colorado has pursued the concept of an “inclusive trauma system,” and exemplary commitment from the medical community across the state was evident. The need for the potential modification of the definition of “inclusive” to include resource matching with patient needs is noted in previous sections. However, participation of all assets and resources should continue to be encouraged.

The SEMTAC, composed of 25 gubernatorial-appointed members, plus 7 ex-officio members is multidisciplinary in an effort to provide integration of EMS and trauma at the state level. Members represent EMS agencies and providers, trauma medical directors, a trauma nurse manager, law enforcement, coroners, the State Department of Transportation, and the Colorado Community College system. Injury prevention is integrated into the system with a designated committee of the SEMTAC. The 11 RETACs also have a cross-section of multidisciplinary representation, and they are tasked with some trauma-related activities in the regions. System integration has had some successes at the local level, such as in areas of injury prevention and community outreach.

The EMS and trauma medical community is fragmented, with some aspects of system management being assigned to other agencies or groups (e.g., Board of Medical Examiners, DPS, and county commissioners). Although there have clearly been individual RETAC efforts and successful programs, no systemwide guidance or infrastructure is apparent that facilitates or rewards collaboration with key partners in the continuum of trauma care. The HRSA Model Trauma System Planning and Evaluation document “Phases of a Pre-Planned Trauma Care Continuum,” is an excellent resource for building the integration of multiple services into the statewide trauma plan (e.g., mental health, social services, child protective services, rehabilitation, and public safety). Improving the integration of these services into the trauma system will improve the quality of care of the injured patient.

Another major imperative for Colorado is to ensure the integration of the statewide trauma system into the planning and care for victims of a mass casualty incident (MCI). The trauma system is a critical component of a full disaster response, but it is frequently overlooked in state disaster preparedness plans. This is despite the fact that people do get injured in natural and man-made disasters. Conventional wisdom suggests that the most likely act of terrorism in the United States will be bombings, resulting in mass casualties and need for the trauma system to respond. The trauma system must be integrated into a MCI response to ensure that the expertise and resources of the trauma system are appropriately utilized, and, to the degree possible, no one trauma center is overwhelmed. Also, in a MCI, the expertise of the trauma centers must be shared with other acute care facilities that may be forced to care for major trauma patients because of the sheer numbers.

The EMTS Section also needs to address and consider the integration of care for other time sensitive conditions, such as stroke, ST elevation myocardial infarction (STEMI), and other non-trauma surgical emergencies such as ruptured abdominal aneurysms. These clinical

conditions lend themselves to the same regionalized care model as for the trauma system. Many states/counties/regions have utilized their existing trauma system model to ensure optimal care to these non-trauma emergency patients. Some states have moved toward restructuring their “EMS Office” to an Office of Emergency Care which is then well positioned to oversee and integrate not only the EMS and trauma functions, but also capable of providing leadership and oversight for STEMI, stroke, and other emerging time-sensitive disease response models.

RECOMMENDATIONS

- Ensure that during the creation of a trauma plan the integration with EMS, mental health, social services, rehabilitation, emergency preparedness (MCI), and public health occurs.
 - Consult the HRSA *Model Trauma System Planning and Evaluation* document, “Phases of a Pre-Planned Trauma Care Continuum” (page 8) for guidance on optimal trauma system integration for patient care.
- Utilize the new SEMTAC Multidisciplinary Trauma Advisory Committee (MTAC) to ensure trauma system integration with all emergency preparedness activities.
- Consider including representation from other time-sensitive clinical conditions and system responses, such as stroke and ST elevation myocardial infarction (STEMI) when developing the trauma system plan.

Financing

Purpose and Rationale

Trauma systems need sufficient funding to plan, implement, and evaluate a statewide or regional system of care. All components of the trauma system need funding, including prehospital, acute care facilities, rehabilitation, and prevention programs. Lead agency trauma system management requires adequate funding for daily operations and other important activities such as advisory committee meetings, development of regulations, data collection, performance improvement, and public awareness and education. Adequate funding to support the operation of trauma centers and their state of readiness to care for seriously injured patients within the state or region is essential. The financial health of the trauma system is essential for ensuring its integrity and its improvement over time.

The trauma system lead agency needs a process for assessing its own financial health, as well as that of the trauma system. A trauma system budget should be prepared, and costs should be reported by each component, if possible. Routine collection of financial data from all participating health care facilities is encouraged to fully identify the costs and revenues of the trauma system, including costs and revenues pertaining to patient care, administrative, and trauma center operations. When possible, the lead agency financial planning should integrate with the budgets and costs of the EMS system and disaster, rehabilitation, and prevention programs to enable development of a comprehensive financial health report.

Trauma system financial planning should be related to the trauma plan outcome measures (for example, patient outcome measures such as mortality rates, length of stay, and quality-of-life indicators). Such information may demonstrate the value added by having a trauma system in place.

OPTIMAL ELEMENTS

- I. Sufficient resources, including financial and infrastructure-related, support system planning, implementation, and maintenance. **(B-204)**
 - a. Financial resources exist that support the planning, implementation, and ongoing management of the administrative and clinical care components of the trauma system. **(I 204.2)**
 - b. Designated funding for trauma system infrastructure support (lead agency) is legislatively appropriated. **(I-204.3)**
 - c. Operational budgets (system administration and operations, facilities administration and operations, and EMS administration and operations) are aligned with the trauma system plan and priorities. **(I-204.4)**

II. The financial aspects of the trauma systems are integrated into the overall performance improvement system to ensure ongoing fine-tuning and cost-effectiveness. **(B-309)**

- a. Collection and reimbursement data are submitted by each agency or institution on at least an annual basis. Common definitions exist for collection and reimbursement data and are submitted by each agency. **(I-309.2)**

CURRENT STATUS

The stakeholders of the Colorado EMS and trauma system are to be commended for their coordinated successful efforts to expand the Highway User's Tax Fund. Mounting a successful campaign to increase funding at a State level is never an easy process, particularly during difficult economic times. This accomplishment illustrates what is possible when all of the interest groups are able to come together and work cooperatively.

A significant portion of money from the Highway Users Tax Fund goes to support the operations of the RETACs and the competitive EMTS grant program through the SEMTAC. Since the SEMTAC/EMTS grants are competitive, the 50% match requirement creates significant leverage on the use of the funds. The grant program has previously supported a few prevention initiatives, but it has not been a major contributor to trauma system improvements.

The EMTS Section budget is supported almost exclusively from the Highway Users Tax Fund. The 2.0 FTE positions dedicated to the trauma program and administrative costs are supported through the Highway Users Tax Fund and the EMTS funds. Funding from trauma designation fees supports the direct costs of the designation process. The EMTS Section has been able to access funding from federal Section 408 funds for data collection efforts and a federal EMS for Children grant to improve pediatric care. Federal Assistant Secretary for Preparedness and Response (ASPR) grant funding is handled by another program within the CDPHE. No direct disaster preparedness program connection or commitment of ASPR funds has been made to the trauma system. This appears to be a missed opportunity that could benefit both programs and the citizens of Colorado. Generally the trauma system will be better served if an ongoing effort is made to apply available federal funding from multiple programs to trauma system priorities.

Colorado uses the fees collected from hospitals seeking trauma center designation to cover the costs of the designation process. These fees are graduated based upon the level of designation sought. The designation process costs and fees collected are closely matched, and this appears to be a fair and reasonable approach to covering some trauma center designation administration costs.

No effort is made to capture data centrally or to report publicly about the costs of implementing and operating the trauma system or the cost of trauma care. Individual hospitals track their own trauma care costs, but this information is not reported or collected at a statewide level. During the TSC visit, several trauma centers described their hospital costs for uncompensated care. The trauma portions of those costs vary by hospital, but the trauma centers have never compiled their trauma-related uncompensated care costs to provide a

statewide picture of the problem. It is important when seeking to obtain and maintain public support for the trauma system to describe both the costs and benefits of having trauma care organized through a statewide system.

In 2003, trauma care reimbursement changed from no-fault automobile insurance to a tort system. Results of this change were studied and findings revealed a doubling of self-pay patients and a migration from auto insurance coverage for trauma care costs to health insurance coverage, often at lower rates of reimbursement. The study of this specific issue and its impact on the trauma system is a good example of the importance of monitoring and reporting financial information related to trauma system care.

In the prehospital setting, participants reported that EMS agencies face uncompensated costs for doing “secondary ambulance transfers” when two different EMS services rendezvous for interfacility transfer of a trauma patient. It was also reported that some volunteer EMS agencies do not charge for their patient care and transportation. Both of these problems end up subsidizing insurers when they fail to collect fees. Neither of these problems is insurmountable. Cooperative agreements between transporting ambulance services to submit a single bill and share the revenue is one approach to the secondary transfer problem. Small low-volume EMS agencies could use a billing service, available at reduced rates through EMS purchasing cooperatives, to improve their revenue stream rather than try to develop cost recovery expertise internally.

It is apparent that many different people and organizations are supporting the cost of developing Colorado’s trauma system and providing trauma care to injured patients. It is less clear that the resources being committed are well focused on the priority needs of the trauma system. As the State moves forward with the development of a trauma needs assessment and trauma plan, the connection of system priorities with system financing should consistently be made.

RECOMMENDATIONS

- Create a statewide picture of the costs and revenues associated with the provision of trauma care.
 - Add financial data to the required reporting from trauma centers.
- Provide an annual public report of the costs and benefits of the trauma system and trauma care in Colorado.
- Develop trauma system plan priorities and commit appropriate financial resources for the plan implementation.
- Solve the secondary transfer billing problem so that ambulance services can recover at least a portion of their operating costs for patient transfers.
- Require all EMS agencies to charge for care and transportation at rates reflecting the cost of providing the service.

- This should be a prerequisite to applying for grants through SEMTAC.
- Enhance the relationship between the State's emergency preparedness program and a trauma system to ensure that Assistant Secretary for Preparedness and Response (ASPR) grant funds help support trauma system development.
- Pursue appropriate federal funding streams to support trauma system development.

Trauma System Assurance

Prevention and Outreach

Purpose and Rationale

Trauma systems must develop prevention strategies that help control injury as part of an integrated, coordinated, and inclusive trauma system. The lead agency and providers throughout the system should be working with business organizations, community groups, and the public to enact prevention programs and prevention strategies that are based on epidemiologic data gleaned from the system.

Efforts at prevention must be targeted for the intended audience, well defined, and structured, so that the impact of prevention efforts is system-wide. The implementation of injury control and prevention requires the same priority as other aspects of the trauma system, including adequate staffing, partnering with the community, and taking advantage of outreach opportunities. Many systems focus information, education, and prevention efforts directly to the general public (for example, restraint use, driving while intoxicated). However, a portion of these efforts should be directed toward emergency medical services (EMS) and trauma care personnel safety (for example, securing the scene, infection control). Collaboration with public service agencies, such as the department of health is essential to successful prevention program implementation. Such partnerships can serve to synergize and increase the efficiency of individual efforts. Alliances with multiple agencies within the system, hospitals, and professional associations, working toward the formation of an injury control network, are beneficial.

Activities that are essential to the development and implementation of injury control and prevention programs include the following:

- A needs assessment focusing on the public information needed for media relations, public officials, general public, and third-party payers, thus ensuring a better understanding of injury control and prevention
- Needs assessment for the general medical community, including physicians, nurses, prehospital care providers, and others concerning trauma system and injury control information
- Preparation of annual reports on the status of injury prevention and trauma care in the system
- Trauma system databases that are available and usable for routine public health surveillance

OPTIMAL ELEMENTS

I. The lead agency informs and educates state, regional, and local constituencies and policy makers to foster collaboration and cooperation for system enhancement and injury control.
(B-207)

- a. The trauma system leaders (lead agency, advisory committees, and others) inform and educate constituencies and policy makers through community development activities, targeted media messaging, and active collaborations aimed at injury prevention and trauma system development. **(I-207.2)**

II. The jurisdictional lead agency, in cooperation with other agencies and organizations, uses analytic tools to monitor the performance of population based prevention and trauma care services. **(B-304)**

- a. The lead agency, along with partner organizations, prepares annual reports on the status of injury prevention and trauma care in state, regional, or local areas. **(I-304.1)**

III. The lead agency ensures that the trauma system demonstrates prevention and medical outreach activities within its defined service area. **(B-306)**

- a. The trauma system is active within its jurisdiction in the evaluation of community based activities and injury prevention and response programs. **(I-306.2)**
- b. The effect or impact of outreach programs (medical and community training and support and prevention activities) is evaluated as part of a system performance improvement process. **(I-306.3)**

CURRENT STATUS

Colorado is to be commended for its extensive focus on injury prevention and outreach. The state developed and published a strategic plan in 2003 for the years 2003-2008. This plan proposed a coordinated approach to injury prevention, including improvements for data collection and data linkage, as well as prevention intervention best practices for individual mechanisms of injury. This plan was recently updated for 2008-2010 with a new chapter focused on unintentional poisoning. The priority mechanisms identified in the strategic plan match the state's major causes of injury mortality and morbidity (e.g., motor vehicle, suicide, falls, and unintentional poisoning).

The state has dedicated staff in the Injury, Suicide, and Violence Prevention (ISVP) unit to provide technical assistance and culturally appropriate programming, and to support the injury coalition. This unit is supported by grants and some state funds.

Injury prevention has been integrated into the emergency and trauma system. While there is no designated representation on the SEMTAC, a standing committee of SEMTAC (Injury Community Planning Group) is active. This committee also serves as the advisory committee for the Centers for Disease Control and Prevention (CDC) capacity building grant.

Colorado has an extensive network of partner organizations and hospitals to help implement injury prevention programs and outreach. The trauma centers are actively engaged in injury prevention and, in some cases, have dedicated injury prevention and outreach employees. The number of partners and range of injury prevention outreach is impressive. In addition, efforts are made to evaluate the interventions, such as formal contracted evaluation projects or monitoring increased use of protective devices and the change in injury rates.

It is not apparent that the ISVP or the Injury Community Planning Group has found a mechanism to commit partners and trauma centers to focus on priority mechanisms of injury or to the use of evidence-based interventions in a collaborative manner, and thus avoid duplication of effort. However, some of this collaboration may occur in the regions. Many partners actively seek and obtain grants to conduct injury prevention efforts.

Colorado has limited focus on tertiary injury prevention. This may be related to the lack of patient outcome data and benchmarking that could identify needed trauma care practices and system improvements. The ACS's Rural Trauma Team Development Course (RTTDC) is offered on the Western slope, and it is the one model of tertiary injury prevention identified. Unfortunately, no mechanism to evaluate the impact of this course (e.g. reduced transfer times, appropriate triage to a higher level trauma center) currently exists due to data analysis deficiencies.

It was not clear that the state has a repository of evidence-based injury prevention programs that partnering groups can easily access and implement. It was reported that a website, under development, will be a mechanism to make these resources available in the future.

RECOMMENDATIONS

- Complete development of the injury prevention website to make prevention program resources more accessible to injury partners.
- Integrate tertiary injury prevention into the planning of injury control priorities for the state.
- Enhance communication and collaboration between the Injury Community Planning Group, trauma centers, and other partnering organizations to foster commitment for use of evidence-based injury prevention strategies recommended in the strategic plan.

Emergency Medical Services

Purpose and Rationale

The trauma system includes, and/or interacts with, many different agencies, institutions, and systems. The EMS system is one of the most important of these relationships. EMS is often the critical link between the injury-producing event and definitive care at a trauma center. Even though at its inception the EMS system was a very broad system concept, over time, EMS has come to be recognized as the prehospital care component of the larger emergency health care system. It is a complex system that not only transports patients, but also includes public access, communications, personnel, triage, data collection, and quality improvement activities.

The EMS system medical director must have statutory authority to develop protocols, oversee practice, and establish a means of ongoing quality assessment to ensure the optimal provision of prehospital care. If not the same individual, the EMS system medical director must work closely with the trauma system medical director to ensure that protocols and goals are mutually aligned. The EMS system medical director must also have ongoing interaction with EMS agency medical directors at local levels, as well as the state EMS for Children program, to ensure that there is understanding of and compliance with trauma triage and destination protocols.

Ideally, a system should have some means of ensuring whether resources meet the needs of the population. To achieve this end, a resource and needs assessment evaluating the availability and geographic distribution of EMS personnel and physical resources is important to ensure a rapid and appropriate response. This assessment includes a detailed description of the distribution of ground ambulance and aeromedical locations across the region. Resource allocations must be assessed on a periodic basis as needs dictate a redistribution of resources. In communities with full-time paid EMS agencies, ambulances should be positioned according to predictable geographic or temporal demands to optimize response efficiencies. Such positioning schemes require strong prehospital data collection systems that can track the location of occurrences over time. Periodic assessment of dispatch and transport times will also provide insight into whether resources are consistent with needs. Each region should have objective criteria dictating the level of response (advanced life support [ALS], basic life support [BLS]), the mode of transport, and the disposition of the patient based on the location of the incident and the severity of injury.

