RESOURCES

FOR OPTIMAL CARE OF THE INJURED PATIENT

2014

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COMMITTEE ON TRAUMA
AMERICAN COLLEGE OF SURGEONS

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Resources for Optimal Care of the Injured Patient

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Contributing Organizations

Similarly, it is impossible to list all of the professional organizations and associations who have reviewed and provided input into the various drafts of this edition of *Resources for Optimal Care of the Injured Patient*.

History

The American College of Surgeons (ACS) was founded in 1913 on the basic principles of improving the care of surgical patients and the education of surgeons. The ACS Committee on Trauma (ACS-COT) is the oldest standing committee of the College. Established in 1922 by Charles L. Scudder, MD, FACS, this committee focuses on improving the care of injured patients, believing that trauma is a surgical disease demanding surgical leadership. This resources document was first published in 1976 and established guidelines for care of injured patients.

The evolution of the name of this document corresponds with the evolution of the philosophy of care set forth by the ACS-COT. The initial name, Optimal Hospital Resources for Care of the Injured Patient (1976), evolved to Resources for Optimal Care of the Injured Patient (1990 and 1993). This subtle change in emphasis from "optimal hospital resources" to "optimal care, given available resources" reflects an important and abiding principle: The needs of all injured patients are addressed wherever they are injured and wherever they receive care. This subtle name change better acknowledges that few individual facilities can provide all resources to all patients in all situations. This reality forces the development of a trauma system of care instead of simply developing trauma centers.

An ideal trauma system includes all the components identified with optimal trauma care, such as prevention, access, prehospital care and transportation, acute hospital care, rehabilitation, and research activities. The term "inclusive" trauma system is used for this all-encompassing approach, as opposed to the term "exclusive" system, which focuses only on the major trauma center. It must be noted however that an "inclusive" system does not mean an unplanned or unregulated system. Each facility should have an identifiable role based on resources and needs of the community rather than their self-selected level of designation. Although this document still addresses trauma center verification and consultation, it also emphasizes the need for various levels of trauma centers to cooperate in the care of injured patients to avoid wasting precious medical resources. The intent of this emphasis is to provide optimal care in a cost-effective manner.

In this revision the principles of developing an inclusive trauma system were further refined. Level I and II criteria were reviewed and revised to ensure that both types of trauma centers are available to provide high quality definitive care. Level IV trauma center criteria were further expanded including the need for participation in the broader regional trauma system. Early clinical decision making is emphasized in the evaluation and transfer of patients, similar to the principles outlined in the Rural Trauma Team Development Course.

Definitive Care Facilities

Essential to the development of a trauma care system is the designation of definitive trauma care facilities. The trauma care system is a network of definitive care facilities that provides a spectrum of care for all injured patients. In an area with adequate Level I resources, it may not be necessary to have Level II centers. Similarly, when Level I, II, and III centers can provide care for the volume of trauma patients in the region, Level III centers may not be necessary. Level II and III centers will be essential for the care of patients in rural and more remote regions. It must be emphasized that in any trauma system, the designating authority should be responsible for determining the anticipated volume of major trauma patients and assessing available resources to determine the optimal number and level of trauma centers in a given area.

Conceptually, effective trauma systems must have a lead hospital. These lead hospitals should be the highest level available within the trauma system. In many areas, Level I centers will serve as the lead hospitals. In systems with less dense populations, Level II facilities may assume this role. In smaller community and rural settings, Level III centers must serve as the lead hospital.

In most trauma systems, a combination of levels of designated trauma centers will coexist with the other acute care facilities who should also be formal members of the trauma system caring for injured patients of lessor acuity and providing data and participating in performance improvement. The trauma care system must establish trauma facility standards. Historically, these standards have been based on the guidelines established in this ACS-COT document. We have attempted to emphasize resource differentiation between centers. We do not view our classification scheme as a ranking of medical care, but as a ranking of resource depth. We expect the commitment to quality care to be the same regardless of resources. In this revision, improving quality of care is further refined with the addition of risk adjusted benchmark of trauma center outcomes.

Level I

The Level I facility is a regional resource trauma center that is a tertiary care facility central to the trauma care system. Ultimately, all patients who require the resources of the Level I center should have access to it, either directly or through efficient transfer processes. This facility must have the capability of providing leadership and total care for every aspect of injury, from prevention through rehabilitation. In its central role, the Level I center must have adequate depth of resources and personnel.

Because of the large personnel and facility resources required for patient care, education, and research, most Level I trauma centers are, for the most part, university-based teaching hospitals. Other hospitals willing to commit these resources, however, may meet the criteria for Level I recognition.
In addition to acute care responsibilities, Level I trauma centers have a major responsibility for providing leadership in education, research, and system planning. This responsibility extends to all hospitals caring for injured patients in their regions.

Medical education programs include residency program support and postgraduate training in trauma for physicians, nurses, and prehospital providers. Education can be accomplished through a variety of mechanisms, including classic continuing medical education (CME), trauma and critical care fellowships, preceptorships, personnel exchanges, and other approaches appropriate to the local situation. Research and prevention programs, as defined in this document, are essential for a Level I trauma center.

Level II

The Level II trauma center is a hospital that also is expected to provide initial definitive trauma care, regardless of the severity of injury. Level I and Level II trauma centers are expected to be clinically equivalent except for complex, specialized injuries such as replantation. Depending on geographic location, patient volume, personnel, and resources, however, the Level II trauma center may not be able to provide the same comprehensive care as a Level I trauma center. Therefore, patients with more complex injuries may have to be transferred to a Level I center. Level II trauma centers may be the most prevalent facility in a community, managing the majority of trauma patients. In this revision, the criteria for Level I and II criteria were reviewed and revised where necessary to ensure that both types of trauma centers can provide comprehensive, definitive care of severely injured patients. The designating authority, in partnership with the broader regional trauma system, should ensure that the optimum number and type of trauma centers exist in a given geographic region. The development of Level II trauma centers should not compromise the flow of patients to existing high volume Level I trauma centers.

The Level II trauma center can be an academic institution or a public or private community facility located in an urban, suburban, or rural area. Where a Level I center does not exist, the Level II center should take on the responsibility for education and system leadership. Where a Level I center exists, the Level II trauma center should work with the Level I trauma center to ensure optimal care for patients in the region. The ideal trauma system, as outlined in this document, is based on a professional model where the patients' interest supersedes the providers and institutions' interests. An optimal trauma system builds consensus around doing the right thing for the patient and doing things right for the patient. Timely, structured cooperation and communication is essential for optimal care.

Level III

The Level III trauma center serves communities that do not have immediate access to a Level I or II institution. Level III trauma centers can provide prompt assessment, resuscitation, emergency operations, and stabilization and also arrange for transfer to a facility that can provide definitive trauma care when needed. Well trained emergency department physicians and general surgeons are required in a Level III facility. Planning for care of injured patients in these hospitals requires transfer agreements and standardized treatment protocols. As such, participation in the larger regional trauma system is essential. In remote areas, the Level III trauma center may take on the responsibility for education and system leadership. Level III trauma centers are generally not appropriate in an urban or suburban area with adequate Level I and/or Level II resources.

Level IV

Level IV trauma facilities provide advanced trauma life support before patient transfer in remote areas where no higher level of care is available (see Chapter 13, Rural Trauma Care). Because of geographic isolation, the Level IV trauma facility is the de facto primary care provider. A well trained physician or midlevel provider must be continually available. If willing to make the commitment to provide optimal care, given its resources, the Level IV trauma facility should be an integral part of the inclusive trauma care system, and participation within the larger trauma system is essential. As with Level III trauma centers, treatment protocols for resuscitation, transfer protocols, data reporting, and participation in system performance improvement are essential.

A Level IV trauma facility must have a good working relationship with the nearest Level I, II, or III trauma center. This relationship is vital to the development of a rural trauma system in which realistic standards must be based on available resources. Optimal care in rural areas can be provided by skillful use of existing professional and institutional resources supplemented by guidelines that result in enhanced education, resource allocation, and appropriate designation for all levels of providers. Also, it is essential for the Level IV facility to have the involvement of a committed physician who can provide leadership and sustain the affiliation with other centers.

An inclusive system should leave no facility without direct linkage to a trauma center. This association should facilitate expeditious transfer of seriously injured patients who require a higher level of care. Exchange of medical personnel between Level I/II and Level III/IV facilities may be an excellent way to develop this relationship. The Level I and II trauma centers have an obligation to extend their educational outreach to rural areas in the form of professional education, consultation, or community outreach. A mechanism should provide feedback about individual patient care and outcome analysis to the referring hospital. All facilities should participate in the system at a level commensurate with their capabilities and community/system need and should provide data and participate in system performance improvement.

Use of the Resources Document

An obvious outgrowth of the ACS-COT guidelines for optimal care was the development of a verification process whereby a hospital could be evaluated to determine whether ACS criteria were being met. This verification process was established in 1987, and at the time of this writing, more than 2,700 verification and consultation site visits were completed (see Chapter 22, Consultation/Verification Program).This document has become a guide for the Consultation/ Verification program of the ACS-COT. This edition was developed to further aid the process of consultation and verification of trauma centers. Attention was given to providing support for resource expenditure within an inclusive system of trauma care. As the verification process matured, better definitions were sought for many of the areas within a hospital assessed during the verification or consultation process. A goal of this revision was to reduce or eliminate ambiguity with respect to the criteria required to be a verified trauma center.

Principles of Change for This Edition

This is the sixth edition of the ACS-COT document entitled Resources for Optimal Care of the Injured Patient. Each revision has evolved in many ways as new information and needs are recognized. Many individuals volunteered a significant amount of their time, energy, experience, and knowledge in drafting this and previous editions. These individuals are primarily members of the ACS-COT, but input from outside the ACS-COT has been from other groups such as the American Burn Association, the Orthopaedic Trauma Association, the American College of Emergency Physicians, the American College of Radiology, from neurosurgery, pediatric surgery and the National Association of State EMS Officials. The result is a book that attempts to define the resources required to provide optimal care in regional trauma systems. The authors were guided by a number of principles that are worth mentioning. **As used throughout this document, the term "immediately" mean within 15 minutes, and the term "promptly" means within 30 minutes.**

Emphasis on Trauma System Rather than Trauma Center

The care of injured patients requires a system approach to ensure optimal care. A systematic approach is necessary within a facility; however, no one trauma center can do everything alone. Thus, a system approach is necessary within an entire community regardless of its size. Resources for Optimal Care of the Injured Patient: 1993 attempted to define an inclusive system of care but failed to delineate a flow of patients to support it. If resources for optimal care of injured patients are to be used wisely, then some concentration of resources should occur. This type of resource allocation should allow patients to move to the highest level of care available and, ideally, should avoid excessive and inappropriate resource expenditure in a time of limited medical resources. This system should support the development of trauma centers with the right balance of resources and volume of patients.

Differences in External Environment

It is recognized that we provide care to injured patients in urban and rural environments, which are often very different when resources are assessed. Although a perfect definition could not be found for these environments, an attempt was made to recognize the needs of these two environments. However, in either environment, the matrix is predicated on the fact that more severely injured patients must be congregated at more resource-intensive facilities. These facilities must interact with one another to optimize care within and across both environments.