A mechanism for case-based review of trauma patients that involves prehospital and hospital providers allows bidirectional information sharing and continuing education, ensuring that expectations are met at both ends. Ongoing review of triage and treatment decisions allows for continuing quality improvement of the triage and prehospital care protocols. A more detailed discussion of in-field (primary) triage criteria is provided in the section titled: System Coordination and Patient Flow (p 20) (White Book).

Human Resources

Periodic workforce assessments of EMS should be conducted to ensure adequate numbers and distribution of personnel. EMS, not unlike other health care professions, experiences shortages and maldistribution of personnel. Some means of addressing recruitment, retention, and engagement of qualified personnel should be a priority. It is critical that trauma system leaders work to ensure that prehospital care providers at all levels attain and maintain competence in trauma care. Maintenance of competence should be ensured by requiring standards for credentialing and certification and specifying continuing educational requirements for all prehospital personnel involved in trauma care. The core curricula for First Responder, Emergency Medical Technician (EMT) Basic, EMT-Intermediate, EMT Paramedic, and other levels of prehospital personnel have an essential orientation to trauma care for all ages. However, trauma care knowledge and skills need to be continuously updated, refined, and expanded through targeted trauma care training such as Prehospital Trauma Life Support®, Basic Trauma Life Support®, and age-specific courses. Mechanisms for the periodic assessment of competence, educational needs, and education availability within the system should be incorporated into the trauma system plan.

Systems of excellence also encourage EMS providers to go beyond meeting state standards for agency licensure and to seek national accreditation. National accreditation standards exist for ground-based and air medical agencies, as well as for EMS educational programs. In some states, agency licensure requirements are waived or substantially simplified if the EMS agency maintains national accreditation.

EMS is the only component of the emergency health care and trauma system that depends on a large cadre of volunteers. In some states, substantially more than half of all EMS agencies are staffed by volunteers. These agencies typically serve rural areas and are essential to the provision of immediate care to trauma patients, in addition to provision of efficient transportation to the appropriate facility. In some smaller facilities, EMS personnel also become part of the emergency resuscitation team, augmenting hospital personnel.

The trauma care system program should reach out to these volunteer agencies to help them achieve their vital role in the outcome of care of trauma patients. However, it must be noted that there is a delicate balance between expecting quality performance in these agencies and placing unrealistic demands on their response capacity. In many cases, it is better to ensure that there is an optimal BLS response available at all times rather than a sporadic or less timely response involving ALS personnel. Support to volunteer EMS systems may be in the form of quality improvement activities, training, clinical opportunities, and support to the system medical director.

Owing to the multidisciplinary nature of trauma system response to injury, conferences that include all levels of providers (for example, prehospital personnel, nurses, and physicians) need to occur regularly with each level of personnel respected for its role in the care and outcome of trauma patients. Communication with and respect for prehospital providers is particularly important, especially in rural areas where exposure to major trauma patients might be relatively rare.

Integration of EMS Within the Trauma System

In addition to its critical role in the prehospital treatment and transportation of injured patients, EMS must also be engaged in assessment and integration functions that include the trauma system and also public health and other public safety agencies. EMS agencies should have a critical role in ensuring that communication systems are available and have sufficient redundancy so that trauma system stakeholders will be able to assess and act to limit death and disability at the single patient level and at the population level in the case of mass casualty incidents (MCIs). Enhanced 911 services and a central communication system for the EMS/trauma system to ensure field-to-facility bidirectional communications, interfacility dialogue, and all-hazards response communications among all system participants are important for integrating a system's response. Wireless communications capabilities, including automatic crash notification, hold great promise for quickly identifying trauma-producing events, thereby reducing delays in discovery and decreasing prehospital response intervals.

Further integration might be accomplished through the use of EMS data to help define high-risk geographic and demographic characteristics of injuries within a response area. EMS should assist with the identification of injury prevention program needs and in the delivery of prevention messages. EMS also serves a critical role in the development of all-hazards response plans and in the implementation of those plans during a crisis. This integration should be provided by the state and regional trauma plan and overseen by the lead agency. EMS should participate through its leadership in all aspects of trauma system design, evaluation, and operation, including policy development, public education, and strategic planning.

OPTIMAL ELEMENTS

- I. The trauma system is supported by an EMS system that includes communications, medical oversight, prehospital triage, and transportation; the trauma system, EMS system, and public health agency are well integrated. **(B-302)**
 - a. There is well-defined trauma system medical oversight integrating the specialty needs of the trauma system with the medical oversight for the overall EMS system. **(I-302.1)**
 - b. There is a clearly defined, cooperative, and ongoing relationship between the trauma specialty physician leaders (for example, trauma medical director within each trauma center) and the EMS system medical director. **(I-302.2)**
 - c. There is clear-cut legal authority and responsibility for the EMS system medical director, including the authority to adopt protocols, to implement a performance improvement system, to restrict the practice of prehospital care providers, and to generally ensure medical appropriateness of the EMS system. **(I-302.3)**
 - d. The trauma system medical director is actively involved with the development, implementation, and ongoing evaluation of system dispatch protocols to ensure they are congruent with the trauma system design. These protocols include, but are not limited to, which resources to dispatch, for example, ALS versus BLS, air/ground coordination, early notification of the trauma care facility, prearrival instructions, and

other procedures necessary to ensure that resources dispatched are consistent with the needs of injured patients. **(I-302.4)**

- e. The retrospective medical oversight of the EMS system for trauma triage, communications, treatment, and transport is closely coordinated with the established performance improvement processes of the trauma system. **(I-302.5)**
- f. There is a universal access number for citizens to access the EMS/trauma system, with dispatch of appropriate medical resources. There is a central communication system for the EMS/trauma system to ensure field- to- facility bidirectional communications, interfacility dialogue, and all-hazards response communications among all system participants. **(I-302.7)**
- g. There are sufficient and well-coordinated transportation resources to ensure that EMS providers arrive at the scene promptly and expeditiously transport the patient to the correct hospital by the correct transportation mode. **(I-302.8)**

II. The lead trauma authority ensures a competent workforce. **(B-310)**

- a. In cooperation with the prehospital certification and licensure authority, set guidelines for prehospital personnel for initial and ongoing trauma training, including trauma-specific courses and courses that are readily available throughout the state. **(I-310.1)**
- b. In cooperation with the prehospital certification and licensure authority, ensure that prehospital personnel who routinely provide care to trauma patients have a current trauma training certificate, for example, Prehospital Trauma Life Support or Basic Trauma Life Support and others, or that trauma training needs are driven by the performance improvement process. **(I-310.2)**
- c. Conduct at least 1 multidisciplinary trauma conference annually that encourages system and team approaches to trauma care. **(I-310.9)**

III. The lead agency acts to protect the public welfare by enforcing various laws, rules, and regulations as they pertain to the trauma system. **(B-311)**

- a. Incentives are provided to individual agencies and institutions to seek state or nationally recognized accreditation in areas that will contribute to overall improvement across the trauma system, for example, Commission on Accreditation of Ambulance Services for prehospital agencies, Council on Allied Health Education Accreditation for training programs, and American College of Surgeons (ACS) verification for trauma facilities. **(I-311.6)**

CURRENT STATUS

The EMTS Section is established in statute as the lead agency for planning, development, and regulation of statewide EMS and trauma care. These regulatory responsibilities include the certification of all Emergency Medical Technicians, the certification of prehospital education institutions, data collection and record keeping, licensure of air ambulance agencies, administration and management of EMS provider grants, and designation of

trauma centers. First responders are trained and certified under the authority of the Department of Public Safety Division of Fire Safety.

Colorado's requirements for training all levels of EMT meet or exceed the National Standard Curriculum. The state utilizes the National Registry of EMTs (NREMT) for the initial testing and certification for new providers. Once certified, prehospital personnel are not required to maintain NREMT certification as a basis for State licensure. Continuing education hours vary by the certification level and are delineated by the State. All paramedic training programs in the state are required to maintain accreditation by the Commission on Accreditation of Allied Health Education Programs (CAAHEP). National accreditation is used by the EMTS Section to fulfill many of its certification and licensing responsibilities.

The state has approximately 190 ground ambulance services, 16 air transport agencies (8 additional agencies are licensed by Colorado but based in other states), 245 non-transporting agencies (e.g., fire departments, ski patrols, and search and rescue teams). Of the 190 ground ambulance agencies, 98 are advanced life support (ALS), 29 are basic life support (BLS), 32 are ALS and BLS, and the remainder did not identify their level of service. About 60% of ground ambulance services provide care in rural and frontier areas of the state, many responding to fewer than 500 calls per year. In contrast, large urban ambulance services transport more than 55,000 patients per year.

No state mandate exists for a county, city, or town to fund or provide EMS. Rather these jurisdictions determine their own needs and financial ability to provide services. In some cases, jurisdictions may collaborate to offer EMS in a district or a county may coordinate EMS.

As established in state rule, Colorado has defined minimum requirements for ambulance and air ambulance licensure. Of note, the licensure process for air medical services is coordinated through the EMTS Section. Accreditation by the Commission on Accreditation of Medical Transport Systems (CAMTS) is required for a Colorado air ambulance license. The decision to issue or suspend an air medical license rests solely with the EMTS Section. The licensure of ground ambulances is delegated to the county commission in each of the 64 counties, based on requirements established in state rule. No mention was made regarding the use of the Commission on the Accreditation of Ambulance Services (CAAS) to serve as a basis for standardization of ambulance accreditation in lieu of state licensure. Efforts to unify and standardize the process of licensure for ground and air EMS agencies through the EMTS Section would improve efficiency in regulatory and oversight functions.

Of the 15,000 certified prehospital providers, approximately 70% serve as paid or volunteer EMTs. The certification level of these providers is EMT-Basic (11,700), EMT-Intermediate (700), and EMT-Paramedic (3,000). Of those working, approximately 49% are paid, 17% are volunteer, and 5% are both paid and volunteer. The allocation of these providers and EMS agencies are determined locally as each town or city determines its needs and financial ability to provide services. The fact that no state mandate requires any governmental authority or agency to fund or provide emergency medical services seriously limits the EMTS Section's influence on the provision of even basic emergency services. In contrast, fire

protection is mandated statewide, either through fire protection districts or delegation to the County Sheriff.

The State EMTS Medical Director is a part time contract position, with his primary focus on chairing the Department's Medical Director Committee and collaborating with the BME on EMS clinical practice issues. No formal system exists in the EMTS Section to monitor the local medical directors' oversight processes. Most information is gained through education and support to the EMS medical directors. Complaints are the other mechanism for learning about issues with regard to EMT performance, and these are investigated by the EMTS Section. The State Medical Director has inadequate time to fulfill all of the state medical director responsibilities.

EMS medical direction is defined in Rule 500 by the BME; this rule is highly detailed and provides excellent guidance regarding the role and responsibilities of local EMS medical directors. It is unclear how the BME monitors or oversees this aspect of physician practice. Of note, the EMTS Section admits that it does little in the way of physician oversight for EMS. The fragmentation of the physician practice oversight between the two agencies (BME and EMTS Section) leads to unclear lines of authority and responsibility for medical oversight of local EMS practice. The state needs to centralize the authority and responsibility for EMS physician medical direction within the EMTS Section.

See Focus Question 2 on page 87 for more information regarding the fragmentation that exists with the management of the EMS and trauma system functions.

The state does not have statewide EMS protocols, and the EMTS Section has no statutory mandate to create them. Each local medical director devises EMS protocols, leading to a lack of uniformity in the care provided between the regions. On-line medical direction is generally available, and the process is customized to the local or regional level, often coordinated by the EMS agency's medical director. Colorado has developed a statewide Digital Trunk Radio communications system that is in use by many EMS agencies to make communications for on-line medical direction possible in many areas.

One of the state's challenges is to monitor EMT performance. Unfortunately, the MATRIX database, a software program created internally only captures the minimum NEMSIS dataset from EMS agencies. Many desired elements of patient care data are not collected, and it is not possible to identify the EMS provider performing a procedure. Acquisition of a NEMSIS-compliant software program to replace the MATRIX may be a more cost-effective and acceptable method to enable patient data entry than modifying the MATRIX database, especially if billing information is included to reduce double data entry by EMS agencies. Such a software program might more effectively enable linkage with the statewide trauma registry.

The state has no authority to establish minimum training levels for EMS dispatchers. Several attempts have been made to obtain this authority. Monitoring of EMS dispatch is conducted informally through the RETACs.

EMS agencies often face hardship when needing to transport a patient out of their community to receive specialty trauma care. This is of special concern in rural communities that may have only one ambulance. In some cases, EMS agencies rendezvous to transfer a patient to another EMS agency's ambulance for the remainder of the ride to the trauma center. However, this practice often results in only one of the agencies receiving compensation even though it may clearly be in the best interest of the injured patient (e.g. second EMS agency provides a higher level of care).

A disparity exists between the current knowledge/skills of EMS providers and the necessary knowledge and skills for performing critical care interfacility transfers. When air ambulance service is not available due to weather or other reasons, hospitals or trauma centers in rural areas must determine how to safely transfer a critical patient to the appropriate trauma center. Many of these small facilities do not have a nurse or physician available to accompany the patient. No program currently exists in the state to educate EMT Paramedics in critical care. It was reported that local EMS medical directors may write a protocol for critical care and provide local training for the EMT Paramedics to provide critical care transport after a waiver is obtained from the BME to permit this "out of scope" practice. Although the Board of Medical Examiners approves all waivers, the process for EMS medical directors to assure the competency of these providers is unclear. Obtaining a waiver is a lengthy process, and each medical director's request for a waiver is handled individually. One strategy to address this issue is the development of a rule that establishes an advanced-skill EMS provider who is permitted to perform critical care procedures, a specified curriculum for critical care procedures and patient monitoring, and the performance improvement process to evaluate care provided.

Another issue identified by participants is the age discrepancy for EMS trauma triage guidelines and interfacility transfer guidelines. A child is defined as less than 5 years in some EMS protocols. A child is defined as 0 to 5 years and 6 to 12 years in interfacility transfer guidelines. Some rules for trauma care match the "younger than 15 years" definition in the ACS' *Resources for the Optimal Care of the Injured Patient*. Consistency in the definition of age of children should occur in all EMS protocols and standards of care.

RECOMMENDATIONS

- Transfer the responsibility for licensing EMS agencies and ground ambulances from county commissioners to the EMTS Section.
- Allow national accreditation of EMS agencies (Commission on Accreditation of Ambulance Services-CAAS) for eligibility for Colorado ground ambulance licensure.
- Monitor and assure appropriate local EMS medical director performance.
- Standardize the pediatric age criteria (less than 15 years) for EMS protocols and triage and transport destination determination.
- Require standardized education for EMS dispatchers.

- Consider obtaining a NEMESIS-compliant (gold) commercial information system that allows for the selection of clinically relevant data elements.
- Eliminate the discrepancy between EMS provider capabilities and the needs of the critically ill patient who requires transport between facilities.
 - Implement rules, develop a standardized curriculum, develop advanced EMT-Paramedic certification, or whatever means is necessary to improve the quality of critical care transport for injured patients.

Definitive Care Facilities

Purpose and Rationale

Inclusive trauma systems are the systems that include all acute health care facilities, to the extent that their resources and capabilities allow and in which the patient's needs are matched to hospital resources and capabilities. Thus, as the core of a regional trauma system, acute care facilities operating within an inclusive trauma system provide definitive care to the entire spectrum of patients with traumatic injuries. Acute care facilities must be well integrated into the continuum of care, including prevention and rehabilitation, and operate as part of a network of trauma-receiving hospitals within the public health framework. All acute care facilities should participate in the essential activities of a trauma system, including performance improvement, data submission to state or regional registries, representation on regional trauma advisory committees, and mutual operational agreements with other regional hospitals to address interfacility transfer, educational support, and outreach. The roles of all definitive care facilities, including specialty hospitals (for example, pediatric, burn, severe traumatic brain injury [TBI], spinal cord injury [SCI]) within the system should be clearly outlined in the regional trauma plan and monitored by the lead agency. Facilities providing the highest level of trauma care are expected to provide leadership in education, outreach, patient care, and research and to participate in the design, development, evaluation, and operation of the regional trauma system.

In an inclusive system, patients should be triaged to the appropriate facility based on their needs and facility resources. Patients with the least severe injuries might be cared for at appropriately designated facilities within their community, whereas the most severe should be triaged to a Level I or II trauma center. In rural and frontier systems, smaller facilities must be ready to resuscitate and initiate treatment of the major injuries and have a system in place that will allow for the fastest, safest transfer to a higher level of care.

Trauma receiving facilities providing definitive care to patients with other than minor injuries must be specifically designated by the state or regional lead agency and equipped and qualified to do so at a level commensurate with injury severity. To assess and ensure that injury type and severity are matched to the qualifications of the facilities and personnel providing definitive care, the lead agency should have a process in place that reviews and verifies the qualifications of a particular facility according to a specific set of resource and quality standards. This criteria-based process for review and verification should be consistent with national standards and be conducted on a periodic cycle as determined by the lead agency. When centers do not meet set standards, there should be a process for suspension, probation, revocation, or dedesignation.