Differentiation between Levels of Care

A sincere attempt was made to avoid discrepancies of resource needs between the different levels of care. As clinical outcomes of severely injured patients are expected to be equivalent at Level I and II trauma centers, attention was paid to key criteria to ensure this outcome. Although the quality of care is expected to be similar throughout all levels of care, the severity and the volume of injured patients were accepted as the drivers of resource utilization. As severity and volume increase, more human and financial resources are required to ensure optimal care. Hopefully, the differences in resource commitment will allow each facility at each level to expend an acceptable amount of resources based on the needs of the patient population served. Our resource assignment tried to be practical given current medical marketplace demands.

Human Resource Commitment

The roles of general surgeons, neurosurgeons, orthopaedic surgeons, and emergency medicine physicians have been refined. All these specialties must take a very active role in the trauma program in any facility dedicated to the care of injured patients. As the level of care increases, these physicians must become more involved and be part of the resource commitment for a successful trauma program. The role of the trauma program manager (TPM) is better defined. In a larger trauma program, this individual functions as a co-manager of the program with the trauma medical director (TMD).

Involvement of Surgeons and Physicians

Resources can be measured in human and capital equipment parameters. Human resources include medical and ancillary professionals. Optimal care is assumed to be defined for human resources as having the best and the brightest medical professionals available to treat injured patients. This edition further establishes and clarifies the level of responsibility for board-eligible or board-certified general surgeons and emergency medicine physicians. These individuals must be available 24 hours a day in facilities providing the highest level of care and cannot abdicate that responsibility to a resident in training.

Care of Injured Children

Proper care for injured children is defined in terms of resources. Pediatric hospitals are recognized as special resources that are available in some communities. These institutions have the responsibility to meet the same criteria as adult hospitals. This revision recognizes that pediatric hospitals can commit to resource levels that are equivalent to adult Levels I through IV. It is hoped that this change will facilitate more pediatric hospitals to make a commitment to an inclusive trauma system. Surgical participation and involvement is critical for the care of the injured child throughout all phases of care. This revision emphasizes this point. As pediatric specialties resources are a rare resource in many areas, primarily adult or adult/children's hospitals are required to provide quality care to injured children. The intent of the pediatric section is intended to continue to develop a more collaborative systematic approach, using appropriate community resources.

Critical Care Services

High quality critical care is essential for the care of the severely injured patient. A dedicated intensive care unit team with surgical direction is now required at Level I-III institutions. The implication of this change is an attempt to ensure that critically ill patients have immediate physician coverage when needed. This requirement also implies that other surgeons are available to provide immediate care to newly injured patients who are admitted through the emergency department.

Quality and Outcome

The goal of this and previous revisions is to set appropriate standards for the optimal care of the trauma patient, ensure the right infrastructure and people, ensure high quality data for performance improvement and verify that quality outcomes are present. In this revision the inclusion of a mandatory risk adjusted benchmark has been added for trauma centers. The Performance Improvement and Patient Safety processes have been further defined and clarified with the aim of trying to standardize and provide guidance for optimal performance improvement programs.

Goals

As in the last several editions, our goal is to better define what resources are truly needed to provide optimal care of injured patients within an appropriately designed and funded system of care. We intend to continuously review and improve Resources for Optimal Care of the Injured Patient as new information and more data are developed that can be applied to its content.

Another goal was to provide an evidence-based scientific method to support recommendations completely. We have produced a table of evidence supporting each criteria. Although we achieved this goal, it is clear that high quality clinical and system evidence is lacking for many of the criteria, emphasizing the vital need for an increase in high quality trauma clinical and system research. This need for high quality outcomes related research emphasizes the need to preserve and enhance those high-volume, academic trauma centers. From a practical point of view, this means that consensus expert opinion is still the cornerstone of much of the criteria included in this revision.

Finally, in this edition, much emphasis has been exerted on identifying all the essential criteria for each level of trauma center required for successful evaluation at the time of the review. We have diligently worked to clarify and simplify language to avoid ambiguity. We have also aimed to state the criteria in positive rather than negative terms. Moving forward, the Committee on Trauma intends to implement a standard process for revision of this document, including the routine solicitation of input from the committed stakeholders (trauma medical directors, trauma program managers, hospital leadership, EMS and the designation authorities).

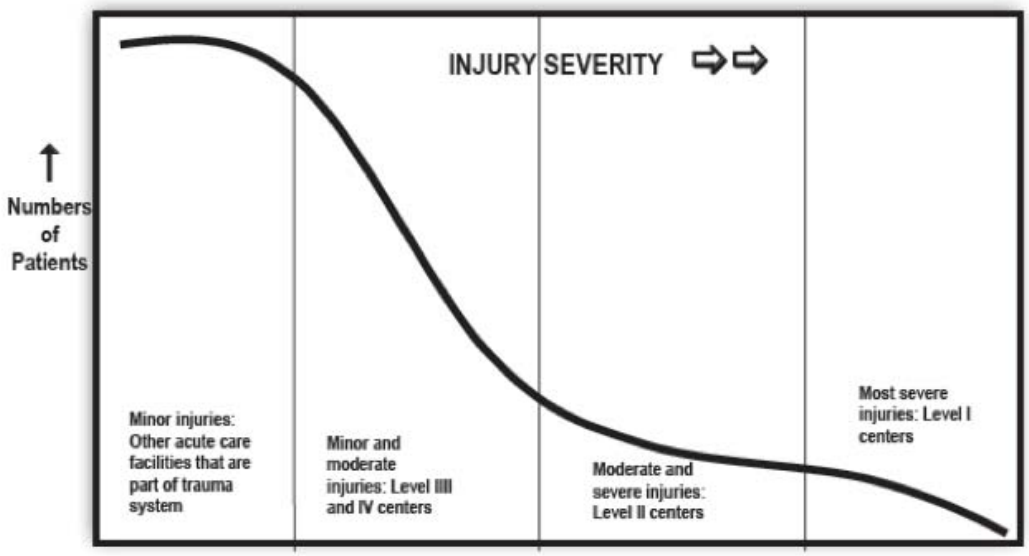
Regional Trauma Systems: Optimal Elements, Integration, and Assessment

Injury is a public health problem of enormous magnitude, whether measured by years of productive life lost, prolonged or permanent disability, or financial cost. Organized approaches within single facilities to care for victims of severe injury have repeatedly demonstrated improved outcomes, an observation that has led to the development of the trauma center verification process. In addition, regionalized trauma systems should have a process for triaging patients, ensuring that a patient gets to the level of trauma care that matches his or her injury severity and resulting in improved outcomes. Moreover, using a rigorous disease management approach to injury across the entire spectrum, from prevention to rehabilitation, has shown improved outcomes. Given the profound impact of injury and the proven efficacy of a regionalized approach, the development and maintenance of a comprehensive system for the management of injury are central to the mission of public health agencies. In fact, to benefit from lessons learned in civilian trauma systems, the U.S. military adopted these principles and developed the Joint Trauma System (JTS) as a systematic and integrated trauma system to optimize and better coordinate battlefield care. The JTS approach demonstrated improvements in outcome at least in part because of the implementation of regional trauma system principles.

The standards contained within this book were originally developed out of a desire to ensure optimal care to injured patients within acute care facilities specializing in trauma care. Historically, efforts at improving injury care focused on the development of an exclusive network of highly specialized trauma centers, most often in urban settings. This approach worked well for the most severely injured patients who were near a trauma center; however, the approach failed to address the larger public health problem posed by injury: how to ensure high-quality trauma care to the U.S. population regardless of the site of injury.

Within an *exclusive trauma system,* the most seriously injured patients are diverted to specialized trauma centers. Most acute care facilities within a region regularly provide care to patients with minor injuries but have no trauma care preparation or interaction with specialized trauma centers. However, these non–trauma center facilities receive more severely injured patients on occasion, especially if the transport time to a specialized trauma center is significant. A uniform approach by all acute care facilities to provide consistent, high-quality care to the injured is essential and includes guidelines of care (management protocols) for patients requiring immediate transfer to a higher level of trauma care and patients with less serious injury who will be treated locally. Trauma centers (of all levels) and non–trauma center facilities are both important elements of an *inclusive* and *integrated trauma system*. Whereas an exclusive trauma system incorporates only specialized trauma centers as the providers of acute trauma care focused on the severely injured, the inclusive and integrated system embraces all facilities and all degrees of injury, acting to match patient care needs to the capabilities of receiving centers (Figure 1).

Figure 1 The Inclusive Trauma System



The *inclusive* trauma system uses the full spectrum of acute care facilities to provide trauma care.

Optimally, all acute care facilities with emergency departments should be formally prepared and designated to care for injured patients at a level commensurate with their resources, their capabilities, and the community's needs. When all acute care facilities are integrated in this manner, the regional trauma system is able to do the following:

- Make the best use of available resources.
- Match patient needs to facility resources.
- Engage all acute care facilities in the management of injured patients.
- Ensure that the trauma system is functioning in the best interests of injured patients through regional performance improvement and patient safety (PIPS) activities.
- Reduce the burden on the highest-level trauma centers.
- Improve surge capacity in the event of mass casualty events.

All activities pertaining to the regional trauma system should be in accordance with a formal written trauma system plan. Typically, the lead agency (state, regional, or county) is responsible for the development of the plan, with input, review, and approval from a formal stakeholder/oversight body. The trauma system plan should address all the critical elements of an integrated system, including the following:

- Optimal access to the highest levels of care, including access to very specialized care such as oral–maxillofacial surgery, complex hand replantation, and ophthalmologic emergencies.
- Optimal utilization of emergency medical services (EMS) resources, for both scene response and interfacility transfers.
- System-wide quality assurance activities.
- Coordinated injury prevention efforts.

- Population-based surveillance of injury-related problems.
- Integration with disaster preparedness programs.
- Financial viability and avoidance of unnecessary duplication of expensive resources.

Trauma System Components and Functions: The Public Health Model

Trauma system development has evolved as specialized trauma care has become more organized. Historically, specialized trauma care began with individual surgeons who developed clinical departments that evolved into organized acute care facilities. Eventually, multidisciplinary, multi-institutional programs developed, and now inclusive and integrated state and regional trauma systems are emerging. As the organization for the provision of trauma services expanded, the need for better integration of trauma care into a larger public health framework became recognized. The public health framework views injury as a disease that can be prevented or managed in a way that reduces severity and improves ultimate outcome. The public health approach incorporates steps remarkably similar to an institutional performance improvement process:

1. Identify a problem (disease or injury) based on available data.
2. Design a corrective action (prevention or intervention).
3. Implement the corrective action and reevaluate subsequent data to assess the effect of the intervention on the outcome.

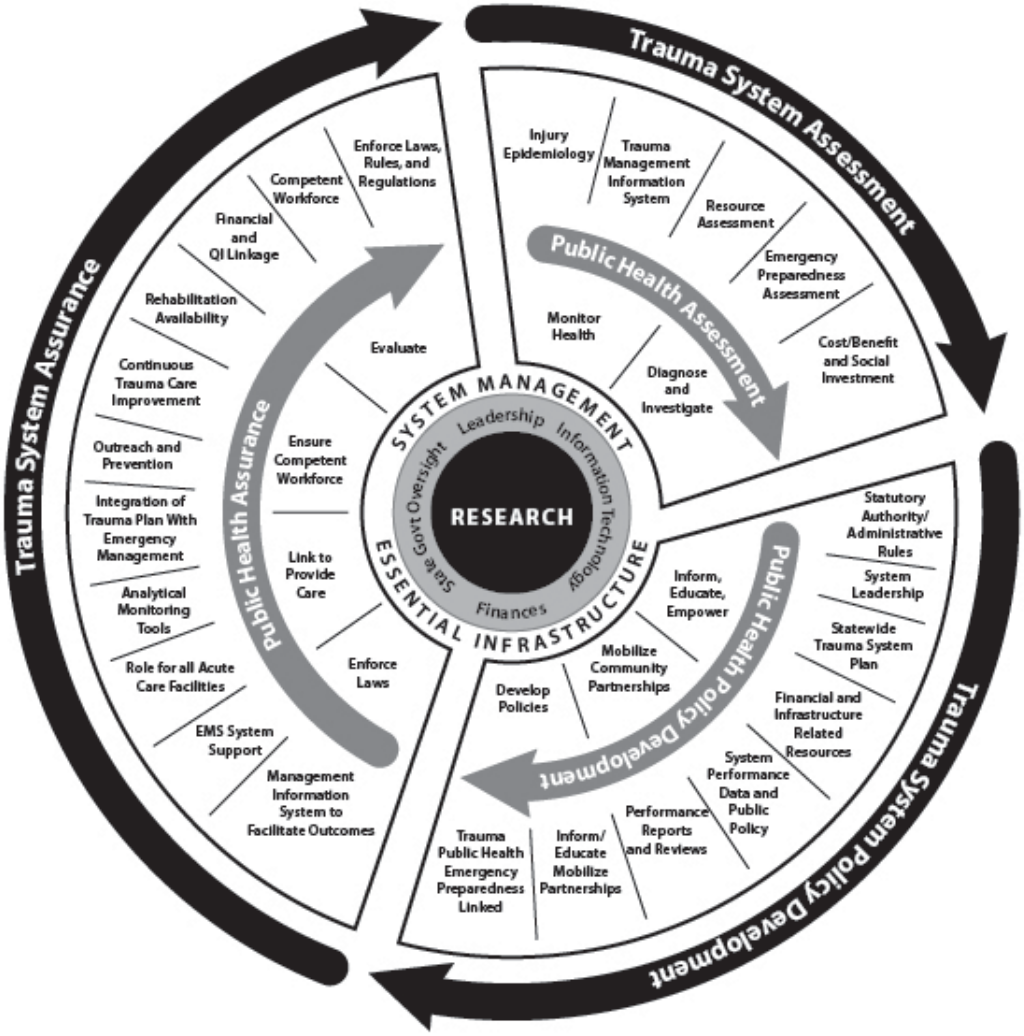
These steps translate into the following core functions of a public health approach to injury:

- **Assessment:** The regular and systematic collection and analysis of injury-related information from population-based and clinical databases, as well as resources for care, are used to describe the injury problem and to identify potential opportunities for intervention. The burden of injury is monitored, gaps in resources are identified, and existing system resources are matched to the needs for prevention and treatment.
- **Policy development:** Comprehensive policies and standards of care (driven by assessment) are designed to meet the overall goals of a trauma system and improve outcomes. Developing criteria for trauma center designation is an example of process- and resource-based standards. Policy development is facilitated through collaboration and by educating elected officials and empowering stakeholders.
- **Assurance:** The provision of necessary services is ensured by the implementation, monitoring, and evaluation of system components, resources, organization, processes, and adherence to policies and standards. Assurance is accomplished through the enforcement of system performance standards and established system policies.

These core functions describe, in broad strategic terms, what a trauma system does, rather than what it is or what elements it includes. The trauma system itself consists of a variety of discrete components interacting in an organized, predetermined manner to perform these core functions and accomplish defined goals. The discrete components of a trauma system were defined in the Health Resources and Services Administration's (HRSA's) 1992 *Model Trauma Care Systems Plan* and were related to the core components of the public health

model in HRSA's 2006 *Model Trauma System Planning and Evaluation*. The concepts have been further refined and applied to trauma systems development in the American College of Surgeons Committee on Trauma (ACS-COT) document *Regional Trauma Systems: Optimal Elements, Integration, and Assessment—Systems Consultation Guide* (see Figure 2).

Figure 2 The Relationship Between Public Health Functions and Services and the Operations of a Trauma System



Source: U.S. Department of Health and Human Services, Health Resources and Services Administration. *Model Trauma System Planning and Evaluation.* Rockville, MD: U.S. Department of Health and Human Services; 2006. Available at: www.facs.org/quality-programs/trauma/tsepc/resource. Accessed September 24, 2013.

A trauma system should have a plan that specifies how the various components illustrated in Figure 2 operate and interact to achieve the intended goals. All trauma centers should participate in support of the trauma system to accomplish all three core functions.

Assessment of the trauma system can be accomplished in several ways. All existing resources can be examined to determine how they can be optimally organized and respond to meet the needs of all injured patients within the region or catchment area, as well as across the spectrum of injury. Identifying gaps or deficiencies in resources and infrastructure that must be addressed to truly attain optimal care of injured patients is an essential step. Many aspects of this assessment can be accomplished through a collaborative effort between the lead agency and the trauma system's multidisciplinary advisory group. In some cases it is preferable to have a team of consultants conduct a comprehensive assessment. Such a team may help identify priorities for trauma system development and strategies for implementation, or even provide a guideline for action by the multidisciplinary advisory group.

Trauma center leaders need to take an active role in policy development for the trauma system. They should participate in oversight and advisory groups to ensure that rules and regulations are developed and implemented in a manner that supports the clinical aspects of injury care. Such oversight and advisory groups should include EMS and disaster preparedness to make sure that trauma care is well integrated with these resources. Additionally, the knowledge of trauma center leadership is essential to help inform the trauma system plan and to assist with the ongoing analysis of system registry data to identify opportunities for system improvement or refinement.

The ACS Trauma System Consultation: a team consultation process. During this process, a multidisciplinary team examines all of the existing information provided by the trauma system lead agency and stakeholders, discusses issues with key stakeholders, and produces a report that contains key recommendations concerning the growth and maturation of the trauma system. ACS trauma system consultations have occurred in more than 30 states, regions, counties, and cities. Follow-up trauma system consultations have been requested by some previously visited trauma systems to obtain guidance in further refining their trauma systems. In all cases, leaders of trauma centers have helped identify and support the need for the trauma system consultation process, and some trauma centers have contributed funds to cover the cost of the consultation. Trauma center leaders have also contributed data and their time to share information that is vital to the success of the consultation process.

- Trauma centers have a vital role in ensuring that the trauma system is performing well.
- Trauma centers contribute clinical data to the system-wide trauma registry, along with financial data, as appropriate.

Trauma centers support the integration of high-quality prehospital care by participation in trauma training, adoption of field triage criteria with linkage to trauma team activation procedures, provision of medical oversight (on-line and off-line), development of treatment protocols, improvement of multidisciplinary performance, and integration of prehospital data into the trauma registry.

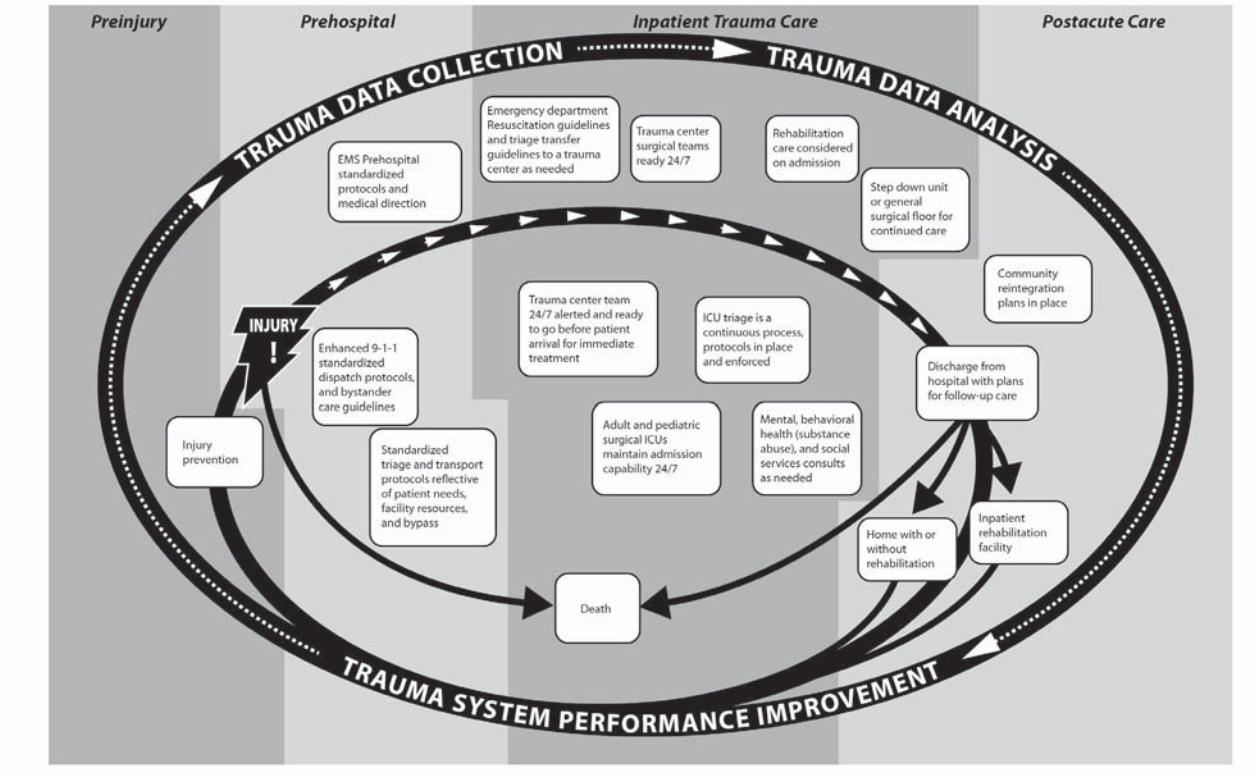
- Each trauma center needs to develop and maintain a competent workforce, ensuring that all clinical health care providers are trained in appropriate trauma principles and procedures.

- Higher-level centers helping lower-level centers gain competence in trauma care through outreach and training programs.
- PIPS activities are essential for all trauma centers. Internal PIPS activities are outlined in Chapter 16. Trauma center leaders participate in or lead external performance improvement of the trauma system through multidisciplinary and multi-institutional PIPS processes.

Role of Designated Trauma Centers in the Development of Regional Trauma Systems

The goal of a health care system is to decrease the risks and the burden of disease to individuals and to the community. With regard to injury, this goal cannot be achieved by simply providing optimal acute care to injured individuals. It requires coordinated efforts along the entire continuum of injury care—from prevention through rehabilitation to re-assimilation of the injured individual back into the community. Figure 3 illustrates the complex and integrated nature of trauma systems.

Figure 3 A Preplanned Trauma Care Continuum



Source: U.S. Department of Health and Human Services, Health Resources and Services Administration. *Model Trauma System Planning and Evaluation.* Rockville, MD: U.S. Department of Health and Human Services; 2006. Available at: www.facs.org/quality-programs/trauma/tsepc/resources Accessed September 24, 2013.