Designation by the lead agency should be restricted to facilities meeting criteria of statewide resource and quality standards and based on patient care needs of the regional trauma system. There should be a well-defined regulatory relationship between the lead agency and designated trauma facilities in the form of a contract, guidelines, or memorandum of

understanding. This legally binding document should define the relationships, roles, and responsibilities between the lead agency and the medical leadership from each designated trauma facility.

The number of trauma centers by level of designation and location of acute care facilities must be periodically assessed by the lead agency with respect to patient care needs and timely access to definitive trauma care. There should be a process in place for augmenting and restricting, if necessary, the number and/or level of acute care facilities based on these periodic assessments. The trauma system plan should address means for improving acute care facility participation in the trauma system, particularly in systems in which there has been difficulty addressing needs.

Human Resources

The ability to deliver high-quality trauma care is highly dependent on the availability of skilled human resources. Therefore, it is critical to assess the availability and educational needs of providers on a periodic basis. Because availability, particularly of subspecialty resources, is often limited, some means of addressing recruitment, retention, and engagement of qualified personnel should be a priority. Periodic workforce assessments should be conducted. Maintenance of competence should be ensured by requiring standards for credentialing and certification and specifying continuing educational requirements for physicians and nurses providing care to trauma patients. Mechanisms for the periodic assessment of ancillary and subspecialty competence, educational needs, and availability within the system for all designated facilities should be incorporated into the trauma system plan. The lead trauma centers in rural areas will need to consider teleconferencing and telemedicine to assist smaller facilities in providing education on regionally identified needs. In addition, lead trauma centers within the region should assist in meeting educational needs while fostering a team approach to care through annual educational multidisciplinary trauma conferences. These activities will do much to foster a sense of teamwork and a functionally inclusive system.

Integration of Designated Trauma Facilities Within the Trauma System

Designated trauma facilities must be well integrated into all other facets of an organized system of trauma care, including public health systems and injury surveillance, prevention, EMS and prehospital care, disaster preparedness, rehabilitation, and system performance improvement. This integration should be provided by the state and/or regional trauma plan and overseen by the lead agency.

Each designated acute care facility should participate, through its trauma program leadership, in all aspects of trauma system design, evaluation, and operation. This participation should include policy and legislative development, legislative and public education, and strategic planning. In addition, the trauma program and subspecialty leaders should provide direction and oversight to the development, implementation, and monitoring of integrated protocols for patient care used throughout the system (for example, TBI guidelines used by prehospital providers and nondesignated transferring centers), including region specific primary (field) and secondary (early transfer) triage protocols. The highest level trauma facilities should provide leadership of the regional trauma committees through their trauma program medical leadership. These medical leaders, through their activities on these committees, can assist the lead agency and help ensure that deficiencies in the quality of care within the system,

relative to national standards, are recognized and corrected. Educational outreach by these higher levels centers should be used when appropriate to help achieve this goal.

OPTIMAL ELEMENTS

I. Acute care facilities are integrated into a resource efficient, inclusive network that meets required standards and that provides optimal care for all injured patients. **(B-303)**

- a. The trauma system plan has clearly defined the roles and responsibilities of all acute care facilities treating trauma and of facilities that provide care to specialty populations (for example, burn, pediatric, SCI, and others). **(I-303.1)**

II. To maintain its state, regional, or local designation, each hospital will continually work to improve the trauma care as measured by patient outcomes. **(B-307)**

- a. The trauma system engages in regular evaluation of all licensed acute care facilities that provide trauma care to trauma patients and of designated trauma hospitals. Such evaluation involves independent external reviews. **(I-307.1)**

III. The lead trauma authority ensures a competent workforce. **(B-310)**

- a. As part of the established standards, set appropriate levels of trauma training for nursing personnel who routinely care for trauma patients in acute care facilities. **(I-310.3)**
- b. Ensure that appropriate, approved trauma training courses are provided for nursing personnel on a regular basis. **(I-310.4)**
- c. In cooperation with the nursing licensure authority, ensure that all nursing personnel who routinely provide care to trauma patients have a trauma training certificate (for example, Advanced Trauma Care for Nurses, Trauma Nursing Core Course, or any national or state trauma nurse verification course). As an alternative after initial trauma course completion, training can be driven by the performance improvement process. **(I-310.5)**
- d. In cooperation with the physician licensure authority, ensure that physicians who routinely provide care to trauma patients have a current trauma training certificate of completion, for example, Advanced Trauma Life Support® (ATLS®) and others. As an alternative, physicians may maintain trauma competence through continuing medical education programs after initial ATLS completion. **(I-310.8)**
- e. Conduct at least 1 multidisciplinary trauma conference annually that encourages system and team approaches to trauma care. **(I-310.9)**
- f. As new protocols and treatment approaches are instituted within the system, structured mechanisms are in place to inform all personnel about the changes in a timely manner. **(I-310-10)**

CURRENT STATUS

Colorado enjoys the benefits of an outstanding medical community, including world-class trauma surgeons, dedicated to the care of the injured. It is exemplary that people and facilities are committed throughout the state to injury care. Colorado has 77 acute care hospitals, and 65 of them are designated as trauma centers, at level I, II, III, IV, or V. Of the 12 non-designated hospitals, seven are located very close to a designated trauma center and five are rural and very distant from definitive care. Of Colorado's 64 counties, 18 have no hospital.

The Denver metropolitan area has 16 designated hospitals and 5 non-designated hospitals including all of the Level I facilities in the state. An additional five (5) level II trauma centers, four (4) level III and one level IV are located along the I-25 Interstate Highway corridor. A Regional Pediatric Trauma Center (RPTC) is located in the Denver metropolitan area. It was reported that a level I trauma center in the Denver metropolitan area has initiated a new pediatric trauma service which will compete with the RPTC for patients. Standardized regulations and rules for prehospital treatment, standards of care (triage and transfer, care of special injuries), and mandatory transfer of patients from non-designated facilities are all excellent components of a comprehensive trauma system.

The process for trauma center designation is complex. A facility may seek State site review or combined State review and ACS verification to determine designation level. All level I, and, many level II centers are both State approved and ACS verified trauma centers. Whether this dual process leads to a variable standard for level II trauma centers or differences in patient outcome is unknown. The dual system appears to exist to benefit the facility in obtaining designation, rather than focusing on optimal access to care for the injured patient. The process for Level III-V designation is simpler and includes only a State designation process.

Colorado has no limitation on the number, level, or geographic location of trauma centers. If a facility is committed and meets most requirements, designation is awarded. Deficiencies were reported in some cases to be excused by waivers. Additionally, one criterion for level I designation is admission of a minimum number of severely injured patients. This criterion is arbitrary, and it neither correlates with data available in the literature, nor a focus on patient needs. While there is no specifically defined volume number, the challenge is to know the needs and to best match the patient needs to resource availability, while avoiding unnecessary and expensive duplication. Colorado does not currently match the number, level, or location of the trauma centers with trauma patient needs consistently across the state. The state has not conducted a statewide assessment of injured patient needs that could be matched to the several statewide assessments of resources.

The population of Colorado is approximately, 5 million. Previous analyses suggest that approximately 1,000 severely (>15 injury severity score [ISS]) injured patients occur for every 1 million population, resulting in an annual estimate of 5,000 severely injured patients in Colorado. If all severe injuries were concentrated in one urban area, this volume could routinely be cared for by a combined total of 3 to 4 level I and II trauma centers (in some combination). The Denver metropolitan area currently has 7 level I and II trauma centers serving a population of approximately 2.5 million plus serving as tertiary care centers for the

rest of the additional 2.4 million residents. This information likely reflects an excess of trauma centers that are competing for patients, reducing the volume at each center, and duplicating expensive resources.

Colorado's effort to involve all acute care facilities in an inclusive system is admirable and essential to the identification, treatment, and transfer of patients in more rural parts of the state. However, the approach has had some unintended consequences concerning the over-concentration and duplication of high level resources along the Front Range. While the suggested trauma needs assessment must be statewide in nature to assure that the needs of persons injured in rural Colorado are met, the assessment needs to specifically address the location, severity, and access to care for injured patients in the Denver metropolitan area. The ACS SVT clearly acknowledges the strong commitment that key trauma resources in the Denver Metro area have made over the past two decades. However, it is unclear that the strategic placement and level of verification of resources have been matched to optimize patient access to care while maintaining appropriate levels of provider proficiency through sufficient patient contact. In this "resource rich" portion of the state, the number of high level centers should be matched to patient need and controlled as necessary to reduce unnecessary duplication. Clearly, some redundancy is appropriate but again must be balanced to ensure both an effective and efficient use of resources.

On the Western Slope, the central hub created by the trauma center in Grand Junction serves as an excellent example of regionalization serving a vast rural area. The outreach and support efforts from that centralized hub have helped to improve the organization of resources at smaller facilities and have led to transfer relationships that appear to be in the best interest of the injured patient. Similar hub and spoke relationships need to be developed in other rural areas of the state.

Currently, the EMTS Section seems to perform minimal, if any, tracking of patient outcomes at the various trauma centers. Likewise, there is limited monitoring to confirm that the trauma centers function at their level of designation, in compliance with transfer and triage guidelines. This lack of system-wide monitoring and adherence to standards potentially places the public's health and welfare in jeopardy.

Several participants noted a lack of collegial collaboration between the various trauma centers, particularly among and between those in competitive proximity to each other. This lack of collaboration between trauma centers has largely undermined any potential joint research or data sharing.

The seven acute care hospitals, in close proximity to designated urban trauma centers, need to be brought into the trauma system either at minimal designation levels or as "participating trauma hospitals". These seven hospitals have signed non-designation agreements that require multiple system injuries to be transferred within 2 hours of arrival, and after initial resuscitation and stabilization. However, these facilities are permitted to treat single system injuries. If these hospitals potentially became "participating trauma hospitals," they could be asked to submit a minimal dataset for patients treated that could enable the state to have a

complete set of trauma data. Data would also enable the state to monitor compliance with the agreement.

Certainly, the recruitment of every acute care hospital to participate in the trauma system at the highest level appropriate to resources available should be the goal in the rural, underserved areas of the state. The EMTS Section has excelled at recruiting and including the numerous isolated acute care hospitals into the trauma system. The current attempt to recruit the remaining five rural facilities into the trauma system would greatly improve access to trauma care in those communities. Grants from the newly acquired funding in the Highway User's Tax Fund and FLEX Grant Funds could potentially be targeted to assist these facilities to achieve designation and contribute to the overall trauma care coverage in the state.

The EMTS Section is to be commended for having developed rules for triage and interfacility transfer. Other rules deal with specific injuries, such as childhood trauma, burns, traumatic brain injury (TBI), spinal cord injury (SCI), and non-designated care delivery. While these are critical to system function, the EMTS Section does little to no monitoring of rule compliance (other than the monitoring of each facility at its trauma designation review), and no assessment of the potential impact of the rules and facility compliance on patient outcomes. The EMTS Section needs to develop a quality improvement process to monitor and track facility compliance to these standards of care and their impact on trauma outcomes. Without these data, it is not possible to determine if or when changes in the standards of care need revision.

RECOMMENDATIONS

- **Perform a *patient-focused* in-depth statewide *needs assessment study* to determine the appropriate level, number, and geographic location of trauma centers for the state.**
- Preserve the exemplary state-wide commitment to care of the injured patient, and assure that this commitment is guided by an inclusive, patient focused, trauma system plan (i.e. appropriate number, level and location of trauma centers).
- Develop a request for proposal process to identify potential level I and II trauma centers for the state.
 - Define the expectation of similar clinical care with expanded outreach, education, and clinical support expected of the level I trauma centers.
- Assist rural facilities with limited resources to achieve designation.
 - Provide outreach and support (by the State and level I and II trauma centers), grants, and other interventions.
 - Continue to collaborate with the Colorado Rural Health Center.
- Focus pediatric trauma care at the regional pediatric trauma center (RPTC) as a regional resource.

System Coordination and Patient Flow

Purpose and Rationale

To achieve the best possible outcomes, the system must be designed so that the right patient is transported to the right facility at the right time. Although on the surface this objective seems relatively straightforward, patients, geography, and transportation systems often conspire to present significant challenges. The most critically injured trauma patient is often easy to identify at the scene by virtue of the presence of coma or hypotension. However, in some circumstances, the patients requiring the resources of a Level I or II center may not be immediately apparent to prehospital providers. Primary or field triage criteria aid providers in identifying which patients have the greatest likelihood of adverse outcomes and might benefit from the resources of a designated trauma center. Even if the need is identified, regional geography or limited air medical (or land) transport services might not allow for direct transport to an appropriate facility.

Primary triage of a patient from the field to a center capable of providing definitive care is the goal of the trauma system. However, there are circumstances (for example, airway management, rural environments, inclement weather) when triaging a patient to a closer facility for stabilization and transfer is the best option for accessing definitive care. Patients sustaining severe injuries in rural environments might need immediate assessment and stabilization before a long-distance transport to a trauma center. In addition, evaluation of the patient might bring to light severe injuries for which needed care exceeds the resources of the initial receiving facility. Some patients might have specific needs that can be addressed at relatively few centers within a region (for example, pediatric trauma, burns, severe TBI, SCI, and reimplantation). Finally, temporary resource limitations might necessitate the transfer of patients between acute care facilities.

Secondary triage at the initial receiving facility has several advantages in systems with a large rural or suburban component. The ability to assess patients at nondesignated or Level III to V centers provides an opportunity to limit the transfer of only the most severely injured patients to Level I or II facilities, thus preserving a limited resource for patients most in need. It also provides patients with lesser injuries the possibility of being cared for within their community.

The decision to transfer a trauma patient should be based on objective, prospectively agreed-on criteria. Established transfer criteria and transfer agreements will minimize discussions about individual patient transfers, expedite the process, and ensure optimal patient care. Delays in transfer might increase mortality, complications, and length of stay. A system with an excess of transferred patients might tax the resources of the regional trauma facility. Conversely, inappropriate retention of patients at centers without adequate facilities or expertise might increase the risk of adverse outcomes. Given the importance of timely, appropriate interfacility transfers, the time to transfer, as well as the rates of primary and secondary over triage basis, and corrective actions should be instituted when problems are identified. Data derived from tracking and monitoring the timeliness of access to a level of

trauma care commensurate with injury type and severity should be used to help define optimal system configuration.

A central communications center with real-time access to information on system resources greatly facilitates the transfer process. Ideally, this center identifies a receiving facility, facilitates dialogue between the transferring and receiving centers, and coordinates interfacility transport.

To ensure that the system operates at the greatest efficiency, it is important that patients are repatriated back to community hospitals once the acute phase of trauma care is complete. The process of repatriation opens up the limited resources available to care for severely injured patients. In addition, it provides an opportunity to bring patients back into their local environment where their social network might help reintegrate patients into their community.

OPTIMAL ELEMENTS

I. The trauma system is supported by an EMS system that includes communications, medical oversight, prehospital triage, and transportation; the trauma system, EMS system, and public health agency are well integrated. **(B-302)**

- a. There are mandatory system-wide prehospital triage criteria to ensure that trauma patients are transported to an appropriate facility based on their injuries. These triage criteria are regularly evaluated and updated to ensure acceptable and system-defined rates of sensitivity and specificity for appropriately identifying a major trauma patient. **(I-302.6)**
- b. There is a universal access number for citizens to access the EMS/trauma system, with dispatch of appropriate medical resources. There is a central communications system for the EMS/trauma system to ensure field-to- facility bidirectional communications, interfacility dialogue, and all-hazards response communications among all system participants. **(I-302.7)**
- c. There is a procedure for communications among medical facilities when arranging for interfacility transfers, including contingencies for radio or telephone system failure. **(I-302.9)**

II. Acute care facilities are integrated into a resource-efficient, inclusive network that meets required standards and that provides optimal care for all injured patients. **(B-303)**

- a. When injured patients arrive at a medical facility that cannot provide the appropriate level of definitive care, there is an organized and regularly monitored system to ensure that the patients are expeditiously transferred to the appropriate system-defined trauma facility. **(I-303.4)**

CURRENT STATUS

To Colorado's credit, a State Prehospital Trauma Triage Algorithm has been developed and established in administrative rule. However, the guideline is not revised to correspond to the current national guideline, and it has not been monitored or routinely assessed for its

effectiveness. Each RETAC can modify the state guideline to correspond to facilities and resources in the region, but the trauma patient assessment portion of the algorithm may not be modified. This guideline needs to be evaluated and updated.

Colorado has also established administrative rules for the interfacility transfer of specialty care patients. It is important to note that the guideline established in rule 6 CCR 1015-4 provides guidance as to when consultation must be sought for specific conditions to help facilitate the decision-making process for interfacility transfer. As with the Prehospital Trauma Triage Algorithm, the interfacility guidelines are not routinely monitored or enforced. They are evaluated through the chart review at the triennial trauma facility review. For example, transfer agreements are required for non-designated facilities and transfers from these facilities must be initiated “within 2 hours of the recognition that a patient has a significant injury.” No mechanism is in place to monitor compliance to these transfer agreements, and data are not readily available to assess the timely transfer of patients from non-designated facilities. Level IV and V trauma centers and non-designated facilities are not required to participate fully in the Colorado Trauma Registry. Data from all hospitals are passively collected through the Colorado Hospital Discharge Dataset. Unfortunately, this dataset only records limited information on patients who were admitted, transferred, or died. This is a significant deficit in the trauma system’s ability to assess if the right patient was sent to the right facility at the right time.

Protocols direct EMS personnel to perform specific actions in the absence of medical direction. Therefore, compliance to the state guidelines should be the standard unless complexities come in to play like time, distance, weather, or the need for rapid specialized care. Protocols should specifically address these issues. The development of protocols or guidelines should be accomplished in a collegial manner with on-line and off-line medical direction. Patient destination should result from an assessment of the critical condition status of the patient with rapid transport to a facility that can provide definitive care. Second transfers need to be assessed and functionally eliminated.

The issue of diversion has been addressed by use of a “Zone Master” system. When patient saturation becomes an issue in the Denver metropolitan area, the Zone Master system allows one facility to assign patients to other facilities within its zone. The process helps to ensure that the facility closest to an MCI is not overwhelmed.

Colorado does not have uniform system-wide policies addressing the mode of transportation, and the type and qualifications of transport personnel used for interfacility transport. According to the PRQ and participant comments, this appears to be a major issue, especially for rural areas where a nurse (if available) must be sent along with the patient for long and time-consuming transports. Also, guidelines for the appropriate use of ground vs. air transport are not well defined on a system-wide basis.

Currently, the scope of practice for EMTs does not include training or certification for critical care. Since the scope of practice for EMTs resides within the Board of Medical Examiners and licensing of ambulances resides at the county level, coordination, monitoring, and

assessment of the critical care interfacility ground transfers may continue to be a challenge. See further information in the Emergency Medical Services section on page 46.

Discussions with participants during the TSC visit indicated that some portion of interfacility transfers are currently occurring without appropriately trained personnel available in the ambulance. The impact of this practice on injured patient outcomes is not known in the absence of a systemwide QI program.

Even though Colorado does not have a central system to coordinate interfacility transfers, they do have a web-based patient and resource tracking system. The EMS system can be used to query hospitals for bed availability and resources for specific types of patients. The system is used by the Denver metropolitan area when patient saturation is an issue.

Some level I and II facilities have voluntarily initiated a system to assist referring facilities by providing a “one call does it all” service. In a multiple casualty event, rural facilities can quickly be overwhelmed and resources limited. Timely assistance in arranging transfers and consultations with specialists is critical. Though the “one call does it all” service is not systemwide, the referring facilities expressed their gratitude for the availability of this service. However, other participants described the challenge of multiple calls to find a trauma center that would accept their patients and transport.

RECOMMENDATIONS

- **Establish a statewide central communications system to coordinate and secure expeditious transports and interfacility transfers with one call.**
- Utilize new technology to support communications for consultations and transfer arrangements.
 - Wireless/Telemedicine
- Develop a mechanism and routinely monitor compliance with triage and transfer guideline rules.
- Utilize the current national standards to update and modify the prehospital triage and hospital transfer guidelines. The Centers for Disease Control and the American College of Surgeons have established revised guidelines.
- Ensure compliance with all specialty care transfer guidelines (traumatic brain injury, spinal cord injury, burns, pediatrics).
- Establish operational rules for critical care transport.
- Establish statewide EMS protocols that take into account variances due to time, distance, and personnel resources in rural areas of Colorado.

- Secure funding to provide additional Rural Trauma Team Development Course (RTTDC), in conjunction with the Colorado Rural Health Center, to rural areas to encourage the appropriate stabilization and transfer of trauma patients.
- Create a system of seamless patient transport across county lines to the appropriate facilities under regionalized medical direction.

Rehabilitation

Purpose and Rationale

As an integral component of the trauma system, rehabilitation services in acute care and rehabilitation centers provide coordinated care for trauma patients who have sustained severe or catastrophic injuries, resulting in long-standing or permanent impairments. Patients with less severe injuries may also benefit from rehabilitative programs that enhance recovery and speed return to function and productivity. The goal of rehabilitative interventions is to allow the patient to return to the highest level of function, reducing disability and avoiding handicap whenever possible. The rehabilitation process should begin in the acute care facility as soon as possible, ideally within the first 24 hours. Inpatient and outpatient rehabilitation services should be available. Rehabilitation centers should have CARF (Commission of Accreditation of Rehabilitation Facilities) accreditation for comprehensive inpatient rehabilitation programs, and accreditation of specialty centers (SCI and TBI) should be strongly encouraged.

The trauma system should conduct a rehabilitation needs assessment (including specialized programs in SCI, TBI, and for children) to identify the number of beds needed and available for rehabilitation in the geographic region. Rehabilitation specialists should be integrated into the multidisciplinary advisory committee to ensure that rehabilitation issues are integrated into the trauma system plan. The trauma system should demonstrate strong linkages and transfer agreements between designated trauma centers and rehabilitation facilities located in its geographic region (in or out of state). Plans for repatriation of patients, especially when rehabilitation centers across state lines are used, should be part of rehabilitation system planning. Feedback on functional outcomes after rehabilitation should be made available to the trauma centers.

OPTIMAL ELEMENTS

- I. The lead agency ensures that adequate rehabilitation facilities have been integrated into the trauma system and that these resources are made available to all populations requiring them. **(B-308)**
 - a. The lead agency has incorporated, within the trauma system plan and the trauma center standards, requirements for rehabilitation services, including interfacility transfer of trauma patients to rehabilitation centers. **(I-308.1)**
 - b. Rehabilitation centers and outpatient rehabilitation services provide data on trauma patients to the central trauma system registry that include final disposition, functional outcome, and rehabilitation costs and also participate in performance improvement processes. **(I-308.2)**

II. A resource assessment for the trauma system has been completed and is regularly updated. **(B-103)**

- a. The trauma system has completed a comprehensive system status inventory that identifies the availability and distribution of current capabilities and resources. **(I-103.1)**

CURRENT STATUS

Colorado State rules for trauma center designation require that trauma centers provide rehabilitation services and transfer agreements to free standing rehabilitation hospitals. As a result, trauma centers have addressed the need to provide these services to optimize care for the severely injured patient.

The State possesses a relative wealth of capacity and capability for rehabilitation across the spectrum of injury (TBI, SCI, amputation, orthopedics, pediatrics, burn care, occupational therapy, physical therapy). The state has 18 acute care hospitals with short-term rehabilitation capabilities and 4 dedicated rehabilitation hospitals with long-term capability. The resulting capacity is approximately 260 short-term beds (STB) and 275 long-term beds (LTB). The majority of the rehabilitation facilities are licensed by the Health Facilities Regulation Section, and some facilities have achieved Commission on Accreditation of Rehabilitation Facilities (CARF) accreditation.

STB capacity resides almost exclusively within the trauma centers (level I through IV), enabling the early identification and referral for the rehabilitation needs of the acutely injured trauma patient. The vast majority of STBs are located in the Denver metropolitan area (32%) or the Front Range (56%) with the remaining (12%) located along the Western Slope or in the central mountains. LTB capacity within the state is located in the Denver metropolitan area (62%) and the Front Range (38%).

Colorado enjoys unusual access to expert and specialty capability as it pertains to rehabilitation services. The National Institute on Rehabilitation and Research recognizes Craig Hospital, a stand-alone rehabilitation hospital in Denver, as a Model System Center for SCI and TBI rehabilitation. Craig is ranked among the top 10 rehabilitation centers in the United States offering rehabilitation services to patients aged 15 years and older. The Children's Hospital possesses inpatient rehabilitation services unique for patients in the 0 to 18 year age range. Each of these facilities offers SCI and TBI capacity to address the needs of these special populations. The University of Colorado Hospital is the state's only burn center accredited by the American Burn Association.

Despite this relative wealth of capacity and capability, the trauma system does not have a mechanism to engage rehabilitation experts in trauma system planning and implementation. No rehabilitation expert is a designated representative to the SEMTAC or RETACs. Rehabilitation experts are also not participating on committees of the SEMTAC.

The collection and analysis of data elements specific to rehabilitation are almost completely lacking at the state and regional levels. The TSC team assumes that some rehabilitation data collection is occurring as a requirement of ACS trauma center designation, or Joint Commission accreditation. The trauma system has made no use of rehabilitation data for QI or program development.

Trauma system stakeholders reported that rehabilitation planning occurs early in the stay for hospitalized patients, generally beginning within 24 to 48 hours of admission. Placement of uncomplicated trauma patients into STB or LTB occurs quickly (from several days up to a week); however, when specialized needs exist, longer time frames for placement are needed (up to two weeks). Participants reported that when patient needs involve ventilator dependence or unfunded care, placement is difficult and may result in patients languishing in the trauma center for extended periods. The financial and bed capacity impact of this problem on trauma centers is unknown.

RECOMMENDATIONS

- Collect data elements related to rehabilitation and utilize these data to inform the trauma system.
- Assure rehabilitation representation on the Multidisciplinary Trauma Advisory Committee.
- Assure rehabilitation specialist involvement in the systemwide needs assessment.
- Develop process improvements regarding difficult placement issues, e.g., ventilator dependent patients and unfunded patients.

Disaster Preparedness

Purpose and Rationale

As critically important resources for state, regional, and local responses to MCIs, the trauma system and its trauma centers are central to disaster preparedness. Trauma system leaders need to be actively involved in public health preparedness planning to ensure that trauma system resources are integrated into the state, regional, and local disaster response plans. Acute care facilities (sometimes including one or more trauma centers) within an affected community are the first line of response to an MCI. However, an MCI may result in more casualties than the local acute care facilities can handle, requiring the activation of a larger emergency response plan with support provided by state and regional assets.

For this reason, the trauma system and its trauma centers must conduct a resource assessment of its surge capacity to respond to MCIs. The resource assessment should build on and be coupled to a hazard vulnerability analysis. An assessment of the trauma system's response to simulated incident or tabletop drills must be conducted to determine the trauma system's ability to respond to MCIs. Following these assessments, a gap analysis should be conducted to develop statewide MCI response resource standards. This information is essential for the development of an emergency management plan that includes the trauma system.

Planning and integration of the trauma system with plans of related systems (public health, EMS, and emergency management) are important because of the extensive impact disasters have on the trauma system and the value of the trauma system in providing care. Relationships and working cooperation between the trauma system and public health, EMS, and emergency management agencies support the provision of assets that enable a more rapid and organized disaster response when an event occurs. For example, the EMS emergency preparedness plan needs to include the distribution of severely injured patients to trauma centers, when possible, to make optimal use of trauma center resources. This plan could optimize triage through directing less severely injured patients to lower level trauma centers or non-designated facilities, thus allowing resources in trauma centers to be spared for patients with the most severe injuries. In addition, the trauma system and its trauma centers will be targeted to receive additional resources (personnel, equipment, and supplies) during major MCIs.

Mass casualty events and disasters are chaotic, and only with planning and drills will a more organized response be possible. Simulation or tabletop drills provide an opportunity to test the emergency preparedness response plans for the trauma system and other systems and to train the teams that will respond. Exercises must be jointly conducted with other agencies to ensure that all aspects of the response plan have the trauma system integrated.

OPTIMAL ELEMENTS

I. An assessment of the trauma system's emergency preparedness has been completed, including coordination with the public health agency, EMS system, and the emergency management agency. **(B-104)**

- a. There is a resource assessment of the trauma system's ability to expand its capacity to respond to MCIs in an all-hazards approach. **(I-104.1)**
- b. There has been a consultation by external experts to assist in identifying current status and needs of the trauma system to be able to respond to MCIs. **(I-104.2)**
- c. The trauma system has completed a gap analysis based on the resource assessment for trauma emergency preparedness. **(I-104.3)**

II. The lead agency ensures that its trauma system plan is integrated with, and complementary to, the comprehensive mass casualty plan for natural and manmade incidents, including an all-hazards approach to planning and operations. **(B-305)**

- a. The EMS, the trauma system, and the all-hazards medical response system have operational trauma and all-hazards response plans and have established an ongoing cooperative working relationship to ensure trauma system readiness for all-hazards events. **(I-305.1)**
- b. All-hazards events routinely include situations involving natural (for example, earthquake), unintentional (for example, school bus crash), and intentional (for example, terrorist explosion) trauma-producing events that test the expanded response capabilities and surge capacity of the trauma system. **(I-305-2)**
- c. The trauma system, through the lead agency, has access to additional equipment, materials, and personnel for large-scale traumatic events. **(I-305.3)**

CURRENT STATUS

Colorado has a State Disaster Plan, and within this plan coordination of Emergency Support Function (ESF) 8 functions are the responsibility of the Emergency Preparedness and Response Division (EPRD) of the CDPHE. The EPRD leads the state implementation of 3 federal disaster response programs (The Hospital Preparedness Program, The Center for Disease Control, and the Waste Isolation Pilot Program). Other, federally sponsored disaster programs in Colorado include the following: Metropolitan Medical Response System (MMRS); National Disaster Medical System (NDMS) Region 8; Strategic National Stockpile (SNS); Medical Reserve Corps (MRC); Emergency System for Advanced Registration of Volunteer Health Professionals (ESAR-VHP), Urban Area Security Initiative (UASI). The EPRD implements projects in collaboration with these federal programs by engaging EMS agencies and trauma centers at the local level.

The EPRD and the EMTS Section are both based in the CDPHE. During disaster incidents, EMTS supports the ESF 8 function by providing resource information (EMS and trauma

resource accounting) at the disaster operations center. However, the EMTS Section reported no direct involvement in the planning and integration of the trauma system into the planning process. EMTS appears to have missed opportunities for past funding through the HRSA program that could have potentially supported trauma system development and greater integration into the state's disaster response plan. Several other states have successfully used HRSA funds to help develop the trauma system.

EMSystem, a web-based tracking system, is utilized by hospitals and public safety answering points (PSAPs) to inform the system regarding hospital capacity and capabilities during daily operations, as well as during MCI or disaster incidents. The EMSystem operates on a statewide basis and is funded through preparedness dollars flowing through the EPRD. Funding, maintenance, training, and updating of EMSystems is conducted through the HPP within the EPRD.

EMS and hospital disaster caches are strategically placed within the state to support surge needs during a disaster. Colorado ranks fifth among the states reporting bed surge capacity, with 1,337 beds per 1 million population. A robust MRC and ESAR-VHP program exists within the state, and Colorado is one of only two states to offer civil and criminal liability protections to health care workers during a disaster (National Report Card on the State of Emergency Medicine, ACEP, 2009).

Formal drills and exercises aimed at testing individual components of disaster response within solitary response disciplines have met with variable success, and interagency efforts are in the formative stage. An event of national significance, the Democratic National Convention, in the fall of 2008, provided the first opportunity for response agencies across a multitude of disciplines to interact on a large scale. Each trauma center possesses a disaster plan (as required by the Joint Commission).

RECOMMENDATIONS

- Assure that input from the State Emergency Medicine and Trauma Advisory Committee (SEMTAC) and Regional Emergency Medicine and Trauma Advisory Committees (RETACs) is incorporated into state, regional, and local disaster plans and activities.
- Mandate dialog between Emergency Preparedness and Response Division (EPRD) and the new Multidisciplinary Trauma Advisory Committee (MTAC) to optimize trauma system improvements for disaster response.

System-wide Evaluation and Quality Assurance

Purpose and Rationale

The trauma lead agency has responsibility for instituting processes to evaluate the performance of all aspects of the trauma system. Key aspects of system-wide effectiveness include the outcomes of population based injury prevention initiatives, access to care, as well as the availability of services, the quality of services provided within the trauma care continuum from prehospital and acute care management phases through rehabilitation and community reintegration, and financial impact or cost. Intrinsic to this function is the delineation of valid, objective metrics for the ongoing quality audit of system performance and patient outcomes based on sound benchmarks and available clinical evidence. Trauma management information systems (MISs) must be available to support data collection and analysis.

The lead agency should establish forums that promote inclusive multidisciplinary and multi-agency review of cases, events, concerns, regulatory issues, policies, procedures, and standards that pertain to the trauma system. The evaluation of system effectiveness must take into account the integration of these various components of the trauma care continuum and review how well personnel, agencies, and facilities perform together to achieve the desired goals and objectives. Results of customer satisfaction (patient, provider, and facility) appraisals and data indicative of community and population needs should be considered in strategic planning for system development. System improvements derived through evaluation and quality assurance activities may encompass enhancements in technology, legislative or regulatory infrastructure, clinical care, and critical resource availability.

To promote participation and sustainability, the lead agency should associate accountability for achieving defined goals and trauma system performance indicators with meaningful incentives that will act to cement the support of key constituents in the health care community and general population. For example, the costs and benefits of the trauma system as they relate to reducing mortality or decreasing years of productive life lost may make the value of promoting trauma system development more tangible. A facility that achieves trauma center verification/designation may be rewarded with monetary compensation (for example, ability to bill for trauma activation fees) and the ability to serve as a receiving center for trauma patients. The trauma lead agency should promote ongoing dialog with key stakeholders to ensure that incentives remain aligned with system needs.