To achieve the goal of decreasing the burden of injury in a state or region, a trauma system needs to develop a network of acute care facilities, personnel, and organizational entities that function in an organized and coordinated manner in the defined geographic area. In this paradigm, the trauma center and its surgical care team provide just one element in an inclusive and integrated system of "disease management" for injury. The individual trauma centers and their health care providers are essential system resources that must be active and engaged participants (CD 1–1). In areas without a well-developed regional trauma system, individual trauma centers are likely to be the primary drivers of a coordinated approach to injury care. They must function in a way that pushes trauma center–based standardization, integration, and PIPS out to the region while engaging in inclusive trauma system planning and development (CD 1–2).

As the organization for trauma care has expanded from single centers to multiple-facility systems, it has become recognized that trauma centers need to be effectively engaged in all aspects of trauma system planning, implementation, and evaluation. As a key element of the trauma system and a focal point for treatment, trauma centers typically contribute administrative leadership, medical leadership, and academic expertise to a state or regional system. Lead trauma centers (Level I, II, or III) in a region, in collaboration with the lead agency, have the additional responsibility of engaging other regional resources (designated trauma centers, acute care facilities, and the EMS system) in a system-wide performance improvement process for the inclusive and integrated trauma system.

Meaningful involvement in state and regional trauma system planning, development, and operation is essential for all designated trauma centers and participating acute care facilities within a region (CD 1–3). The nature of this involvement will depend on the region's local administrative structures, politics, and degree of trauma system development. Examples of participation by trauma center staff include the following:

- Participation in state and regional trauma advisory committees.
- Leadership in state and regional medical audit committees.
- Regular collaboration with regional trauma advisory committees, EMS, or other agencies to promote the development of state and regional systems.
- Participation in media and legislative education to promote and develop trauma systems.
- Participation in state and regional trauma needs assessment or injury surveillance.
- Participation in the development of a state or regional trauma plan or state trauma registry.
- Provision of technical assistance and education to hospitals within the region and their providers to improve system performance.

Not all the elements of a fully developed, inclusive trauma system are within the direct control or influence of individual trauma centers, but a significant number are. If the region or state has an established lead agency and inclusive system infrastructure, the authority and responsibility for policy development and system operation come from that lead agency, with input from the trauma centers. Without a strong lead agency or established infrastructure, the trauma system leadership most often comes from the designated centers until the system matures.

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Descriptions of Trauma Center Levels and Their Roles in a Trauma System

Central to an ideal trauma system is the proper number and location of large, resource-rich trauma centers (Levels I and II**).** Optimal resources at Level II trauma centers include immediate availability of board-certified emergency physicians, general surgeons, anesthesiologists, neurosurgeons, and orthopaedic surgeons. Other board-certified specialists are available, within a short time, to all patients who require their expertise.

To ensure adequate experience and expertise, the Level I trauma center requires a certain volume of injured patients to be admitted each year, including the most severely injured patients from the system. In addition, certain injuries that occur infrequently should be concentrated in this special center to ensure that these patients are properly treated and studied. A minimum volume of patients is required to ensure that an adequate number of injured patients are cared for at the institution to support the required educational programs in training future trauma care providers. Research activities are necessary to enhance our knowledge of the care of injured patients. Basic science research in areas such as shock, resuscitation, brain injury, organ failure, and rehabilitation should be carried out. This trauma center must have an integrated, concurrent performance improvement and patient safety (PIPS) program to ensure optimal care and continuous improvement in care (CD 2–1). The Level I center is responsible not only for assessing the care provided within its trauma program but also for helping to support the assessment of care across the regional trauma system. This trauma center should serve as a comprehensive resource for all entities dealing with injured patients in the system's catchment area. Trauma centers should demonstrate commitment toward reaching this ideal.

Surgical commitment is essential for a properly functioning trauma center (CD 2–2). In fact, without surgical leadership, the program will not be able to meet all the requirements outlined in *Resources for Optimal Care of the Injured Patient,* by the American College of Surgeons Committee on Trauma (ACS-COT). Although surgical commitment is often difficult to measure objectively, it is recognized in a number of ways, including having a surgeon who is the full-time director of the trauma program, surgeons who take an active role in all aspects of caring for injured patients, surgical participation in the trauma PIPS program, and surgeons who assume an advocacy role for injured patients. Surgical leadership in promoting the trauma program to the community, hospital, and other colleagues also is easily recognized. This commitment is a valuable resource that is integral to a successful trauma program.

The ACS-COT supports trauma center and trauma system development and related public health policies, including needs assessment, policy development, and assurance. Each community should assess its true needs for trauma care, emphasizing a systems approach. While there are roles for all acute care hospitals treating injured patients, the ACS-COT trauma center classification scheme (Level I through Level IV) is intended to assist communities in their trauma system development. This approach implies that there should be limitations on the number and level of verified trauma centers within a given area. Every community should ensure that resources are used appropriately to achieve the stated goal of optimal care of injured patients. The goal of every system is to match the needs of injured patients to the capabilities of the trauma facility. Proper triage is a critical feature of a good trauma system and is necessary to achieve this goal. Field triage and transport to appropriate facilities will optimize outcome and utilization of resources. To properly function, the

system requires proper communications systems for prehospital notification and clear, well-defined protocols for triage, transport destination, and trauma team activation that are linked. Objective, extramural verification of a hospital's resources, commitment, and capability is another important early step in the development of a regional trauma system. Owing to the inherent differences in population density, geography, and health care resources, each regional trauma system will be individualized to achieve optimal patient care.

In most communities, it is appropriate for there to be a single identified lead hospital, which is looked upon as the resource leader for other hospitals in the system. In major metropolitan areas, however, there may be more than one Level I trauma center; these centers should work together collaboratively to provide optimal trauma care in the region served.

Outside major population centers, Level II centers serve as the lead hospital for extended geographic areas. In some rural areas, where population densities are low and distances great, a Level III center may be the only resource for miles. In such cases, the lead hospital assumes the responsibility for injury prevention and control, peer review, and educational activities, in addition to the primary functions of stabilization and transport, operative stabilization and transport, and patient care.

Descriptions of Trauma Center Levels

Trauma centers must be able to provide the necessary human and physical resources (physical plant and equipment) to properly administer acute care consistent with their level of verification (CD 2–3). What follows is a description of the criteria for Level I, II, III, and IV trauma centers. Centers at each level play an integral role in the trauma system. **The standards for the provision of clinical care to injured patients for Level I and Level II trauma centers are identical**. Level I trauma centers are distinguished from Level II centers in that they must do the following:

- Meet the admission volume requirements (see below).
- Maintain a surgically directed critical care service (see Chapter 11, Collaborative Clinical Services).
- Participate in the training of residents and be a leader in education and outreach activities (see Chapter 17, Education and Outreach).
- Conduct trauma research (see Chapter 19, Trauma Research and Scholarship).

A Level I trauma center should be a regional resource center and generally serves large cities or population-dense areas. This institution should serve as the lead hospital for a system. In larger population-dense areas, more than one Level I trauma center may be needed. All Level I institutions are expected to manage large numbers of severely injured patients.

A Level I trauma center must admit at least 1,200 trauma patients yearly or have 240 admissions with an Injury Severity Score of more than 15 (CD 2–4). This is the minimum volume that is believed to be adequate to support the education and research requirements of a Level I trauma center. Through the trauma PIPS program and hospital policy, the trauma director must have responsibility and authority for determining each general surgeon's ability to participate on the trauma panel based on an annual review (CD 2–5).

Qualified attending surgeons must participate in major therapeutic decisions, be present in the emergency department for major resuscitations, be present at operative procedures, and be actively involved in the critical care of all seriously injured patients (CD 2–6).

The 24-hour in-house availability of the attending surgeon is the most direct method for providing this involvement. A resident in postgraduate year 4 or 5 or an attending emergency physician who is part of the trauma team may be approved to begin resuscitation while awaiting the arrival of the attending surgeon but cannot independently fulfill the responsibilities of, or substitute for, the attending surgeon (CD 2–6). The presence of such a resident or attending emergency physician may allow the attending surgeon to take call from outside the hospital. In this case, local criteria and a PIPS program must be established to define conditions requiring the attending surgeon's immediate hospital presence (CD 2–7).

For Level I trauma centers, it is expected that the surgeon will be in the emergency department on patient arrival, with adequate notification from the field. The maximum acceptable response time is 15 minutes for the highest-level activation, tracked from patient arrival. The minimum criteria for full trauma team activation are provided in Table 2 in Chapter 5. The program must demonstrate that the surgeon's presence is in compliance at least 80 percent of the time (CD 2–8). The attending surgeon's immediate (within 15 minutes) arrival for patients with appropriate activation criteria must be monitored by the hospital's trauma PIPS program (CD 2–9).

For some patients in stable condition who do not meet the criteria for the immediate availability of the trauma surgeon, evaluation can be initiated according to trauma team protocols by the attending emergency physician. The patient can be examined by the trauma surgeon when clinically appropriate.

The trauma surgeon on call must be dedicated to a single trauma center while on duty (CD 2–10). In addition, a published backup call schedule for trauma surgery must be available (CD 2–11).

Level II

A Level II trauma center provides comprehensive trauma care in two distinct environments that have been recognized in the ongoing verification program sponsored by the ACS-COT. The first environment is a population-dense area in which a Level II trauma center may supplement the clinical activity and expertise of a Level I institution. In this scenario, the Level I and II trauma centers should work together to optimize resources expended to care for all injured patients in their area. This implies a cooperative environment between institutions that allows patients to flow between hospitals, depending on resources and clinical expertise and matched to patient need.

The second Level II environment occurs in less population-dense areas. The Level II hospital serves as the lead trauma facility for a geographic area when a Level I institution is not geographically close enough to do so. Many rural areas use this model. This lead trauma hospital should have an outreach program that provides support to smaller institutions in the same service area (see Chapter 13, Rural Trauma Care).

Through the trauma PIPS program and hospital policy, the trauma director must have responsibility and authority for determining each general surgeon's ability to participate on the trauma panel based on an annual review (CD 2–5). Qualified attending surgeons must participate in major therapeutic decisions, be present in the emergency department for major resuscitations, be present at operative procedures, and be actively involved in the critical care of all seriously injured patients (CD 2–6).

The 24-hour in-house availability of the attending surgeon is the most direct method for providing this involvement. A resident in postgraduate year 4 or 5 or an attending emergency physician who is part of the trauma team may be approved to begin resuscitation while awaiting the arrival of the attending surgeon but cannot independently fulfill the responsibilities of, or substitute for, the attending surgeon (CD 2–6). The presence of such a resident or attending emergency physician may allow the attending surgeon to take call from outside the hospital. In this case, local criteria and the PIPS program must be established to define conditions requiring the attending surgeon's immediate hospital presence (CD 2–7). For Level II trauma centers, it is expected that the surgeon will be in the emergency department on patient arrival, with adequate notification from the field. The maximum acceptable response time is 15 minutes for the highest level of activation, tracked from patient arrival. The minimum criteria for full trauma team activation are provided in Table 2 in Chapter 5. The program must demonstrate that the surgeon's presence is in compliance at least 80 percent of the time (CD 2–8). Compliance with this requirement and applicable criteria must be monitored by the hospital's PIPS program (CD 2–9).