OPTIMAL ELEMENTS

I. The trauma MIS is used to facilitate ongoing assessment and assurance of system performance and outcomes and provides a basis for continuously improving the trauma system, including a cost-benefit analysis. **(B-301)**

- a. The lead trauma authority ensures that each member hospital of the trauma system collects and uses patient data, as well as provider data, to assess system performance

and to improve quality of care. Assessment data are routinely submitted to the lead trauma authority. **(I-301.1)**

II. The jurisdictional lead agency, in cooperation with other agencies and organizations, uses analytic tools to monitor the performance of population based prevention and trauma care services. **(B-304)**

III. The financial aspects of the trauma system are integrated into the overall performance improvement system to ensure ongoing fine tuning and cost-effectiveness. **(B-309)**

- a. Financial data are combined with other cost, outcome, or surrogate measures, for example, years of potential life lost, quality-adjusted life years, and disability adjusted life years; length of stay; length of intensive care unit stay; number of ventilator days; and others, to estimate and track true system costs and cost- benefits. **(I-309.4)**

CURRENT STATUS

Colorado is not alone with its challenge to develop a state systemwide performance improvement (PI) process, benchmarks, and measures. Many states have struggled and continue to struggle with this particular system attribute. Many different aspects of the statewide system must be assessed and evaluated. This effort requires sufficient resources, comprehensive data, and clinical expertise at the state level. The challenge of a systemwide PI program can sometimes be overwhelming without these key elements in place. Additionally a PI plan is needed that identifies the system measures to assess if the right patient is going to the right facility at the right time. Home rule, previous political issues, affiliation with facilities, and targeted EMS marketing have no place in determining the most appropriate destination for a seriously injured patient. The collaboration between hospitals, EMS agencies, and medical directors is essential to conduct PI and to assess the triage and transfer guidelines.

Fortunately, Colorado has several strengths that will facilitate the development of a state PI program resulting in trauma system evaluation. The EMTS Section has collected trauma registry data for 10 years. However, the current data collection does not provide all the needed information necessary to assess trauma care. Not all facilities submit trauma registry data; only the designated level I, II, and III trauma centers submit, representing 30 of the 77 acute care facilities. All facilities should submit data to properly evaluate the effectiveness of the state trauma system. The EMTS Section does have access to the Hospital Discharge dataset (UB04) through the Colorado Hospital Association, which enables the State to attempt to assess the appropriate transfers of severely injured trauma patients. However, the hospital discharge dataset does not include the data elements needed to adequately assess under- and over-triage and the appropriateness of transfers, particularly since it does not routinely capture emergency department activities.

The EMTS Section has been collecting prehospital data through the MATRIX. The data collected represent 70% of the EMS providers and 80% of the overall patient transports. The EMTS Section reported the capability to link trauma registry data with motor vehicle crash data and hospital discharge data, but this has not occurred on a regular basis. Both trauma registry data and EMS data meet the national standards set forth in the National Trauma

Data Standard (NTDS) and the NEMSIS. However, the MATRIX is lacking vital patient care information like initial vital signs that is important for evaluating patient care.

The EMTS Section is fortunate to have capable trauma program staff, though inadequate in numbers to sufficiently implement an inclusive statewide trauma system. A trauma program manager, with a strong public health background, is available for assessment, planning, implementation, and evaluation of the state trauma system utilizing the current HRSA public health model for trauma system planning and evaluation. The trauma program assistant and an injury epidemiologist provide support to the trauma program. The recently added staff member in the Data Management program has improved efforts to analyze data and generate reports.

The EMTS Section has inadequate staff to sufficiently monitor compliance with triage and transfer guidelines, statute, rules, and criteria. Because of limited resources, the State has not been able to provide effective oversight for state or regional PI. The TSC team felt that the number of EMS agency medical directors made it more difficult to monitor consistency of trauma treatment and PI.

Colorado appears to have several elements in place for a successful State PI program. The Colorado Emergency Medical and Trauma Services Act provides statutory authority to collect data and to establish a “continuing quality improvement program.” Sufficient authority exists to monitor trauma center compliance, and corrective action plans can be required to address deficiencies. Department rules require each ambulance service to have an off-line medical director who is responsible for quality assurance.

The EMTS Section has sufficient authority to both establish a state PI system and to provide system oversight and evaluation. However, the PI process and data at the local and regional level may be discoverable.

The EMTS Section has a Governor- appointed advisory council (SEMTAC) with various committees in place to assist with systemwide development and trauma care issues. The SEMTAC Public Health and Safety Committee monitors system standards and criteria for prehospital care providers and trauma centers. The SEMTAC Standards and Solutions Committee establishes standards for access and coordination of care. The SEMTAC Information Support Committee addresses the needs for a Trauma and EMS data collection system. The TSC team could not determine which committee would ultimately be responsible for development, implementation, and review of state and regional PI plans.

The adoption of a trauma triage guideline and algorithm into rule allows the EMTS Section to assess over- and under-triage in order to match the needs of the patient with the most appropriate facility. Routine evaluations for transfer times and over- and under-triage are not conducted. Once an issue is identified, no process is in place for intervention and “loop closure” for the patient care issue. To complicate the system evaluation process, each of the above mentioned committees can identify, select, and prioritize trauma system and care issues.

The CDPHE appears to have some broad confidentiality protection in place for the data collected and the implementation of a PI process at the State level. However, there is uncertainty regarding the extent of the protection for entities other than the Department to view case level data.

The State also conducted a study in 2002 to 2003 on the effectiveness of the trauma system using trauma registry data. The investigators looked at the severity of patients injured, where they were treated and the number of patients being treated. The purpose of the study was to determine if a regionalized system of providing trauma care improved patient outcomes.

Three questions were posed:

- Has there been a change in where the patients are being treated?
- Are patients being treated at hospitals that have the resources to treat the patients?
- Has there been an improvement in patient outcomes?

The study was completed and findings revealed improvements in getting patients to the right facility for level of injury. However, no evidence was provided that the EMTS Section used the study findings for the purpose of further improving the trauma system by reviewing and modifying algorithms or guidelines.

Best practices for regional trauma PI already exist within Colorado. The Child Fatality Review process may be a model for state review of sentinel trauma deaths. Isolated models of PI exist within RETACs with strong regional medical directors. Some evidence was provided that some rural level II trauma centers had models for trauma PI with referring facilities and EMS agencies through their outreach programs.

RECOMMENDATIONS

- **Develop a statewide trauma system performance improvement (PI) plan in collaboration with trauma system constituents within the next 12 months.**
 - **Consider using a contractor for development of the plan**
 - **Query other states for a template.**
- Assure the protection of the data and the trauma performance improvement process at local, regional, and state levels.
 - The EMTS Section should establish administrative rules or take any other necessary action.
 - Seize the opportunity to incorporate protection for the multidisciplinary performance improvement peer review process during the review of the sunseting Medical Practice Act.
- Hire a trauma program specialist with clinical expertise to educate and assist the RETACS and small rural facilities with the PI process.
 - Ensure regional plans for PI are integrated into the state process.

- Establish system PI audit filters and measures that address process and outcomes.
- Provide educational opportunities to orient and train all trauma system stakeholders on the recommendation of issues to be investigated.
- Ensure the data collected from hospitals and EMS is complete, validated, consistent, and comprehensive to effectively conduct system PI.
- Establish regional medical directors within the RETACS to support the implementation of regional PI.
- Provide access to data for the RETACs to facilitate regional PI under the leadership of the regional medical director.
- Monitor the triage and transfer guidelines and protocols for compliance routinely. Require plans of correction to address deviations, and trend deviations to determine a need for change in the protocol or guideline.
- Ensure that the evaluation of the state trauma system is ultimately inclusive of the entire continuum of care (dispatch, prehospital, emergency department, trauma care, and rehabilitation) to fully assess impact of trauma care on mortality, as well as morbidity.
- Build upon the best practice models of PI being promoted within individual RETACs and existing outreach programs.

Trauma Management Information Systems

Purpose and Rationale

Hospital-based trauma registries developed from the idea that aggregating data from similar cases may reveal variations in care and ultimately result in a better understanding of the underlying injury and its treatment. Hospital-based registries have proven very effective in improving trauma care within an institution but provide limited information regarding how interactions with other phases of health care influence the outcome of an injured patient. To address this limitation, data from hospital-based registries should be collated into a regional registry and linked such that data from all phases of care (prehospital, hospital, and rehabilitation) are accessible in 1 data set. When possible, these data should be further linked to law enforcement, crash incident reports, ED records, administrative discharge data, medical examiner records, vital statistics data (death certificates), and financial data. The information system should be designed to provide system-wide data that allow and facilitate evaluation of the structure, process, and outcomes of the entire system; all phases of care; and their interactions. This information should be used to develop, implement, and influence public policy.

The lead agency should maintain oversight of the information system. In doing so, it must define the roles and responsibilities for agencies and institutions regarding data collection and outline processes to evaluate the quality, timeliness, and completeness of data. There must be some means to ensure patient and provider confidentiality is in keeping with federal regulations. The agency must also develop policies and procedures to facilitate and encourage injury surveillance and trauma care research using data derived from the trauma MIS. There are key features of regional trauma MISs that enhance their usefulness as a means to evaluate the quality of care provided within a system. Patient information collected within the management system must be standardized to ensure that noted variations in care can be characterized in a similar manner across differing geographic regions, facilities, and EMS agencies. The composition of patients and injuries included in local registries (inclusion criteria) should be consistent across centers, allowing for the evaluation of processes and outcomes among similar patient groups. Many regions limit their information systems to trauma centers. However, the optimal approach is to collect data from all acute care facilities within the region. Limiting required data submission to hospitals designated as trauma centers allows one to evaluate systems issues only among patients transported to appropriate facilities. It is also important to have protocols in place to ensure a uniform approach to data abstraction and collection. Research suggests that if the process of case abstraction is not routinely calibrated, practices used by abstractors begin to drift.

Finally, every effort should be made to conform to national standards defining processes for case acquisition, case definition (that is, inclusion criteria), and registry coding conventions. Two such national standards include the National Highway Traffic Safety Administration's National Emergency Medical Services Information System (NEMSIS), which standardizes EMS data collection, and the American College of Surgeons National Trauma Data Standard,

which addresses the standardization of hospital registry data collection. Strictly adhering to national standards markedly increases the value of state trauma MISs by providing national benchmarks and allowing for the use of software solutions that link data sets to enable a review of the entire injury and health care event for an injured patient.

To derive value from the tremendous amount of effort that goes into data collection, it is important that a similar focus address the process of data reporting. Dedicated staff and resources should be available to ensure rapid and consistent reporting of information to vested parties with the authority and vision to prevent injuries and improve the care of patients with injuries. An optimal information reporting process will include standardized reporting tools that allow for the assessment of temporal and/or system changes and a dynamic reporting tool, permitting anyone to tailor specific “views” of the information.

OPTIMAL ELEMENTS

I. There is an established trauma MIS for ongoing injury surveillance and system performance assessment. **(B-102)**

- a. There is an established injury surveillance process that can, in part, be used as an MIS performance measure. **(I-102.1)**
- b. Injury surveillance is coordinated with statewide and local community health surveillance. **(I-102.2)**
- c. There is a process to evaluate the quality, timeliness, completeness, and confidentiality of data. **(I-102.4)**
- d. There is an established method of collecting trauma financial data from all health care facilities and trauma agencies, including patient charges and administrative and system costs. **(I-102.5)**

II. The trauma MIS is used to facilitate ongoing assessment and assurance of system performance and outcomes and provides a basis for continuously improving the trauma system, including a cost-benefit analysis. **(B-301)**

- a. The lead trauma authority ensures that each member hospital of the trauma system collects and uses patient data, as well as provider data, to assess system performance and to improve quality of care. Assessment data are routinely submitted to the lead trauma authority. **(I-301.1)**
- b. Prehospital care providers collect patient care and administrative data for each episode of care and not only provide these data to the hospital, but also have a mechanism to evaluate the data within their own agency, including monitoring trends and identifying outliers. **(I-301.2)**
- c. Trauma registry, ED, prehospital, rehabilitation, and other databases are linked or combined to create a trauma system registry. **(I-301.3)**
- d. The lead agency has available for use the latest in computer/technology advances and analytic tools for monitoring injury prevention and control components of the trauma

system. There is reporting on the outcome of implemented strategies for injury prevention and control programs within the trauma system. **(I-301.4)**

CURRENT STATUS

The State has a rich history of data collection, particularly, with the Colorado Trauma Registry (CTR). The CTR is based, primarily, on the Traumabase™ platform developed and maintained by Clinical Data Management (CDM). Trauma Registry data are captured and submitted from the level I, II, and III trauma centers. Plans are progressing to provide a web-based entry solution, developed for the same platform, to capture a more limited set of information from the level IV and V facilities. Traumabase™ is compliant with the NTDS promulgated by the ACS. Data are submitted monthly to the EMTS Section by the trauma centers. Error checking occurs prior to any analysis. Trauma center data registrars receive some training and technical support from the EMTS Section. The majority of data registrars have served in that capacity for a substantial period, suggesting a high level of expertise within individual facilities.

The recent development of the MATRIX data system, which is used to electronically capture prehospital events, further strengthens the data pool that can be used to monitor, evaluate, and improve the trauma system. The MATRIX system was developed in a collaborative process with key EMS stakeholders providing input over a two year period. Data collection began in 2006, and current efforts are focused on getting all 190 EMS agencies to submit data. Limited evidence was provided to the TSC team at the time of the visit concerning the exploration of data. MATRIX is based on the NEMSIS definitions and the Extensible Markup Language (XML) transaction standard. However, it does not appear that MATRIX has undergone NEMSIS compliance testing at either the gold or silver level. The initial data elements captured by MATRIX at the state level include only those required in the NEMSIS national dataset. As such, limited clinical elements are included which can be used to identify the injury severity of trauma patients.

It was reported that the same, or a similar group that contributed to the original development of MATRIX, will be convened to consider the addition of other variables. Beyond that effort, it is unclear how MATRIX will be updated as changes in the NEMSIS dataset are made or refined and how MATRIX will be maintained over time.

RECOMMENDATIONS

- **Collect trauma registry data from all hospitals in order to conduct a complete and comprehensive assessment of trauma care in Colorado.**
 - **Select a minimum dataset for trauma participating facilities at lower level designations or without designation in addition to the dataset already collected from hospital discharge.**
 - **Continue development of a web-based portal for data entry.**
- Assure the protection of the data and the trauma performance improvement process at local, regional, and state levels.

- The EMTS Section should establish administrative rules or take any other necessary action.
- Seize the opportunity to incorporate protection for the multidisciplinary performance improvement peer review process during the review of the sunseting Medical Practice Act.
- Work with other states using Clinical Data Management (CDM) software (e.g. Utah, Ohio, and North Dakota) to encourage the development of a CDM state-level capture and reporting module with routine reporting features included.
- Convene the trauma managers and trauma directors to define the key data reports that need to be run on a quarterly and annual basis.
 - Provide those report parameters to CDM (see previous recommendation).
 - Develop SAS Statistics routines that will allow the regular generation of the data reports until the CDM module is developed.
- Produce and distribute reports on a quarterly and annual basis to all data contributing facilities and to personnel and committees charged with system oversight and quality improvement.
- Conduct a cost/benefit analysis and, if indicated, use a portion of the initial year's Highway User's Tax grant program funds, to purchase an "off the shelf", NEMSIS compliant (Gold Level) program with multiple options for data input at the provider level and robust reporting at the state level.
- Develop a unique patient identification system to allow for patient tracking through all aspects of the trauma system from initial contact with EMS to disposition at rehabilitation.

Research

Purpose and Rationale

Overview of Research Activity

Trauma systems are remarkably diverse. This diversity is simply a reflection of authorities tailoring the system to meet the needs of the region based on the unique combination of geographic, economic, and population characteristics within their jurisdiction. In addition, trauma systems are not fixed in their organization or operation. The system evolves over years in response to lessons learned, critical review, and changes in population demographics. Given the diversity of organization and the dynamic nature of any particular system, it is valuable when research can be conducted that evaluates the effectiveness of the regional or statewide system. Research drives the system and will provide the foundation for system development and performance improvement. Research findings provide value in defining best practices and might alter system development. Thus, the system should facilitate and encourage trauma-related research through processes designed to make data available to investigators. Competitive grants or contracts made available through lead authorities or constituencies should provide funds to support research activities. All system components should contribute to the research agenda. The extent to which research activities are required should be clearly outlined in the trauma system plan and/or the criteria for trauma center designation.

The sources of data used for research might be institutional and regional trauma registries. As an alternative, population-based research might provide a broader view of trauma care within the region. Primary data collection, although desirable, is expensive but might provide insights into system performance that might not be otherwise available.