For some patients in stable condition who do not meet the criteria for the immediate availability of the trauma surgeon, evaluation can be initiated according to trauma team protocols by the attending emergency physician. The patient can be examined by the trauma surgeon when clinically appropriate. The trauma surgeon on call must be dedicated to a single trauma center while on duty (CD 2–10). In addition, a published backup call schedule for trauma surgery must be available (CD 2–11).

Level III

For many areas, a Level III trauma center represents an important part of the trauma system. A Level III trauma center should have the capability to initially manage the majority of injured patients and have transfer agreements with a Level I or II trauma center for seriously injured patients whose needs exceed the facility's resources. A Level III trauma center must have continuous general surgical coverage (CD 2–12). Through the trauma PIPS program and hospital policy, the trauma director must have responsibility and authority for determining each general surgeon's ability to participate on the trauma panel based on an annual review (CD 2–5). For Level III trauma centers, it is expected that the surgeon will be in the emergency department on patient arrival, with adequate notification from the field. The maximum acceptable response time is 30 minutes for the highest level of activation, tracked from patient arrival. The PIPS program must demonstrate that the surgeon's presence is in compliance at least 80 percent of the time (CD 2–8).

Level III trauma centers may frequently treat patients who ultimately need to be transferred to a higher level of care. It is important to have guidelines approved by the trauma director and monitored by the PIPS program that define appropriate patients for transfer and retention. Well-defined transfer plans are essential (CD 2–13). Even in the event of an early decision to transfer, the trauma surgeon is expected to respond promptly to evaluate the patient. However, transfer should not be delayed while awaiting the surgeon's arrival.

Level IV

Most Level IV hospitals are in rural locations and usually supplement care within a larger trauma system. Level IV facilities provide initial evaluation and assessment of injured patients, but most patients will require transfer to higher-level trauma centers. A Level IV facility must have 24-hour emergency coverage by a physician or midlevel provider (CD 2–14). Specialty coverage may or may not be available, but a well-organized resuscitation team is important. Well-defined transfer plans are essential (CD 2–13). For Level IV trauma centers, it is expected that the physician (if available) or midlevel provider will be in the emergency department on patient arrival, with adequate notification from the field. The maximum acceptable response time is 30 minutes for the highest level of activation, tracked from patient arrival. The PIPS program must demonstrate that the physician's (if available) or midlevel provider's presence is in compliance at least 80 percent of the time (CD 2–8).

Level IV trauma centers expand the trauma system to sparsely populated, geographically isolated, and often medically underserved rural communities. These hospitals are typically the only source of medical care for many miles and function as an initial point of evaluation and treatment of injured patients. A defining difference between Level IV centers and higher-level trauma centers is the absence of continuous surgical and/or orthopedic coverage. The emergency department at Level IV centers must be continuously available for resuscitation, with coverage by a registered nurse and physician or midlevel provider, and it must have a physician director (CD 2–15). Primary care physicians usually lead the evaluation and resuscitation at these facilities, with the assistance of midlevel providers. These providers must maintain current Advanced Trauma Life Support® certification as part of their competencies in trauma (CD 2–16). To maintain knowledge of current, evidence-based trauma guidelines, all providers should attend trauma-related continuing medical education (CME) of at least 8 hours yearly.

Collaborative treatment and transfer guidelines reflecting the Level IV facilities' capabilities must be developed and regularly reviewed, with input from higher-level trauma centers in the region (CD 2–13). Because of the greater need for collaboration with receiving trauma centers, the Level IV trauma center must also actively participate in regional and statewide trauma system meetings and committees that provide oversight (CD 2–20). The Level IV trauma center must also be the local trauma authority and assume the responsibility for providing training for prehospital and hospital-based providers (CD 2–21). Level I, II, III, and IV trauma center facilities must participate in regional disaster management plans and exercises (CD 2–22).

Leadership of the trauma program is essential. For Level I, II, III, and IV trauma centers, a trauma medical director and trauma program manager knowledgeable and involved in trauma care must work together with guidance from the trauma peer review committee to identify events; develop corrective action plans; and ensure methods of monitoring, reevaluation, and benchmarking (CD 2–17). In Level I, II, III, and IV trauma centers, the multidisciplinary trauma peer review committee must meet regularly, with required attendance of medical staff active in trauma resuscitation, to review systemic and care provider issues, as well as propose improvements to the care of the injured (CD 2–18). In Level I, II, III, and IV trauma centers, a PIPS program must have audit filters to review and improve pediatric and adult patient care (CD 2–19). Depending on the severity of injury, many patients will require transfer to higher-level hospitals for definitive care.

Adult Trauma Center Treating Injured Children

Pediatric trauma centers should be used to the fullest extent feasible. However, pediatric resources for trauma care are scarce in many communities. In such areas, adult trauma centers, of necessity, may serve as the primary pediatric resource for the region and, therefore, may need to provide initial care for injured children. Any adult trauma center that annually admits 100 or more injured children younger than 15 years must fulfill the following additional criteria demonstrating their capability to care for injured children: Trauma surgeons must be credentialed for pediatric trauma care by the hospital's credentialing body (CD 2–23). For example, credentialing could be based on Pediatric Advanced Life Support, pediatric trauma CME, completion of a pediatric fellowship, or documentation of performance as measured by PIPS. There must be a pediatric emergency department area, a pediatric intensive care area, appropriate resuscitation equipment, and a pediatric-specific trauma PIPS program (CD 2–24). For adult trauma centers annually admitting fewer than 100 injured children younger than 15 years, these resources are desirable. These hospitals, however, must review the care of their injured children through their PIPS program (CD 2–25).

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Prehospital Trauma Care

The principles of modern prehospital management of severely injured patients have been derived from concepts developed in military conflicts. The goals of the emergency medical services (EMS) system are to prevent further injury, initiate resuscitation, and provide safe and timely transport of injured patients. Surgeons should be actively involved in the training of prehospital personnel, the performance improvement process, and the development of the trauma components of EMS. High-quality, consistent emergency care requires that all prehospital personnel in a trauma region understand the trauma triage criteria and destination protocols, treatment protocols, transportation alternatives, and capabilities of trauma facilities in their geographic region.

Injured patients should be taken directly to the center most appropriately equipped and staffed to handle their injuries, as defined by the region's trauma system (see Chapter 1, Regional Trauma Systems: Optimal Elements, Integration, and Assessment). These destinations should be clearly identified and understood by prehospital personnel and should be determined by system guidelines, trauma destination protocols, on-line and off-line medical direction, and the designation of trauma centers. Prehospital personnel should bypass facilities not designated by the trauma system as appropriate destinations, even if the facilities are closest to the incident.

Prehospital Training and Performance Improvement and Patient Safety

The trauma program must participate in the training of prehospital personnel, the development and improvement of prehospital care protocols, and performance improvement and patient safety programs (CD 3–1). Improving the final outcome of injured patients is dependent on effectively monitoring, integrating, and evaluating all components of patient care. Prehospital personnel should be involved in the multidisciplinary performance improvement process and be accountable to the medical direction system that is in place at the trauma center and in the geographic region (see Chapter 16, Performance Improvement and Patient Safety).

Trauma program staff should be actively involved in prehospital personnel training through programs such as Prehospital Trauma Life Support (PHTLS), grand rounds, trauma conferences, and case reviews. These staff members should also champion the inclusion of prehospital personnel in the multidisciplinary performance improvement process and in the development of trauma components of EMS. High-quality, consistent trauma care requires that prehospital personnel understand the trauma destination criteria, treatment protocols, transportation methods, and destination facilities in their geographic region.

Medical Direction

High-quality medical direction of prehospital trauma care is provided by two methods. Off-line medical direction is by protocol; it involves development, revision, and monitoring by physicians of all operating protocols and procedures, including reviewing prehospital reports for completeness and compliance with established procedures. Surgeons should participate closely with the EMS medical director in the development of trauma components of the EMS system and provide leadership during the development of trauma protocols. On-line medical direction is by two-way voice communication between emergency medical personnel in the field and a physician. Clinical findings are presented, and orders are received for the initial and continuing care of the patient.

Initial Management

The prehospital medical team provides initial on-scene assessment and management. Medical direction of prehospital trauma care is provided by preexisting protocols (off-line medical direction) or physician-directed communication (on-line medical direction).

The protocols that guide prehospital trauma care must be established by the trauma health care team, including surgeons, emergency physicians, medical directors for EMS agencies, and basic and advanced prehospital personnel (CD 3–2). This team approach helps establish continuity of care between prehospital care and hospital protocols. The prehospital trauma care protocols should be consistent throughout the system and be based on principles contained in PHTLS or similar standardized and medically approved trauma training programs.

Treatment of an injured patient in the prehospital arena should consist of assessment, extrication, initiation of resuscitation and stabilization, and safe and timely transport to the closest trauma center or acute care facility whose capabilities match the patient's needs. For severely injured patients, the essential components of resuscitation should be limited to the establishment of an airway, provision of ventilation, hemorrhage control, stabilization of fractures, and if indicated, immobilization of the entire spine. Time-consuming field interventions should generally be avoided so as not to delay definitive care. For example, intravenous access may be established en route to the hospital.

Destination Criteria

The field triage criteria should be used to help define the patient destination. The destination will vary by geographic area. In some cases, a Level III center may be the highest-level center within a reasonable transport distance. In other cases, there may be a number of Level I and Level II trauma centers clustered within a relatively small geographic and temporal distance. It is incumbent upon the trauma system leadership, most often a governmental agency, to ensure that destination protocols are developed for each region and that they are based on the maxim "right patient, right place, and right time." Every effort should be made to get the patient to the right place the first time, except in extremes of distance or travel conditions. To take this idea a step further, ideally the right team should meet the patient. Direct linkage of the triage criteria, destination protocols, and trauma team activation criteria is desirable.

The same decision points (particularly the physiologic criteria) that lead prehospital personnel to determine that a particular patient's needs will be best met in a high-level trauma center should also trigger an appropriate level of trauma team activation at that center. If the trauma team is being overactivated, it means that patients are being overtriaged and that the destination criteria, the field triage guidelines, or the application of those guidelines by prehospital personnel should be adjusted. These adjustments should involve multidisciplinary performance improvement processes for the ongoing monitoring and refinement of the triage, destination, and activation processes.

Overtriage and Undertriage

The prehospital trauma system is driven by the goal of getting the right patient to the right place at the right time. Lack of clear criteria or an unwillingness to follow established criteria may result in overtriage (minimally injured patients transported to higher-level trauma centers) and undertriage (severely injured patients transported to lower-level trauma centers or other acute care facilities) of patients. In general, priority has been given to reduction of undertriage, because undertriage may result in preventable mortality or morbidity from delays in definitive care. Although overtriage has minimal adverse medical consequences for the patient, it results in excessive costs and burden for higher-level trauma centers in the routine care of injured patients. However, in disaster and mass casualty events, overtriage can adversely affect patient care and survival and should be minimized. The trauma community should be more concerned about undertriage and the medical consequences that result from inadequate use of a trauma system. Rigorous multidisciplinary performance improvement is essential to evaluate overtriage and undertriage rates to attain the optimal goal of less than 5 percent undertriage (CD 3–3). This care should neither overburden the receiving trauma centers with minimally injured patients nor unnecessarily transport minimally injured patients long distances.

To ensure the efficient flow of trauma patients to appropriate destinations, trauma center bypass (diversion) should be held to an absolute minimum. Additionally, when diversion becomes necessary, there must be a specific process and procedure in place to alert prehospital personnel and surrounding trauma centers. The trauma director must be involved in the development of the trauma center's bypass (diversion) protocol (CD 3–4). The trauma surgeon must be involved in the decision regarding bypass (diversion) each time the center goes on bypass (CD 3–5). The trauma center must not be on bypass (diversion) more than 5 percent of the time (CD 3–6).

When a trauma center is required to go on bypass or to divert, the center must have a system to notify dispatch and EMS agencies (CD 3–7). The center must do the following:

- Prearrange alternative destinations with transfer agreements in place.
- Notify other centers of divert or advisory status.
- Maintain a divert log.
- Subject all diverts and advisories to performance improvement procedures.

EMS Patient Records

The prehospital patient care record should include the type and mechanism of injury; the anatomic and physiologic condition of the patient; relevant times of the incident; extrication; on-scene care; and the timing of, and response to, interventions. Documentation of these events allows personnel in the trauma center to have an understanding of the event and the potential for injuries. Some programs have found photographs to be useful, but obtaining them should not delay the process of care. The degree of damage to a motor vehicle and descriptions of other high-velocity mechanisms should be reported, especially if the patient seems to have minimal injuries. This information prompts hospital personnel to evaluate the patient for occult injuries. Accurate, promptly available EMS patient care records also are essential for building trauma registries.

As electronic prehospital patient care reports become the norm, trauma center leadership is crucial to ensuring the immediate transmission and integration of those records. Missing or delayed prehospital patient care reports should be noted as part of the multidisciplinary performance improvement process and corrective actions taken to increase compliance with established benchmarks for timeliness, completeness, and accuracy. Some trauma programs have found that EMS "time-outs" to allow for the unfettered exchange of a patient summary are useful in ensuring continuity of care. This is particularly true if written or electronic prehospital summaries are not left at the trauma center at the time of patient handoff.

Air Transportation

Air medical transportation has become an important method of rapidly transporting injured patients from the scene or the transferring facility to a trauma center. Criteria and procedures for requesting air medical transport should be developed and monitored as part of the trauma performance improvement process. A structured air medical safety program should be in place to guide prehospital personnel in establishing a safe landing site, proper loading procedures, communications with pilots and medical personnel, and safe procedures in proximity to an operating helicopter. The National Association of EMS Physicians has developed air medical dispatch guidelines. On-line and off-line medical direction is invaluable in the determination of appropriate air medical care. The medical flight crew should have a structured air medical educational curriculum and an ongoing performance improvement program that is integrated with the trauma system performance improvement program.

Additional Issues

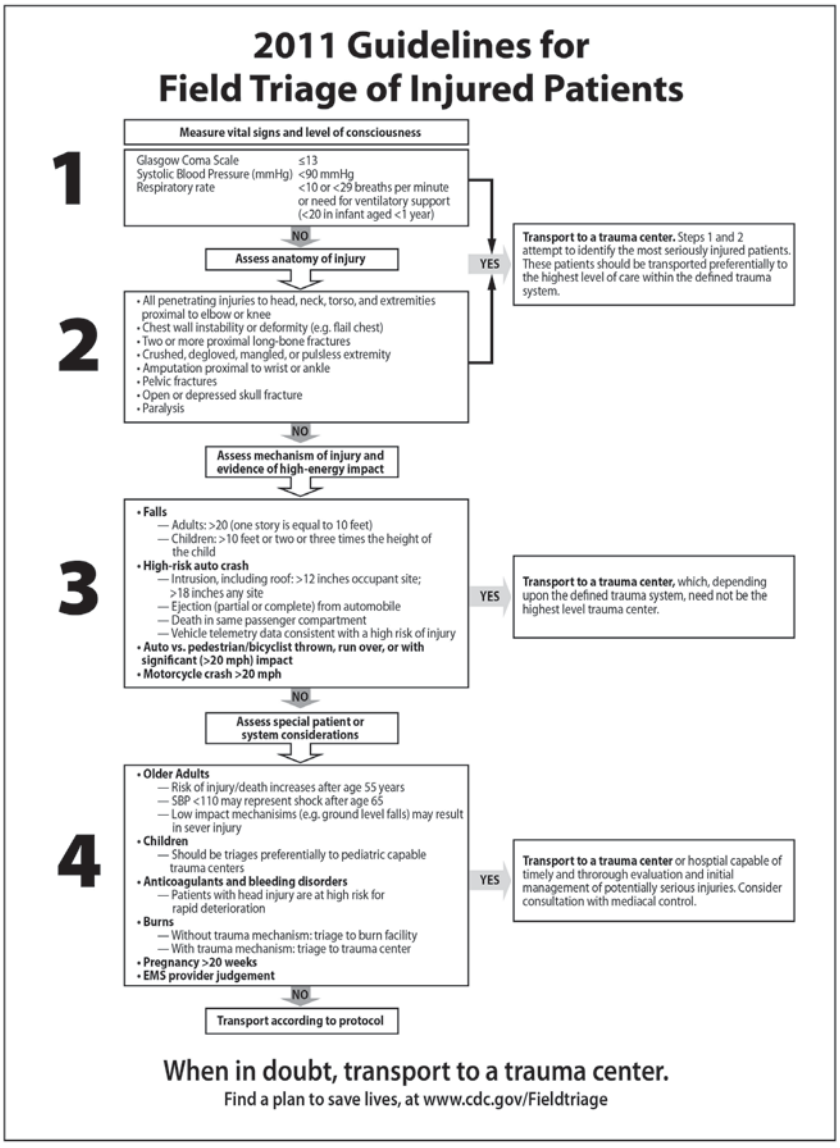
The decision to withhold or terminate resuscitation efforts in the field is difficult. To assist in developing protocols for on-line and off-line medical direction after traumatic cardiopulmonary arrest, the American College of Surgeons Committee on Trauma (ACS-COT) and the National Association of EMS Physicians have developed evidence-based guidelines that define when termination of resuscitation is appropriate. (See *www.facs.org/quality-programs/trauma/vrc/resources* to access Guidelines for Withholding or Termination of Resuscitation in Prehospital Traumatic Cardiopulmonary Arrest.)

Prehospital trauma care should emphasize the safety of patients and EMS personnel both at the scene and in transport. Communicable diseases, such as hepatitis infections and AIDS, are a significant potential risk for prehospital personnel. Compliance with Occupational Safety and Health Administration standards is mandatory, and training should emphasize these standards. All prehospital responders should use appropriate personal protective equipment.

The integration and utilization of prehospital personnel during large-scale emergencies is critical to the appropriate use of all system assets. Training in the National Incident Management System (NIMS) at appropriate levels should be encouraged. Frequent exercises to maintain skill levels also are encouraged.

An expert panel representing EMS, emergency medicine, trauma surgery, and public health recently revised the field triage decision scheme originally developed by the ACS-COT (see Figure 1). The panel was convened by the Centers for Disease Control and Prevention (CDC), with support from the National Highway Traffic Safety Administration (NHTSA). The contents of the field triage decision scheme are the views of the expert panel and do not necessarily represent the official views of the CDC or the NHTSA.

Figure 1



Source: Sasser SM, Hunt RC, Faul M, et al; Centers for Disease Control and Prevention. Guidelines for field triage of injured patients: recommendations of the National Expert Panel on Field Triage, 2011. *MMWR Recomm Rep*. 2012;61(RR-1):1-20. Available at: www.facs.org/quality-programs/trauma/vrc/resources.

Monitoring Overtriage and Undertriage

A trauma system should establish and monitor acceptable rates of undertriage and overtriage. *Undertriage* is defined as a triage decision that classifies patients as not needing trauma center care when, in fact, they do. This classification is false-negative triage. Undertriage is a medical problem. It may result in an adverse patient outcome. The receiving medical facility may not be adequate to diagnose and treat the trauma victim.

Defining acceptable levels of undertriage is dependent on how one defines patients requiring trauma center care (major trauma patients). One method is to identify all the potentially preventable deaths that occur within a regionalized trauma system. Undertriaged patients would be those who were taken to a non–trauma center hospital and then died of potentially preventable causes. By using this method, a target undertriage rate should be 1 percent or less.

Another method is to determine how many major trauma patients were transported incorrectly to a non–trauma center. If an Injury Severity Score of 16 or more is used to define major trauma patients, undertriaged patients would be patients with an Injury Severity Score of 16 or more who were taken to a non–trauma center hospital. By using this method, an acceptable undertriage rate could be as high as 5 percent.

Overtriage is a decision that incorrectly classifies a patient as needing trauma center care, although retrospective analysis suggests that such care was not needed. Overtriage results in overutilization of finite resources (financial and human) and, as such, is also important to monitor. Overtriage commonly is calculated by classifying major trauma patients by using standard registry criteria. One example, as originally introduced with the Major Trauma Outcome Study, would be patients who died or who were admitted to the hospital for more than 48 hours, admitted to an intensive care unit, or taken to the operating room. The patients triaged to the trauma center who did not meet these criteria become the numerator. The total number of patients triaged to the trauma center would be the denominator. Most agree that an acceptable percentage of overtriage is in the range of 25 to 35 percent.

Figure 2 provides one method for calculating overtriage and undertriage rates.

Figure 2 Matrix Method

	Not Major Trauma	Major Trauma	Total	Overtriage
Highest Level TTA	A	B	C	A/C x 100
Midlevel TTA	D	E	F	Undertriage =
No TTA	G	H	I	(E+H) / (F+I) x 100

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Interhospital Transfer

Collaboration among all the hospitals in a regional trauma system is crucial to the optimal interhospital transfer of patients. The development of mutually agreed upon written guidelines for the transfer of trauma patients between institutions is an essential part of a trauma system. These agreements should define which patients should be transferred and the process for doing so. Elucidating each hospital's treatment capabilities, as well as regional transportation options, is the first step. This information is then used to develop guidelines for rapid resuscitation, identification of injured patients who require a higher level of care, transportation options, and two-way communication of performance improvement and patient safety (PIPS) issues between hospitals. The best plans are carefully considered, mutually approved, written, and frequently reviewed.

These guidelines and agreements for trauma patient transfer are *not* the classic transfer agreements of the past, in which the main purpose of the documents was to ensure the acceptance of the trauma patient by the receiving facility. With current Emergency Medical Treatment and Labor Act (EMTALA) laws, this purpose is moot, as institutions with capabilities greater than the hospital transferring the patient are required to accept the patient. These guidelines and agreements should be crafted with the full support of trauma center administration and leadership.

The trauma patient transfer guidelines should include, at a minimum, (1) identification of patients/injuries that require transfer; (2) methods for physician-to-physician communication between facilities and discussion of patient injuries, current treatments, and agreement on transportation mode; (3) transportation guidelines as to when to consider ground vs. air medical transportation and what type of personnel are recommended (for example, emergency medical technician, paramedic, and registered nurse); and (4) documentation requirements, which may include a mutually agreed upon transfer form as an attachment and a process for identification and communication of patient safety and performance improvement issues, including responsible parties and contacts for each institution.