Trauma Registry–Based Research

Investigators examining trauma systems can use the information recorded in trauma registries to great advantage to determine the prevalence and annual incidence rate of injuries, patterns of care that occur to injured patients in the system's region, and outcomes for the patients. These data can be compared with standards available from other trauma registries, such as the NTDB. Such comparisons can then enable investigators to determine if care within their region is within standards and can allow for benchmarking. Initiating and sustaining injury prevention initiatives is a vital goal in mature trauma systems. Investigators can take a leadership role in performing research using trauma registry data that identify emerging threats and instituting public health measures to mitigate the threats. For example, a recent surge in death and disability related to off-road vehicles can be identified and the scope of the problem defined in terms of who, where, and how riders are injured, and then, through presentations and publications, the public can be informed of a new threat.

Trauma system administrators have a responsibility to control investigators' access to the registry. The integrity and reliability of data in a trauma systems registry are essential if accurate research and valid conclusions are to be reached using the data. Trauma system administrators should have a process that screens data entered into the system's composite registry from individual institutions. There should be a mechanism that ensures that the information is stored in a secure manner. Investigators who seek access to the trauma registry must follow a written policy and procedure that includes approval by an authorized institutional review board. Trauma registry data may include unique identifiers, and system administrators must ensure that patient confidentiality is respected, consistent with state and federal regulations.

Population-Based Trauma System Research

A major disadvantage of using only trauma registry data to conduct research that evaluates injured patients in a region is the bias resulting from missing data on patients not treated at trauma centers. Specifically, most registry data are restricted to information from hospitals that participate in the trauma system. Although ideally all facilities participate in the form of an inclusive system, many systems do not attain this goal. Thus, a population-based data set provides investigators with the full spectrum of patients, irrespective of whether they have been treated in trauma centers or non-designated centers or were never admitted to the hospital owing to death at the scene of incident or because their injuries were insufficiently severe to require admission. The state and national hospital discharge databases are examples of population-based data. These discharge databases contain information that was abstracted from medical records for billing purposes by hospital employees who enter these data into an electronic database. For investigators seeking a wider perspective on the care of injured patients in their region, these more inclusive data sets, compared with registries, are essential tools. Other population based data that may be of help include mortality vital statistics data recorded in death certificates. Selected regions might have outpatient data to capture patients who are assessed in the ED and then released.

Investigators can use these population-based data to study the influence of a regional trauma system on the entire spectrum of patients within its catchment area.

Participation in Research Projects and Primary Data Collection

Multi-institutional research projects are important mechanisms for learning new knowledge that can guide the care of injured patients. Investigators within trauma systems can participate as co-investigators in these projects. Investigators can participate by recruiting patients into prospective studies, being leaders in the design and administration of grants, and preparing manuscripts and reports. Evidence of this collaboration is that investigators within a trauma system are recognized in announcements of grants or awards. Lead agency personnel should identify and reach out to resources within the system with research expertise. These include academic centers and public health agencies.

Measures of Research Activity

Research can be broadly defined as hypothesis-driven data analysis. This analysis leads the investigators to a conclusion, which might become a recommendation for system change. Full manuscripts published in peer reviewed research journals are an exemplary form of research activity. Research reported in annual reviews or in public information formats

intended to inform the trauma system's constituency can also be considered legitimate research activity.

OPTIMAL ELEMENTS

I. The trauma MIS is used to facilitate ongoing assessment and assurance of system performance and outcomes and provides a basis for continuously improving the trauma system, including a cost-benefit analysis. **(B-301)**

- a. The lead agency has available for use the latest in computer/technology advances and analytic tools for monitoring injury prevention and control components of the trauma system. There is reporting on the outcome of implemented strategies for injury prevention and control programs within the trauma system. **(I-301.4)**

II. The lead agency ensures that the trauma system demonstrates prevention and medical outreach activities within its defined service area. **(B-306)**

- a. The trauma system has developed mechanisms to engage the general medical community and other system participants in their research findings and performance improvement efforts. **(I-306.1)**
- b. The effect or impact of outreach programs (medical community training/support and prevention activities) is evaluated as part of a system performance improvement process. **(I-306.3)**

III. To maintain its state, regional, or local designation, each hospital will continually work to improve the trauma care as measured by patient outcomes. **(B-307)**

- a. The trauma system implements and regularly reviews a standardized report on patient care outcomes as measured against national norms. **(I-307.2)**

CURRENT STATUS

Colorado has a rich history of basic science and clinical research pertinent to care of the injured patient. This research continues at the level I trauma centers in the Denver metropolitan area.

However, to date, only sporadic and limited research has been conducted on issues of importance to trauma system design, operations, and improvement. Using Donabedian's model of structure, process, and outcome as a framework for system research, opportunities abound for Colorado to make significant contributions to the understanding of trauma system performance in a mixed urban/rural environment. When asked about a systemwide preventable mortality rate, the participants indicated that they could not venture a guess as to what that rate might be.

It was noted that University of Colorado at Denver has recently established a School of Public Health offering both masters and doctoral degrees. It is also noted that researchers at the University of Colorado's School of Engineering are identified as experts in workflow engineering. Opportunities may exist to engage these, and other academic units, in trauma system research.

Few, if any, requests have been received by the EMTS Section for access to the CTR and MATRIX data. When asked why not, some members of the audience expressed concern about the data reliability. Continued efforts to clean and check the data as it is received must be continued.

A final impediment to system research was noted to be a highly competitive relationship between and among the higher level trauma centers, particularly in the Denver metropolitan area. If this challenge cannot be resolved in a collegial manner, changes to the verification standards requiring level I and II facilities to participate in multi-institutional, multi-component systems research may be necessary.

RECOMMENDATIONS

- Appoint a task group under the aegis of the Multidisciplinary Trauma Advisory Committee to develop a state trauma system research agenda that will encourage the systematic and scientific examination of all elements of trauma system performance.
- Improve the accuracy and validity of the Colorado Trauma Registry and MATRIX data sets, or their successors, to support systems research.
- Partner with appropriate academic institutions and research agencies that can provide resources (personnel, research design knowledge, and financial support) to assist in the completion of the trauma system research agenda.
- Conduct a statewide preventable mortality study that reports preventable, potentially preventable, and opportunities for improvement (regardless of preventability) across the system and all phases of care.

FOCUS QUESTIONS

Focus Question 1: Does Colorado have too many level I/II trauma centers along the Front Range? The Front Range is the entire area along Interstate-25 from Fort Collins in the north to Pueblo in the south. The number of trauma centers along the Front Range has been an on-going debate since the inception of the system.

Table 7. Current Front Range Trauma Assets

Geographic Location	Approximate Population	Level I	Level II	Level III/IV	Non-designated Hospitals
Denver Metro area (Denver, Adams, Arapaho, Broomfield, Douglas, Jefferson counties)	2,440,000	3 plus 1 RPTC	3	3 Level III 3 Level IV	4
Colorado Springs (El Paso County)	590,000	0	2	1 Level IV	1
Pueblo County	160,000	0	2	0	0
Northern Colorado (Boulder, Larimer)	583,000	0	1	6 Level III	1
Northern Colorado (Boulder, Larimer, Weld)	828,000	0	2	6 Level III	1

Response:

Colorado does have too many level I and II trauma centers along the Front Range, for the population-based needs of the citizens (refer to Definitive Care Facilities section).

It is much more difficult to answer such questions as

- what number of trauma centers should be designated?
- what trauma center levels should exist?
- where should these trauma centers be located?

Essential information to answer these questions can be obtained from a comprehensive statewide needs assessment. Much of the system development required for optimal care must be based on the number of patients, their geographic distribution, transfer patterns, and resource availability. Specialized capabilities (particularly in relation to the evolving regionalization of time-sensitive diseases such as ST-elevation myocardial infarction (STEMI) and stroke), should also be considered when developing the overall plan.

The answer as to the number, levels, and distribution of trauma centers should be based primarily on trauma patient needs. Mandatory tracking and analysis of the impact of trauma center designations on patient outcomes must also be measured. The decision about the

number, levels, and distribution of trauma centers should not be based on minimum or arbitrary patient volume numbers. Rather, the decision should be based on a rational balance of patient need to trauma center resources. This balance should produce a high quality, efficient care delivery system to meet the current and future challenges of health care reform and the highest value of care for Colorado's severely injured patients. Future health care reform is likely to include increasing demands for regionalization, where optimal care is provided by having the right patient in the right facility, but without permitting expensive duplication of resources, (e.g., manpower, technology, or other inefficiently used resources).

The Denver metropolitan area currently has 3 level I and 3 level II trauma centers, and one RPTC. Colorado's population is approximately 5 million. Previous analyses have routinely suggested that approximately 1,000 severely injured patients (> 15 ISS) occur annually for every 1 million population. Colorado could expect approximately 5,000 severely injured patients annually. If concentrated in one urban area, this patient volume could easily be cared for by 3 to 4 level I and II trauma centers. The Denver metropolitan area has an estimated population of 2.5 million

Along the I-25 corridor there are 3 level I and 9 level II trauma centers, plus the RPTC in the Denver metropolitan area. Using national experiences and also keeping a focus on the future, consider a regionalized care system for time-sensitive diseases, which will frequently overlap with trauma needs in the same facilities. A rough guideline is proposed that must be reviewed by all the involved parties. This guideline must also be viewed through the lens of trauma system planners with a far greater knowledge of actual and proposed future patient numbers and facility resources.

As a modest proposal, based on theoretical constructs, the population of the Denver metropolitan area (and the expected development of expertise for time sensitive disease, such as STEMI and stroke) warrants, at most, 3 to 4 level I and II trauma centers, plus the RPTC. Traditionally, this would indicate a single level I facility with 2 to 3 level II trauma centers geographically placed for optimal patient access. However, the Denver metropolitan area might prefer to have a different combination, such as 2 level I trauma centers and 1 or 2 level II centers. Keep in mind that clinically level I and II trauma centers are very similar, and it is particularly difficult to design any method for prehospital providers to discriminate between them, unless specific specialty care is available in a select facility. The decrease in numbers of level I and II trauma centers in the Denver metropolitan area should increase patient volumes at the designated level I to level II trauma centers. Selecting an option for one or three level I trauma centers may become increasingly dependent on the time-sensitive disease requirements and willingness and documented commitment of the facility to assume the additional components of a level I trauma center. For example, a robust extensive multi-institutional research effort moving the field of trauma care forward, outreach (including telemedicine) to assist other facilities clinically, and provision of education and PI to the rest of the system could be criteria for the level I trauma centers in this region. Commitment to these specific designation criteria should be obtained during the RFP process and monitored to ensure compliance with the level of designation.

The expertise of the RPTC should also be optimally utilized. All of the most severely injured children, (rationally proposed as <15 years old) should be triaged to the RPTC.

Approximately 80-85% of all trauma patients can, and should be, cared for in “local” facilities, including levels III, IV and V, which both maintains volume and expertise in the “local” facility and prevents over-triage and overloading of the level I and II trauma centers.

Along, the I-25 corridor, based on population density as a surrogate for patient need, one potential model would be to have 1 level II trauma center in Colorado Springs, 0 to 1 level II trauma center in Pueblo, and 1 to 2 level II trauma centers in northern Colorado. It is expected that when a level II trauma center is the highest designated facility in an area, it will function as a true regional resource to provide clinical support and outreach for surrounding facilities. If any level I or II trauma centers do not perform these critical functions, the designation level should be lowered.

Recommendations

- Complete an in-depth statewide assessment of patient needs and resources available.
- Obtain a revised statute or regulations permitting a limitation in the number of designated trauma centers based on the need of patients rather than institutional commitment.
- Develop a request for proposals (RFP) to identify potential level I and II trauma centers for the state. Clearly define the expectations of similar clinical care with expanded outreach, education, and clinical support expected of the level I trauma center or only level II trauma center in the region.
 - Base the designation process on creating optimal health care value (quality/cost) and avoid expensive duplication and non-productive competition.

Focus Question 2: The regulation, certification, and oversight of care delivered by prehospital personnel are fragmented in Colorado. The responsibility for the regulation of EMS providers is divided between:

- The Department of Public Health and Environment, which certifies and disciplines EMTs;
- The Department of Regulatory Affairs, Board of Medical Examiners, which determines the scope of practice for EMTs and oversees physicians providing prehospital medical direction of EMTs;
- The Colorado Department of Public Safety, Division of Fire Safety, which is responsible for training and certifying medical first responders and determining their scope of practice; and
- Colorado counties, which are statutorily responsible for the development and implementation of ambulance licensing standards in their jurisdiction.

This fragmentation results in confusion for the public, lack of consistency in training, confusion regarding oversight responsibilities and difficulty in coordinating the various functions. How do we simplify regulatory oversight of the care delivered by prehospital personnel?

Response:

The answer to this question appears simple in concept and difficult in execution. All of the regulatory functions relating to EMS should be consolidated within the EMTS Section. This would include:

- Certification (licensure) of all levels of EMS personnel, including first responders, and the ability to take disciplinary action.
- Licensing of all forms of EMS agencies including non-transporting first response squads, ground ambulances, and air ambulances, as well as the EMS vehicles used.

The more difficult question is how to manage the change from Colorado's current model of home rule regulation to a more consolidated one.

A first step would be to get input from SEMTAC about the idea of consolidating regulatory authority for all these functions within the EMTS Section. The support of SEMTAC would give the EMTS Section a legitimate directive to gather the other parties (counties, BME and the DPS) to explore consolidation. Some formal exploration will be needed as it is not known how committed the other parties are to maintaining the status quo arrangements for regulation. The goal for this step is to reach consensus among the group of regulators that a consolidated model under the EMTS Section is a better approach.

Presuming that step one can be accomplished, it will be necessary to inform the regulated parties and key legislative champions about the merits of the new approach. Among the benefits that should be mentioned:

- More consistent public protection through regulation
- Better service to the EMS community
- Administrative efficiencies

- The lead agency status is already in statute for the EMTS Section, and the proposed change is consistent with its existing role.

Making the change to a centralized model implies statutory amendments and possibly funding and position adjustments, at least within the EMTS Section. The SEMTAC and the EMTS Section have good insight into that process given the recent experience with obtaining an increase in EMS and trauma funding.

The EMTS Section and the SEMTAC should carefully consider the transition process for movement from the current approach to a consolidated model. The EMTS Section may want to establish a regulatory advisory body that would include representation from SEMTAC, the counties, the DPS, and the BME. This advisory body might exist for a year or two as a resource to the EMTS Section while authorities are transitioned and the EMTS Section assumes operational responsibilities for new regulatory functions.

The most significant paradigm change in achieving consolidation is likely to be overcoming the strong tradition of home rule. Objectively, having multiple authorities doing EMS regulatory functions increases the possibility for inconsistencies and conflicts. Inconsistency leads to differing levels of public protection or confusion among the regulated entities.

Patients across Colorado deserve a consistent level of care quality when they require EMS and trauma care. Eliminating the fragmentation of EMS regulation will serve that end without threatening the ability to make local decisions about EMS operations, such as who provides the service, who dispatches the service, and who provides local medical direction.

Recommendations

- Seek input from SEMTAC regarding a consolidated model of EMS regulation.
- Convene a meeting of representatives from the counties, the Board of Medical Examiners and the Department of Public Safety to explore barriers and opportunities for a consolidated model of EMS regulation.
- Seek legislative and rule change for the consolidated model if agreement is reached with other agencies and groups.
- Plan the transition to the consolidated model if legislation and rule change is successful.

Focus Question 3: What activities and/or policies can Colorado consider to keep rural trauma centers interested/willing/able to stay in the trauma system and remain designated?

Complicating factors include:

- Rural centers are usually the only facilities in the area – there may be nowhere else to take the patient for 45+ miles.
- There is no requirement or incentive to participate in the trauma system.
- There is financial disincentive for participation as the facility must pay to be part of the trauma system, through trauma designation fees, training/education of employees, additional data collection requirements, etc.

Response:

The goal of every regional or statewide trauma system is to establish an inclusive emergency healthcare delivery system representing all facilities and all injured patients. This principle requires that all facilities participate in the system at a level commensurate with their resources and matched to patients' needs. Each hospital has to clearly understand the importance of its role within this trauma care system. A well-crafted and comprehensive state trauma system plan will help to provide that clarification.

It is important to note, that level I and II trauma centers must execute their leadership role in collaborating with the level III, IV and V facilities, especially in the rural areas of Colorado. Their efforts for outreach and education are key to the successful management of the trauma patient. In addition, all facilities must collect data on trauma patients and participate in the state and regional PI process to ensure that patients are appropriately triaged and transferred.

Financial support and costs can be an obstacle for small facilities to become designated as a trauma center. However, once facilities become designated, they become eligible to assess trauma team activation fees to generate revenue. The eligibility for this revenue source can only be accomplished if the facility is designated as a trauma center.

While level I and II trauma centers receive the most severely injured patients, level III, IV and V facilities take care of the majority of the injured patients. In addition, level III, IV, and V facilities are vital to ensuring that severely injured patients are stabilized, resuscitated, and rapidly transported to higher level facilities that can provide definitive care. Training and consultation available through telemedicine are essential to assist rural facilities with treatment and transfer decisions.