There are identifiable injuries and combinations of injuries that result in high mortality, even when patients are managed in Level I and II trauma centers. Patients with such critical injuries should be considered for early transfer. Injury patterns often requiring early transfer from Level III centers to a higher center are outlined in Table 1. Obviously, Level IV centers and other community or critical access hospitals without surgical capabilities should not delay transfer to obtain studies that would be needed to identify those specific injuries. Table 1 shows examples of criteria for transfer from hospitals with limited or no surgical capability. These criteria are intended to prompt consideration for transfer and are not inclusive or hospital-specific.

Table 1 Criteria for Consideration of Transfer from Level III Centers to Level I or II Centers

1. Carotid or vertebral arterial injury.
2. Torn thoracic aorta or great vessel.
3. Cardiac rupture.
4. Bilateral pulmonary contusion with Pao_2:Flo_2 ratio less than 200.
5. Major abdominal vascular injury.
6. Grade IV or V liver injuries requiring transfusion of more than 6 U of red blood cells in 6 hours.
7. Unstable pelvic fracture requiring transfusion of more then 6 U of red blood cells in 6 hours.
8. Fracture or dislocation with loss of distal pulses.
9. Penetrating injuries or open fracture of the skull.
10. Glasgow Coma Scale score of less than 14 or lateralizing.
11. Spinal fracture or spinal cord deficit.
12. Complex pelvis/acetabulum fractures.
13. More than two unilateral rib fractures or bilateral rib fractures with pulmonary contusion (if no critical care consultation is available).
14. Significant torso injury with advanced comorbid disease (such as coronary artery disease, chronic obstructive pulmonary).

Once the decision for transfer has been made, it is the responsibility of the referring physician to initiate resuscitation measures within the capabilities of the local hospital. The Advanced Trauma Life Support® (ATLS®) program offers one proven method to accomplish this task (see the *ATLS Student Course Manual*). The referring physician should select a mode of transport according to the patient's needs so that the level of care is appropriate during transport. Direct physician-to-physician contact is essential (CD 4–1). Specifically, the accepting trauma surgeon should review the current physiologic status of the injured patient and discuss the initial management and the optimal timing of transfer. For example, it may be in the best interest of an injured patient to undergo a "damage control" operation for ongoing hemorrhage before transfer if a qualified surgeon and operating room resources are promptly available. However, delay of transfer to perform tests such as computed tomography scans in hospitals with no surgical capability only delays definitive care and should be avoided.

The decision to transfer an injured patient to a specialty care facility in an acute situation must be based solely on the needs of the patient and not on the requirements of the patient's specific provider network (for example, a health maintenance organization or a preferred provider organization) or the patient's ability to pay (CD 4–2). The subsequent decisions regarding transfer to a facility within a managed care network should be made only after stabilization of the patient's condition and in accordance with the American College of Surgeons Statement on Managed Care and the Trauma System. See the American College of Surgeons' ACS Verification, Review, & Consultation Program resources website at *www.facs.org/quality-programs/trauma/vrc/resources*.

Level IV trauma centers should refer to the Rural Trauma Team Development Course,© as well as to Appendix XI of the textbook. Interfacility Transfer of Injured Patients—Guidelines for Rural Communities, for guidance on the criteria for transferring patients to higher-level facilities. The transfer guidelines are also available at *www.facs.org/quality-programs/trauma/vrc/resources*.

Federal legislation through the Consolidated Omnibus Budget Reconciliation Act (COBRA) of 1987 (Public Law 100–203) imposes civil penalties on individual practitioners and hospitals failing to provide emergency care in a timely manner. This "antidumping" law, EMTALA, was designed to prevent the transfer of patients based solely on the patient's ability to pay.

Additional elements in EMTALA relative to the obligations of the referring physician and facility include the following:

- Identifying a facility with available space and qualified personnel that has agreed to accept the patient before beginning the transfer.
- Not transferring patients in hemodynamically unstable condition, except for medical necessity and only after providing medical treatment within the facility's capacity that minimizes the risks to the individual's health. (In hospitals with no surgical availability, hemodynamic stability may never occur, and delaying transportation past intravenous access, blood and fluid resuscitation, and possibly pelvic binder may prove fatal.)
- Providing appropriate transportation with a vehicle augmented with life support equipment and staff to meet the anticipated contingencies that may arise during transportation.
- Sending all records, test results, radiologic studies, and other relevant reports or data with the patient to the referring facility unless delay would increase the risks of transfer, in which case the information should be sent as soon as possible.
- Issuing a provider transfer certificate and consent for transfer to accompany the patient.

Receiving hospitals also have obligations under EMTALA. Hospitals that have entered into a Medicare provider agreement and have specialized capabilities or facilities are obligated to accept the appropriate transfer of patients requiring such services if the hospitals have the capacity to treat them. Institutional definitions of *capacity* should be routinely reviewed by the trauma PIPS process to ensure that critically injured patients are appropriately accepted and care is not delayed.

A very important aspect of interhospital transfer is an effective PIPS program that includes evaluating transport activities (CD 4–3). These activities can be accomplished in a number of ways, depending on the transport service. Regardless of how the process is accomplished, the receiving hospital should have input from, feedback to, and adequate communication with the personnel responsible for the transport process and the referring hospital to ensure that problems occurring during and associated with transport are addressed in a timely manner. The input, feedback, and communication also should include recognition of transportation efforts that are consistent with optimal care.

Guidelines for Transferring Patients

Transferring physician responsibilities:

- Identify patients needing transfer.
- Initiate the transfer process by direct contact with the receiving trauma surgeon.
- Initiate resuscitation measures within the capabilities of the facility.
- Determine the appropriate mode of transportation in consultation with the receiving surgeon.
- Transfer all records, test results, and radiologic evaluations to the receiving facility.
- Perform a PIPS review of all transfers (CD 4–3).

Receiving physician responsibilities:

- Ensure that the resources required to care for the patient are available at the receiving facility.
- Provide consultation to the referring physician regarding specifics of the transfer, additional evaluation, or resuscitation before transport.
- Once transfer of the patient is established, clarify who will provide medical control of the patient during transport.
- Identify a PIPS process for transportation, allowing feedback from the receiving trauma surgeon to the transport team directly, or at least to the medical director for the transport team and the referring hospital.
- Provide feedback to the transferring facility regarding the patient's condition, plan of care, and any PIPS issues identified.

Management during transport:

- Ensure that qualified personnel and equipment are available during transport to meet anticipated contingencies.
- Make sure that sufficient supplies—such as intravenous fluids, blood, and medications, as appropriate–accompany the patient during transport.
- Monitor vital signs frequently.
- Support vital functions (for example, provide ventilation and spinal protection, and support hemodynamics and the central nervous system).
- Keep records during transport, and provide them to the receiving facility during patient handoff. Maintain communication with on-line medical direction during transport.

Trauma system responsibilities:

- Ensure prompt transport once a transfer decision is made.
- Review all transfers for PIPS.
- Ensure that transportation resources are commensurate with the patient's severity of injury.

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Hospital Organization and the Trauma Program

A decision by a hospital to become a trauma center requires the commitment of the institutional governing body and the medical staff (CD 5–1). The commitment and collaboration of these two bodies are necessary to facilitate the allocation of resources and the development of programs designed to improve the care of injured patients. The elements of a trauma program include the following: (1) hospital organization; (2) medical staff support; (3) the trauma medical director (TMD); (4) the trauma resuscitation team; (5) the trauma service; (6) the trauma program manager (TPM); (7) the trauma registrar; (8) the performance improvement support personnel; and (9) the multidisciplinary trauma peer review committee of the performance improvement and patient safety (PIPS) program.

Hospital Organization

The hospital's administrative structure must support the trauma program. The TPM should report to an administrative level that best supports the role and responsibilities of the position, as well as to the TMD. Documentation of administrative commitment is required from the governing body and the medical staff (CD 5–1) (Table 1). This support must be reaffirmed continually (every 3 years) and must be current at the time of verification (CD 5–2). Administrative support of the trauma program helps provide adequate resources for the optimal care of injured patients. The administrative representative works closely with the TMD to establish and maintain the components of the trauma program. The participation of an administrator helps ensure that the written commitment to the trauma program is aligned with optimal multidisciplinary trauma care.

Table 1 Hospital Commitment

Resolved, that the XYZ Hospital Board of Directors (or other administrative governing authority) approves the establishment of a Level __ trauma center (or "applies for verification or reverification of a Level __ trauma center"). The Board commits to maintain the high standards needed to provide optimal care of all trauma patients. The multidisciplinary trauma performance improvement program has the authority to evaluate care across disciplines, identify opportunities for improvement, and implement corrective actions.

Medical Staff Support

Resolved, that the Medical Staff or Executive Committee of XYZ Hospital (or other governing body of the medical staff) supports the establishment of a Level __ trauma center (or "supports verification or reverification of a Level __ trauma center"). This statement acknowledges the commitment to provide specialty care as required to support optimal care of trauma patients. The multidisciplinary trauma performance improvement program has the authority to evaluate care across disciplines, identify opportunities for improvement, and implement corrective actions.

Physician Liaison Commitment

Resolved, that XYZ liaison and trauma surgeons acknowledge and commit to the criterion expectations for a Level __ trauma center. This includes but is not limited to credentialing, certification, continuing education, and adequate involvement in performance improvement. The multidisciplinary trauma performance improvement program has the authority to evaluate care across disciplines, identify opportunities for improvement, and implement corrective actions.

The administrative structure of the hospital should demonstrate institutional support and commitment and must include an administrator, TMD, and TPM. Sufficient authority for the trauma program to achieve all programmatic goals should be reflected in the organizational structure. Administrative support includes human resources, educational activities, and community outreach activities to enable community cooperation and a systematic approach to the care of injured patients (see Chapter 17, Education and Outreach). Adequate funding of the trauma program is the direct responsibility of the institution.

Medical Staff Support

Medical staff commitment ensures that the members of the medical staff support the trauma program by their professional activities. This support includes a current written commitment acknowledging the medical staff's willingness to provide enough specialty care to support the optimal care of injured patients (see Table 1). The support must be reaffirmed continually (every 3 years) and must be current at the time of verification (CD 5–3).

The Trauma Program

The trauma program must involve multiple disciplines and transcend normal departmental hierarchies (CD 5–4). Because optimal care extends from the scene of an injury through the acute care setting to discharge from a rehabilitation center, the trauma program should have appropriate specialty representation from all phases of care. Representatives of all disciplines provide the appropriate skills as team members working in concert to implement treatment based on a prioritized plan of care.

The Trauma Medical Director

The TMD is a general surgeon who leads the multidisciplinary activities of the trauma program. The TMD must be a current board-certified general surgeon (or a general surgeon eligible for certification by the American Board of Surgery according to current requirements) or a general surgeon who is an American College of Surgeons Fellow with a special interest in trauma care and must participate in trauma call (CD 5–5). The TMD must be current in Advanced Trauma Life Support® (ATLS®) (CD 5–6). The TMD must maintain an appropriate level of trauma-related extramural continuing medical education (16 hours annually, or 48 hours in 3 years) (CD 5–7) (see Chapter 6, Clinical Functions: General Surgery).