Recommendations

- Ensure that level I, II, and III trauma centers provide outreach education to level IV and V trauma centers and EMS agencies according to routine referral and transport patterns.
- Establish Memoranda of Understanding between level I, II and III facilities and level IV and V facilities to provide education, conduct performance improvement, and repatriate patients back to their communities.
- Attend the Colorado Hospital Association meetings to educate the chief executive officers of rural hospitals about the benefits of trauma system participation and to gain input regarding rural EMS and trauma issues.
- Clearly define roles and responsibilities of level IV and V trauma centers in the state trauma system plan.
- Conduct a cost benefit analysis for level IV and V trauma centers including possible revenue generated from UB04 trauma team activations.
- Allow hospitals applying for level IV and V trauma center designation to seek funding from the EMT and FLEX grant programs for resources needed to meet criteria.
- Encourage further implementation and utilization of telemedicine to increase accessibility of rural providers to education and patient consultation.
- Engage community support through media campaigns.
- Allow level IV and V trauma centers to apply for EMTS grant funds to support injury prevention programs within their communities.
- Secure funding to provide prehospital trauma education (e.g. Prehospital Trauma Life Support and Basic Trauma Life Support) and RTTDC in rural communities.
- Ensure representation of rural providers on all task forces, workgroups, and committees pertaining to trauma system development.

Focus Question 4: What should the leaders of the EMTS system throughout Colorado be doing today to ensure appropriate succession planning at all levels of the system?

The generation of people who founded the Emergency Medical and Trauma Services System are retiring and/or moving on. How does Colorado develop another generation of leaders who are committed to and enthusiastic about improving the system?

Complicating factors include:

- Exodus of young people from rural areas.
- Centralization of collective wisdom/history/knowledge among one or two people.

Response:

Numerous federal agencies and consultative bodies have examined Colorado's EMS and trauma systems (pg 46 PRQ). These reports should be archived into a central repository with augmentation by the collective wisdom, history, and knowledge among the present and past leadership. The augmentation step is critical in the short term since this information is subject to degradation over time.

Going forward in time, leaders in the system should engage in mentoring relationships to foster the retention and promotion of new energy and ideas into the trauma system. Establishing such mentoring efforts through grant support or other incentives may be necessary to encourage senior leadership participation in the process.

It is imperative to identify champions for the developing trauma system among current trauma center directors. Two leaders may be needed, one for the urban system and one for the rural system. Support these leaders with meeting facilitation support and communications with stakeholders. Similar processes are necessary for trauma coordinators, registrars, and EMS providers.

Engage a blend of seasoned and new leadership in the development of a strategic plan for the trauma system. Facilitate communication between system stakeholders that makes it possible for short planning or business meetings to occur that do not require travel, e.g. web conferencing.

Recommendations:

- Support the development of an institutional memory by electronically archiving all documents of historical significance to EMS and trauma system development in Colorado and, as appropriate, nationally.
- Create a mentor/mentee matching system with appropriate access to resources and support to offset the mentors' time.
- Ensure that new staff and other newly appointed leaders are provided with a specific historical orientation to trauma and EMS system development in Colorado. The overview provided the first night of the TSC visit serves as an excellent starting point for this task.

Focus Question 5: How can the Colorado EMTS system more effectively transport critically ill patients from outlying facilities across vast distances to the Level I or II care that the patient needs?

Complicating factors include:

- Trained personnel are relatively unavailable (both EMS, doctors, nurses, lab techs, etc.)
- The care of critically ill patients may be out-of-scope for the EMS personnel available to transport.
- Rural facilities have limited resources, in terms of both personnel and equipment. A transport may take up to 12 hours round trip potentially leaving the area uncovered for additional 911 calls.
- No political entity (town, city, district) in Colorado is required to provide EMS services.
- Colorado is a local control state. Authority for licensure of ambulance agencies rests with county, not the Department.

What are other large western states doing to address this problem?

Response:

One challenge surrounding this issue is the competence of the EMS workforce to provide optimal care to the patients with critical injuries who require transport between hospitals.

In Colorado, the education, scope of practice, and educational curricula are established in State rules (Rule 500, 3-CCR-713-6). These rules do not sufficiently address the advanced knowledge and skills necessary to ensure competence in critical care interfacility transport. This issue is further complicated by the absence of national guidance in the form of curricula or a specific certification process for paramedic advanced practice.

The EMTS Section, local and regional EMS medical directors, and paramedics acknowledge this shortfall and the potential for adverse clinical outcomes. To address this issue, the BME has designated some specific skills and medications associated with critical care (BME 500-Appendix A and B). However, the addition of critical care functions to the medical skills and acts permitted in the paramedic scope of practice is attained by way of a waiver as granted in Rule 500 Sections 7.4 – 7.8. EMS medical directors develop an educational plan and monitoring plan for the advanced practice of paramedics within their individual EMS agencies. These plans are reviewed and adjudicated by the Department's Medical Direction Committee and then submitted to the Board of Medical Examiners for approval. EMTS section and BME documents reveal an extensive amount of committee time is spent in the evaluation and development of EMS practice waivers.

The extensive history, wisdom, and knowledge of waivers by members of the Medical Direction Committee and the BME could position these two groups to develop a standardized and comprehensive advanced practice curriculum unique to Colorado. Guidance and consensus from EMS medical directors would provide face validity as the curricula and processes for monitoring competence and compliance are developed. In lieu of such a standardized advanced care level, the current waiver process could be substantially

streamlined by the development of a menu of “enhancements” that could be added to a provider’s existing license level. The medical director could select from the list and, with only minimal application requirements, move toward training with a standard curriculum and ensure competence with a standardized evaluation process overseen by him/her.

Another challenge surrounding this issue is the availability of personnel and equipment to perform these critical care transports while avoiding the loss of services at the local level.

Recent bipartisan legislation, *Medicare Ambulance Access Preservation Act* (S. 1066), introduced by U.S. Senator Jeff Sessions (R-Al) would assist the financing of rural and frontier ambulance services by boosting the Medicare reimbursement rate by 6% for rural-based services and 17% for services in extremely remote areas. This funding adjustment is in line with recommendations from the Government Accountability Office (GAO-07-383), which recommended that “CMS monitor utilization of ambulance transports to ensure that Medicare payments are adequate to provide for beneficiary access to ambulance services, particularly in super-rural areas.”

Particularly in rural and frontier locations one solution is to have “surge” or “flex up” resources (personnel/vehicles) to be readily available to perform critical care transports. This could be provided through the development of an on-call schedule, utilizing personnel with advanced training (critical care). Such a system would prevent leaving the community devoid of services (routinely scheduled providers and ambulance to maintain the local continuity of operations rather than pulling them from service for long distance transfers between facilities). Necessary funding streams (e.g, US Senate Bill 1066, GAO-07-383) and the unique issues for volunteer providers would need to be addressed.

Recommendations:

- Develop an advanced practice EMT-Paramedic training program.
 - Compile a list of commonly required procedures and assessments required for interfacility transport of patients with severe injuries.
 - Identify an EMS training academy with access to appropriate faculty and a simulation laboratory to teach the performance of essential advance practice skills.
 - Develop a curriculum covering either the entire spectrum of essential skills or a modular format to support a menu driven list of enhancements.
 - Develop a process to evaluate the competence of newly trained advance practice EMT-Paramedics prior to certification.
 - Identify a source of funding for provider training.
- Develop a performance improvement program to monitor the care of seriously injured patients provided by advance practice EMT-Paramedics during long transports.

- Develop a mechanism for “on call” or “stand by” resources to provide personnel and an ambulance for the performance of critical care interfacility transports.
- Consider mechanisms (e.g., US Senate Bill 1066) to optimize funding for rural and frontier ambulance services and to provide for “surge” or “flex” capacity to perform long distance transfers between remote primary hospitals and distant tertiary centers.

Acronyms Used in the Colorado Trauma System Consultation Report

ACS – American College of Surgeons

ALS – advanced life support

ASPR – Assistant Secretary for Preparedness and Response

BIS – benchmarks, indicators, and scoring

BLS – basic life support

BME – Board of Medical Examiners

CAAHEP – Commission on Accreditation of Allied Health Education Programs

CAMT – Commission on Accreditation of Medical Transport Services

CARF – Commission on Accreditation of Rehabilitation Facilities

CDM – Clinical Data Management

CDPHE – Colorado Department of Public Health and Environment

CQI – continuous quality improvement

CTR – Colorado Trauma Registry

DPS – Department of Public Safety

EMS – emergency medical services

EMTS – Emergency Medical and Trauma System

EPRD – Emergency Preparedness and Response Division

ESAR-VHP – Emergency System for Advanced Registration of Volunteer Health Professionals

ESF – Emergency Support Function

FTE – full time equivalent

HPP – Hospital Preparedness Program

HRSA – Health Resources and Services Administration

ISS – injury severity score

ISVP – Injury, Suicide, and Violence Prevention

LTB – long term bed(s)

MATRIX – Colorado EMS Ambulance Trip Report Information Exchange

MCI – mass casualty incident

MMRS – Metropolitan Medical Response System

MRC – Medical Reserve Corps

MTAC – Multidisciplinary Trauma Advisory Committee

MTSPE – Model Trauma System Planning and Evaluation document from HRSA

NDMS – National Disaster Medical System

NEMESIS – National Emergency Medical Services Information System

NHTSA – National Highway Traffic Safety Administration
NREMT – National Registry of Emergency Medical Technicians
NTDS – National Trauma Data Standard

PI – performance improvement
PRQ – Pre-Review Questionnaire
PSAP – public safety answering point

QI – quality improvement

RETAC – Regional Emergency Medical and Trauma Advisory Committee
RFP – request for proposals
RPTC – Regional Pediatric Trauma Center

SCI – spinal cord injury
SEMTAC – State Emergency Medical and Trauma Services Advisory Committee
SNS – Strategic National Stockpile
STB – short term bed(s)
STEMI – ST elevation myocardial infarction

TBI – traumatic brain injury
TSC – trauma system consultation

XML – Extensible Markup Language

Appendix A: Methodology

The Colorado Department of Public Health and Environment requested this trauma system consultation, which was conducted under the auspices of the American College of Surgeons (ACS), Trauma System Consultation program (TSC). The multi-disciplinary Site Visit Team (SVT) consisted of: two trauma/general surgeons, one emergency physician, a State EMS/trauma director, a trauma program manager, a rural trauma and prehospital specialist, and a public health and injury specialist. Biographical sketches for team members are included as Appendix B of this report.

The primary objective of this ACS trauma system consultation is to guide and help promote a sustainable effort in the graduated development of an inclusive system of trauma care for the State of Colorado. The format of this report correlates with the public health framework of assessment, policy development, and assurance outlined in the ACS *Regional Trauma Systems Optimal Elements, Integration, and Assessment: System Consultation Guide*. Prior to the visit, the SVT reviewed the ACS Pre-Review Questionnaire (PRQ) submitted by the Trauma Program Director. The SVT also reviewed a number of related supporting documents provided by the Colorado Department of Public Health and Environment and information available on state government websites.

The SVT convened in Denver, Colorado on May 17th-20th, 2009, to review the State of Colorado trauma system. The meetings during the four-day visit consisted of plenary sessions during which the SVT engaged in interactive dialogue with a broad range of representative trauma system participants. There was also an opportunity for informal discussion with the participants, and time devoted to questions and answers. During the survey, the SVT also met in sequestered sessions for more detailed reviews and discussion and for the purpose of developing a team consensus on the various issues, preparing a report of their findings, and developing recommendations for future development of the trauma system in Colorado. This report was developed independently of any other trauma system consultations or assessments.

Appendix B: Review Team Biographical Sketches

A. BRENT EASTMAN, MD, FACS

A general, vascular, and trauma surgeon and a long-established leader on the issue of trauma and emergency surgical care, A. Brent Eastman, M.D., serves as chief medical officer and corporate senior vice president for Scripps Health, N. Paul Whittier Chair of Trauma for Scripps Memorial Hospital La Jolla, and Clinical Professor of Surgery UCSD.

Dr. Eastman, a native of the state of Wyoming, received his undergraduate degree in premed, College of Arts & Sciences at the University of Wyoming and his medical degree from the University of California, San Francisco, where he completed his general surgical residency and served as chief surgical resident.

Both nationally and internationally, Dr. Eastman has played a leadership role in the development of trauma systems. He is one of the founders of San Diego County's trauma system. Dr. Eastman has helped develop trauma systems throughout the United States, as well as in Canada, England, Ireland, Australia, Brazil, Argentina, Mexico, South Africa, and most recently in India and Pakistan.

Dr. Eastman recently was appointed Vice Chair of the Board of Regents of the American College of Surgeons. Previous appointments and chairmanships include: Chairman, Committee on Trauma, American College of Surgeons; Chairman, Trauma Systems Committee, U.S. Department of Health & Human Services; Chairman, Acute Care Treatment Research Agenda Steering Committee, Centers for Disease Control and Prevention; Member, Board of Directors, American Association for the Surgery of Trauma; Member, Board of Directors, The Scripps Research Institute; and Member, Editorial Board, Journal of Trauma. Scientific Consultant on Trauma Care Systems to the Joint Working Group for the Indo US Collaboration led by the US Centers for Disease Control and Prevention for establishment of trauma systems for the subcontinent of India and the country of Pakistan.

Dr. Eastman has authored or co-authored multiple publications related to trauma.

JANE W. BALL, RN, DRPH

Dr. Jane W. Ball served as the Director of the National Resource Center (NRC) at the Children's National Medical Center in Washington, D.C. from 1991 through 2006. The NRC provided support to two Federal Programs in the U. S. Department of Health and Human Services' Health Services and Resources Administration (HRSA): the Emergency Medical Services for Children (EMSC) Program and the Trauma-Emergency Medical Services Systems Program. As director of the NRC, she coordinated the support provided to the Federal Program Directors as well as the provision of technical assistance to state grantees. Support to the Federal Program Directors often included meeting facilitation, preparation of special reports (such as the Model Trauma Systems Evaluation and Planning document), and consultation on Program issues. Technical assistance often included strategic planning, providing guidance in securing funding, developing and implementing grants, developing injury prevention plans and programs, building coalitions, shaping public policy, conducting training, and producing educational resource materials.

Dr. Ball has authored numerous articles and publications as well as several health care textbooks, including Mosby's Guide to Physical Examination (6 editions), Child Health Nursing (first edition), Pediatric Nursing: Caring for Children (4 editions), Maternal and Child Nursing (2 editions), and Pediatric Emergencies: A Manual for Prehospital Care Providers (2 editions). One of these texts, Pediatric Nursing: Caring for Children, received the 1999 and 2001 Robert Wood Johnson Foundation Last Acts Coalition Outstanding Specialty Book Award. As an expert in the emergency care of

children, Dr. Ball has frequently been invited to join committees and professional groups that address the unique needs of children.

Dr. Ball recently completed her term as the President of the National Academies of Practice, an organization composed of distinguished health care practitioners from 10 disciplines that promote education, research, and public policy related to improving the quality of health care for all through interdisciplinary care. She currently serves as the organization's Immediate Past President.

Dr. Ball graduated from the Johns Hopkins Hospital School of Nursing. She obtained her master's degree and doctorate in Public Health from John Hopkins University School of Hygiene and Public Health. She is a Certified Pediatric Nurse Practitioner.

RONALD V. MAIER, MD, FACS

Dr. Maier is the Jane and Donald D. Trunkey Professor of Trauma Surgery and Vice Chairman of the Department of Surgery at the University of Washington and Surgeon-in-Chief at Harborview Medical Center, Seattle. Dr. Maier obtained a BS magna cum laude from the University of Notre Dame and, subsequently, an MD degree from Duke University Medical School. Following his General Surgery residency training at the University of Washington, he completed a post-doctoral fellowship in Immunopathology at the Scripps Clinic and Research Foundation in La Jolla, California. He has been a member of the Faculty of the Department of Surgery at the University of Washington since 1981. Throughout his career, he has been interested in the critically ill surgical patient and the underlying pathophysiology driving the aberrant host immuno-inflammatory response and subsequent clinical syndrome of multiple organ failure with its attendant high morbidity and mortality. Dr. Maier has been funded continuously by the NIH since 1981 and has been a member and Chair of the NIH Surgery, Anesthesiology and Trauma Study Section. He is past-President of the Society of University Surgeons, Shock Society, American Association for the Surgery of Trauma, Surgical Infection Society, North American Trauma Association, and the International Association for the Surgery of Trauma and Surgical Intensive Care. He is a past Director and Chair of the American Board of Surgery. He has also been a Fellow of the American Association for the Advancement of Science since 1994. He was the co-founder and has been heavily involved with the Harborview Injury Prevention and Research Center, one of the original CDC-funded Injury Centers in America. His long-standing interest in trauma has involved extensive clinical studies of acute management of the severely injured and critically ill patient. He has also conducted an extensive number of studies, investigating the impact of trauma system development on improvement in trauma care and outcomes of the severely injured.

W. DANIEL MANZ, BS

W. Daniel Manz is the Director of Emergency Medical Services for the Vermont Department of Health. He has been in emergency medical services (EMS) for more than 30 years and has worked as an emergency medical technician (EMT), volunteer squad leader, hospital communications technician, EMS regional coordinator, EMS trainer, and State EMS Director. Much of his work has been in rural areas including Maine and Saudi Arabia. Mr. Manz has been active in the National Association of State EMS Officials, serving as their President for 2 years, liaison to the American College of Surgeons, and representing the association for several national projects including the EMS Agenda for the Future, the HCFA Negotiated Rule Making process, and the recently released National EMS Scope of Practice Model. He is currently Chairperson of the National Association of State EMS Officials task force on implementation of the EMS Education Agenda for the Future. He is also working with the CDC on an India-US Joint Working Group for Implementation of a Road Traffic Injury Prevention and Control Project. Mr. Manz remains active as a volunteer EMT-Intermediate with the

local ambulance service in his community. Mr. Manz served on the Institute of Medicine's ED Subcommittee for the Future of Emergency Care within the U.S. Health Care System project.

KATHY J. RINNERT, MD, MPH

Kathy J. Rinnert, MD, M.P.H., began her career in emergency medicine and emergency medical services (EMS) in the early 1980's as a Nationally Registered Paramedic in a five-county, rural EMS agency in the Allegheny Mountains of Southeast Ohio. She completed medical school at the Ohio State University, followed by an internship in Internal Medicine at Loyola University, and residency training in Emergency Medicine at the University of Chicago. Following residency, Dr. Rinnert completed a two-year fellowship in EMS at the University of Pittsburgh. She simultaneously obtained a Master's in Public Health at the Graduate School during her tenure in Pittsburgh.

Dr. Rinnert currently serves as Associate Professor in Emergency Medicine at the University of Texas Southwestern Medical Center at Dallas (UTSWMC). In addition, she is the Associate Medical Director for the UTSW/BioTel EMS system, encompassing sixteen municipalities and their fire-based EMS and Public Safety agencies. In this capacity, she oversees the out-of-hospital practice of over 1700 paramedics operating in urban, suburban, and rural environments. Dr. Rinnert directs the Center for Government Emergency Medical Security Services (GEMSS) at the UTSWMC, which provides academic and clinical tactical support to government agencies. At the Center, she directs both the EMS and GEMSS fellowship programs, which provide post-doctoral training in these subspecialty areas of emergency medicine.

Dr. Rinnert has special interest and expertise in trauma, injury prevention and control, air medical transport, tactical EMS, urban search and rescue, and domestic preparedness for weapons of mass effect (WME) and counterterrorism. She serves as the Chairman and medical representative on the Panel of Commissioners (POC) for the Commission on Accreditation of Ambulance Services (CAAS), the national body for accreditation of EMS agencies in the United States and Canada. In addition, Dr. Rinnert is an active site reviewer for the Committee on Accreditation of Educational Programs for the EMS Professions (CoAEMSP) and trauma systems consultant to the American College of Surgeons Committee on Trauma (ACS-COT). Dr. Rinnert was recently elected to the Board of Directors of the National Association of EMS Physicians, the premier organization for physician practice in EMS.

NELS D. SANDDAL, MS, REMT-B

Mr. Sanddal is currently the president of the Critical Illness and Trauma Foundation (CIT), in Bozeman, Montana. CIT is a non-profit organization dedicated to improving the outcomes of people who are injured in rural America through programs of prevention, training, and research. He recently completed a detachment as the Director of the Rural EMS and Trauma Technical Assistance Center which was funded by the Department of Health and Human Services, Health Resources and Services Administration. Mr. Sanddal worked as the training coordinator for the EMS and Injury Prevention Section of the Montana Department of Public Health and Human Services in the late 1970's. He has served as the Chairperson of the National Council of State EMS Training Coordinators and as the lead staff member for that organization, as well as the National Association of EMT.

Mr. Sanddal has been a co-investigator for six state or regional rural preventable trauma mortality studies and has conducted research in the area of training for prehospital and nursing personnel as well as in rural injury prevention and control. He is a core faculty member for the NHTSA Development of Trauma Systems course and has conducted several statewide EMS assessments for NHTSA. Mr. Sanddal served on the IOM Committee on the Future of Emergency Care in the U.S.

He received his EMT training in Boulder, Montana, in 1973 and has been an active EMT with numerous volunteer ambulance services since that time. He currently responds with the Gallatin River Ranch Volunteer Fire Department where he serves as the Medical Officer and Assistant Chief.

He completed his undergraduate work at Carroll College, received his Master's degree in psychology from Montana State University and is currently completing his doctorate in Health and Human Behavior from Walden University.

JOLENE R. WHITNEY, MPA

Jolene R. Whitney has worked with the Bureau of Emergency Medical Services, Utah Department of Health for 28 years. She spent the first 6 years of her career as a regional EMS consultant. She became Assistant Training Coordinator in 1986. She has been a program manager for EMS systems and trauma system development since 1991. She is currently the Deputy Director for the Bureau of EMS and Preparedness, which includes Trauma System Development, Chemical Stockpile Emergency Preparedness, Hospital Surge Capacity Planning, ED, Trauma and Pre-hospital databases, EMS Licensing and Operations, and EMS for Children.

She spent 250 hours in the Olympic Command Center, serving as an EMS liaison for the 2002 Winter Olympics in Salt Lake City, Utah. She has been involved with all aspects of EMS including ambulance licensure, EMS councils, certification and training, computer testing, and curricula development. She has experience in statute and rule development, grant writing, system plan development, coalition building, and disaster preparedness.

She has served on several national committees and teams, which involved conducting a state EMS system assessment for NHTSA, reviewing rural trauma grant applications, and developing the HRSA model trauma system plan, the NASMESO trauma system planning guide, and the NHTSA curriculum for an EMT refresher course.

Jolene has a Masters in Public Administration from Brigham Young University and a B.S. in Health Sciences, with an emphasis in Community Health Education from the University of Utah. She was certified as an EMT-Basic in 1979. She also obtained certification as an EMT instructor and became certified as an EMT III (Intermediate) in 1983. She has attended numerous conferences, courses, and workshops on EMS, trauma, and disaster planning and response. She also completed a course for investigator training from CLEAR. Jolene is a co-author of three publications on domestic violence and surge capacity planning.

She is the current Chair for the National Council of State Trauma System Managers/NASEMSO and served as Vice- Chair for the previous two years. She is a member of the American Trauma Society, and previous member of the National Association of State EMS Training Coordinators.

In 2005, she was nominated by her staff and received a Utah Manager of the Year Nominee Award from the Governor. She also received recognition from the Utah Association of Emergency Medical Technicians in 2006.

Appendix C: PARTICIPANT LIST

Lynn	Andersen	Trauma Program Manager	Memorial Health System Colorado Springs
Jeanne-Marie	Bakehouse	EMTS	CDPHE Denver
Katie	Bakes		Denver Health Medical Center Denver
Carlton	Barrett		
Bobbie	Barrow		Denver Health Medical Center Denver
Kathy	Beauchamp	Physician/Surgeon	Denver Health Medical Center Denver
Kathy	Bennett	ED Director	Lincoln Community Hospital Hugo
Peggy	Berkey	Trauma Nurse Coordinator	Sky Ridge Medical Center Lone Tree
Andrew	Berson	Medical Director	Memorial Health System Colorado Springs
Billy	Bertram	Director EMS	The Memorial Hospital Craig
Walter	Biff	Surgeon	Denver Health Medical Center Denver
Michael	Bilo	EMS Chief	South Metro Parker
Pamela	Bourg	Trauma Program Manager/Director	St. Anthony Central Hospital Denver
Marilyn	Bourn	Training Coordinator	CDPHE Denver
Scott	Bourn	SEMTAC Chair	AMR Englewood
Seve	Boylls	EMTS	CDPHE Denver
Kerry	Broderick		
Jen	Brown		The Denver Post Denver
Michelle	Bryskiewicz	Trauma Program Manager/Director	The Medical Center of Aurora Aurora
Jack	Burke	Hospital Administrator	North Colorado Medical Center Greeley
Debra	Carpenter	Trauma Program Manager/Director	Denver Health Medical Center Denver
Rio	Chowdhury	EMTS	CDPHE Denver
Clay	Cothren		
Anne	Clouatre	EMS Director	Adventist Hospitals
Kent	Collins		
Chris	Colwell	Emergency Physician	Denver Health Medical Center Denver
Ray	Coniglio	Trauma Program Manager/Director	St. Anthony Central Denver
Gail	Cooper	Consultant	CDPHE
Chris	Cribari	Medical Director	Medical Center of the Rockies Loveland
Dee	Crump	Trauma Program Manager/Director	Parkview Medical Center Pueblo
Natalie	DeBakker	Trauma Nurse Coordinator	7 Mile Medical Clinic, Winter Park Winter Park
Jim	Denton	Trauma Director	Medical Center of Aurora Aurora
Theresa	Dorsey	Trauma Nurse Coordinator	Avista Adventist Hospital Louisville
Will	Dunn	Quality Improvement Manager	Eagle County Ambulance District Edwards
Donovan	Ehrman	Trauma Program	North Colorado Medical Center
Trish	Evans	Trauma Coordinator	Platte Valley Medical Center Brighton
Nancy	Falleur	RETAC Coordinator	SWRETAC Lewis
Gail	Finley	VP of Policy and Strategic Planning	Colorado Hospital Association Greenwood Village
Cari	Fouts	Agency Director	Colorado Rural Health Center Aurora
Reginald	Franciose	Colorado Committee on Trauma	Vail Valley Medical Center
Nancy	Frizell	Trauma Coordinator	Valley View Medical Center
John	Gentzel	Trauma Program Manager/Director	Penrose Medical Center Colorado Springs
Lucinda	Giblin	Trauma Program	The Children's Hospital Aurora
Marci	Givens		
Elizabeth	Gonzales	Intern	Colorado Hospital Association
Stephanie	Haley-Andrews	EMS Coordinator	The Children's Hospital Aurora
Kristine	Hansen	Trauma Program Manager	The Children's Hospital
Holly	Hedegaard	EMTS	CDPHE Denver
Paula	Herzmark		
John	Hill	CEO	Medical Center of Aurora Aurora
David	Hiltbrunn	Trauma Program	St. Mary-Corwin
Allen	Hughes	RETAC Coordinator	Western RETAC Montrose
Tim	Hurtado		
Karan	Hutchins	Trauma Coordinator	Denver Health Medical Center Denver
Theresa	Jimison	RETAC Coordinator	Southern Colorado RETAC, Inc. Pueblo
Jeff	Johnson	Surgeon	Denver Health Medical Center Denver
Virginia	Jones	Trauma Nurse Coordinator	Exempla Lutheran Medical Center Wheat Ridge
Art	Kanowitz	EMTS Medical Director	CDPHE Denver
Jeffry	Kashuk	Surgeon	Denver Health Medical Center Denver
Bert	Katubig	Trauma Director	Sky Ridge Medical Center Lone Tree

David	Kearns	Director, Denver	Flight For Life Colorado Denver
Seven	Kim	Trauma Director	Littleton Adventist Hospital Littleton
Randy	Kuykendall	EMTS Section Chief	CDPHE Denver
Daniel	Lammerts	Physician/Surgeon	Craig Hospital Englewood
Zane	Laubhan	Coroner & EMS Director	Gilpin County
Tracy	Lauzon	Trauma Coordinator	Medical Center of Aurora
Rob	Leeret		Denver Health Medical Center Denver
Valerie	Leswing		
Charles	Mains	Trauma Service Director	St. Anthony's Central Denver
Jim	Manson		Denver Health Paramedics Denver
Jean	Marso	Trauma Nurse Coordinator	University of Colorado Hospital Aurora
Kathleen	Mayer	Hospital Administrator	Flight For Life Colorado Denver
Lori	McDonald	Trauma Program Manager/Director	Medical Center of the Rockies Loveland
Margie	McElroy	Trauma Nurse Coordinator	Sky Ridge Medical Center Lone Tree
Jean	McMains	EMTS	CDPHE Denver
Michael	Merrill	RETAC Coordinator	SECRETAC Colo. Springs
Melody	Mesmer	RETAC Coordinator	Central Mountains RETAC
Tessa	Mesmer		
Cheryl	Milner	Trauma Nurse Coordinator	Poudre Valley Hospital Ft. Collins
Jon	Montano	RETAC Coordinator	San Luis Valley RETAC Alamosa
Ernest	Moore	Trauma Director	Denevr Health Denver
Lyle	Moore	Emergency Preparedness	CDPHE Denver
Steven	Morgan	Physician/Surgeon	Denver Health denver
Fred	Morrison	Agency Director	Eagle County Ambulance District Edwards
Steve	Moulton	Medical Director	The Children's Hospital Aurora
Kim	Muramoto	Trauma Program Manager/Director	Littleton Adventist Hospital Littleton
Roger	Nagy	Trauma Director	Penrose Hospital Colorado Springs
John	Nichols	Neurosurgeon	St. Anthony's Central Denver
Dan	Noonan	Chief	Durango Fire & Rescue Authority
Sherrie	Nugent	Trauma Program Manager/Director	Longmont United Hospital Longmont
John	Nurney		
Paddy	O'Rourke	Consultant	CDPHE
Joan	Palen	Trauma Nurse Coordinator	Boulder Community Hospital Boulder
Vikki	Pope	Trauma Nurse Coordinator	Parker Adventist Hospital Parker
Robert	Putfark	Field Provider (EMT/Paramedic)	Pridemark Paramedic Services Arvada
Lara	Rappaport	Emergency Physician	The Children's Hospital Aurora
Greg	Raymond		
Michelle	Reese	EMTS, Deputy Section Chief	CDPHE Denver
Larry	Reeves	Agency Director	Crowley County Ambulance Service Ordway
Jim	Riesberg	Colorado State Representative	Greeley
James	Robinson	Chief Paramedic	Denver Paramedics Denver
Bill	Rodman	Surgeon	Aspen Valley Hospital Aspen
Howard	Roitman	Director, HFEMSD	CDPHE Denver
Dave	Ross	Emergency Physician	Penrose Hospital Colorado Springs
Margaret	Sabin	President/CEO	Penrose Hospital Admin.
Grace	Sandeno	EMTS	CDPHE Denver
Joel	Schaefer	Trauma Director	St. Mary's Hospital Grand Junction
Kim	Schallenberger	RETAC Coordinator	Plains to Peaks RETAC Kit Carson
Glenn	Schlabs	Chair, Board of Health	Sherman & Howard LLC Colorado Springs
Eric	Schmidt	RETAC Coordinator	Northwest RETAC Meeker
John	Schullek		
Jamie	Sharpe	Trauma Program Manager	St. Mary's Hospital Grand Junction
Sue	Slone	Trauma Medical Director	Swedish Medical Center Englewood
Wade	Smith	Physician/Surgeon	Denver Health Medical Center Denver
Nicole	Stafford		Denver Health Medical Center Denver
Cheryl	Stiles		
Diane	Swagger	Hospital Administrator	St. Thomas More Hospital Canon City
Michele	Sweeney	Medical Director	Pueblo Community College Pueblo
Ryan	Tedrow		
Shirley	Terry	RETAC Coordinator	Mile-High RETAC Denver
Stephanie	Thomas	Hospital Administrator	Denver Health Denver
Skip	Tinnell		Clinical Data Management Evergreen

Pat	Tritt	Director, EMS and Trauma	Swedish Medical Center Englewood
Linda	Underbrink	RETAC Coordinator	Foothills RETAC Kremmling
Phyllis	Uribe	Trauma Program Manager/Director	Swedish Medical Center Englewood
Ralph	Vickery	EMS Chief	Cunningham Fire
Bill	Voges	EMTS	CDPHE Denver
Tien	Vu	Emergency Physician	The Children's Hospital Aurora
Bob	Walter	Agency Director	Morgan County Ambulance Ft. Morgan
Anne	Wardrop	Trauma Program Manager	Vail Valley Medical Center Aspen
Celeste	White	EMTS	CDPHE Denver
Chris	Wiant	President/CEO	Caring for Colorado Foundation Denver
Monika	Wilkins	Trauma Nurse Coordinator	Lincoln Community Hospital Hugo
Jana	Williams	Agency Director	AIRLIFE Denver Englewood
Leslie	Williams	Trauma Nurse Coordinator	St. Mary's Hospital Grand Junction
Chris	Winter	Medical Director	Parker Adventist Hospital Parker
Chip	Woodland	Medical Director	Vail Valley Medical Center Vail
Brent	xEastman	Consultation Team Leader	Scripps Health
Ronald	xMaier	ACS Consultation Team	Harborview Medical Center
Dan	xManz	ACS Consultation Team	Vermont Department of Health
Holly	xMichaels	ACS Consultation Team	American College of Surgeons
Kathy	xRinnert	ACS Consultation Team	Univ of Texas Southwestern at Dallas
Nels	xSanddal	ACS Consultation Team	Critical Illness and Trauma Foundation
Jolene	xWhitney	ACS Consultation Team	Utah Department of Health
Brandon	Backlund		