Membership and active participation in regional or national trauma organizations are essential for the trauma director in Level I and II trauma centers and are desirable for TMDs in Level III and IV facilities (CD 5–8). Organizations that are acceptable for Level I TMDs include the American Association for the Surgery of Trauma (AAST), Eastern Association for the Surgery of Trauma (EAST), American College of Surgeons Committee on Trauma (ACS-COT), Western Trauma Association (WTA), Society of Critical Care Medicine (SCCM), and regional committees on trauma (including past and present region chiefs, state/provincial chairs and vice-chairs, or international chairs). Membership in the ACS-COT state committees on trauma is not equivalent to membership in national trauma organizations. A Level II TMD meets this requirement by active participation on the state regional council/advisory committee. Membership in the American Pediatric Surgical Association (APSA) does not fulfill this requirement for pediatric TMDs.

The TMD's responsibility extends far beyond the technical skills of surgery. The TMD must have the authority to manage all aspects of trauma care (CD 5–9). The TMD must chair and attend a minimum of 50 percent of the multidisciplinary trauma peer review committee meetings (CD 5–10). The TMD authorizes trauma service privileges of the on-call panel, works in cooperation with the nursing administration to support the nursing needs of trauma patients, develops treatment protocols along with the trauma team, and coordinates the performance improvement and peer review processes. The TMD, in collaboration with the TPM, must have the authority to correct deficiencies in trauma care and exclude from trauma call the trauma team members who do not meet specified criteria (CD 5–11). In addition, the TMD must perform an annual assessment of the trauma panel providers in the form of Ongoing Professional Practice Evaluation (OPPE) and Focused Professional Practice Evaluation (FPPE) when indicated by findings of the PIPS process (CD 5–11). The TMD should identify representatives from neurosurgery, orthopaedic surgery, anesthesiology, emergency medicine, and other appropriate disciplines to determine which physicians from their disciplines are qualified to be members of the trauma program and on-call panel. With the assistance of the hospital administrator and the TPM, the TMD should coordinate the budgetary process for the trauma program.

The TMD must have the responsibility and authority to ensure compliance with the above requirements and may not direct more than one trauma center (CD 5–12).

The Trauma Resuscitation Team

The trauma resuscitation team consists of physicians, nurses, and allied health personnel. The size and composition of the team may vary with hospital size, the severity of injury, and the corresponding level of trauma team activation. A high-level response to a severely injured patient usually includes the following: (1) a general surgeon; (2) an emergency physician; (3) surgical and emergency residents; (4) emergency department nurses; (5) a laboratory technician; (6) a radiology technologist; (7) a critical care nurse; (8) an anesthesiologist or certified registered nurse anesthetist; (9) an operating room nurse; (10) security officers; (11) a chaplain or social worker; and (12) a scribe. In contrast, the trauma resuscitation team in response to a less severely injured patient usually consists of only an emergency physician and the emergency department nurses until the general surgeon arrives.

In hospitals with limited resources, trauma team members may be drawn from available physicians and nursing and allied health personnel. The team leader should be a general surgeon. In small rural hospitals where no general surgeon or emergency physician is available, the leader may be a primary care physician, physician assistant, nurse practitioner, or nurse who coordinates stabilization and transfer to definitive care. The criteria for a graded activation must be clearly defined by the trauma center, with the highest level of activation including the six required criteria listed in Table 2 (CD 5–13). Typically, trauma centers have a tiered trauma activation that is based on predetermined prehospital criteria. The prehospital information used includes physiologic, anatomic, mechanism of injury criteria, along with comorbid conditions. The field triage decision scheme, as outlined in Figure 1, Chapter 3, should be used to guide the levels of activation.

In Level I and II trauma centers, the highest level of activation requires the response of the full trauma team within 15 minutes of arrival of the patient, and the criteria should include physiologic criteria and some or several of the anatomic criteria (CD 5–14). In Level III and IV trauma centers, the team must be fully assembled within 30 minutes (CD 5–15). The limited response criteria may include some anatomic criteria, as well as high-risk mechanisms of injury.

Table 2 Minimum Criteria for Full Trauma Team Activation

- Confirmed blood pressure less than 90 mm Hg at any time in adults and age-specific hypotension in children;
- Gunshot wounds to the neck, chest, or abdomen or extremities proximal to the elbow/knee;
- Glasgow Coma Scale score less than 9 with mechanism attributed to trauma;
- Transfer patients from other hospitals receiving blood to maintain vital signs;
- Intubated patients transferred from the scene, - OR -
- Patients who have respiratory compromise or are in need of an emergent airway
  - Includes intubated patients who are transferred from another facility with ongoing respiratory compromise (does not include patients intubated at another facility who are now stable from a respiratory standpoint)
- Emergency physician's discretion

To meet this requirement, most trauma centers have a multitiered trauma team activation protocol. Even though facilities may have different nomenclature to identify various activation levels, the intent is that there will be levels commensurate with "full" and "limited" activation levels, as described in Table 3. The limited activation criteria should be based on high-risk mechanisms of injury.

Table 3 An Example of a Tiered Trauma Team Activation Protocol

<table>
<tr><th colspan="4">FULL Trauma Team Criteria
Persons who sustain injury with any of the following</th><th>LIMITED Trauma Team Criteria
Persons who sustain injury with any of the following</th></tr>
<tr><td colspan="4">PRIMARY SURVEY: PHYSIOLOGIC</td><td rowspan="2">MECHANISM OF INJURY
• Falls: adult >20 ft; child >10 ft or 3× height
• Fall from any height if anticoagulated older adult
• High-risk auto crash with:
- Intrusion of vehicle >12″ in occupant compartment; >18″ in other site
- Ejection (partial or complete) from automobile
- Death in same passenger compartment
• Auto vs. pedestrian/cyclist thrown, run over, or with significant (>20 mph) impact
• Motorcycle crash >20 mph
• High-energy dissipation or rapid decelerating incidents, for example:
- Ejection from motorcycle, ATV, animal, and so on
- Striking fixed object with momentum
- Blast or explosion
• High-energy electrical injury
• Burns >10% TBSA (second or third degree) and/or inhalation injury
• Suspicion of hypothermia, drowning, hanging
• Suspected nonaccidental trauma
• EMS provider judgment
• Blunt abdominal injury with firm or distended abdomen or with seatbelt sign</td></tr>
<tr><td>Airway</td><td>Unable to adequately ventilate Intubated or assisted ventilation</td><td colspan="2">Unable to adequately ventilate Intubated or assisted ventilation</td></tr>
<tr><td>Breathing</td><td>Respiratory rate <10 or >29 per minute</td><td colspan="2">Any sign of respiratory insufficiency (hypoxia, accessory muscle use, grunting)</td></tr>
<tr><td>Circulation</td><td>SBP <90 mm Hg perfusion</td><td colspan="2">Any sign of abnormal (capillary refill >2 secs, BP low for age)</td></tr>
<tr><td></td><td></td><td>Age
<1 y
1–10 y
>10 y</td><td>SBP (mm Hg)
<60
<70 + 2× age
<90</td></tr>
<tr><td>Deficit</td><td>GCS motor score ≤5, GCS ≤13</td><td colspan="2">AVPU: responsive to pain or unresponsive</td></tr>
<tr><td colspan="4">• Deterioration of previously stable patient
• Transfers requiring blood transfusion</td><td></td></tr>
<tr><td colspan="4">SECONDARY SURVEY: ANATOMIC
• Penetrating injuries to the head, neck, torso, or extremities proximal to the elbow/knee
• Open or depressed skull fracture
• Paralysis or suspected spinal cord injury
• Flail chest
• Unstable pelvic fracture
• Amputation proximal to the wrist or ankle
• Two or more proximal long bone fractures (humerus or femur)
• Crushed, degloved, or mangled extremity</td><td></td></tr>
</table>

SBP indicates systolic blood pressure; BP, blood pressure; GCS, Glasgow Coma Scale score; AVPU, alert, verbal, pain, unresponsive; ATV, all-terrain vehicle; TBSA, total body surface area; and EMS, emergency medical services.

Other potential criteria for trauma team activation that have been determined by the trauma program to be included in the various levels of trauma activation must be evaluated on an ongoing basis in the PIPS process (CD 5–16) to determine their positive predictive value in identifying patients who require the resources of the full trauma team. This important performance improvement activity should lead to appropriate evidence-based revisions in the criteria for the levels of trauma activation.

Linkage of Prehospital Trauma Triage to Trauma Team Activation

The initial assessment and evaluation of severely injured trauma patients should begin with emergency medical dispatch (EMD) and prehospital systems of care and then seamlessly transition through the emergency department and hospital phases of care. There should be concordance among the field triage criteria, destination protocols, and the trauma team activation criteria. Prehospital providers should have the authority to call for a trauma team activation based on agreed-upon criteria, most often involving physiologic and anatomic findings in the field. Multidisciplinary performance improvement is essential to refining the undertriage and overtriage rates and the appropriateness of prehospital-based trauma team activations. The emergency physicians and trauma surgeons should work closely to ensure appropriate and timely activation of the trauma team to allow surgeon arrival prior to the arrival of the severely injured patient. A preplanned and coordinated approach should be defined for patients who do not arrive at the highest level of activation. These patients may need consultation or admission by the trauma service or other specialty services. The emergency physician may initially evaluate the limited-tier trauma patient, but the center must have a clearly defined response expectation for the trauma surgical evaluation of those patients requiring admission (CD 5–16).

All team members, including on-call specialists, should coordinate their interventions as defined by established principles and guidelines. The team leader ensures that each phase of care flows in continuity. During the resuscitation phase, the general surgeon, emergency physician, and anesthesiologist may work simultaneously. During operative care, multiple surgical specialists may work simultaneously and ensure that the working environment facilitates correct and timely decisions. Teamwork is important and extends throughout all aspects of care.

The Trauma Service

A trauma service represents the primary structure for providing care for injured patients. The service includes personnel and other resources necessary to ensure the appropriate and efficient provision of care. The precise nature of a trauma service may vary based on specific needs of the medical facility, available personnel, and the quantity of resources. In a Level I or II trauma center, seriously injured patients must be admitted to, or evaluated by, an identifiable surgical service staffed by credentialed trauma providers (CD 5–17). Programs that admit more than 10 percent of injured patients to nonsurgical services must review all nonsurgical

admissions through the trauma PIPS process (CD 5–18). Sufficient infrastructure and support to ensure adequate provision of care must be provided for this service (CD 5–19). To be sufficient, the infrastructure and support may require additional qualified physicians, residents, nurse practitioners, physician's assistants, or other physician extenders. The volume of patients requiring care and the complexity of their conditions should determine the number and type of individuals required for a trauma service. In teaching facilities, the requirements of the residency review committees must be met (CD 5–20).

In Level III centers, injured patients may be admitted to individual surgeons, but the structure of the program must allow the trauma director to have oversight authority for the care of these patients (CD 5–17). Programs that admit more than 10 percent of injured patients to nonsurgical services must review all nonsurgical admissions through the trauma PIPS process (CD 5–18). There must be a method to identify the injured patients, monitor the provision of health care services, make periodic rounds, and hold formal and informal discussions with individual practitioners (CD 5–21). These activities may be carried out by the TPM in conjunction with the TMD at a frequency commensurate with the volume of trauma admissions. In this model, it becomes particularly important for team members to attend trauma committee meetings regularly and participate in peer review activities.

The Trauma Program Manager

The TPM is fundamental to the development, implementation, and evaluation of the trauma program. In addition to administrative ability, the TPM must show evidence of educational preparation and clinical experience in the care of injured patients (CD 5–22).

In Level I and II trauma centers, the TPM should hold membership and actively participate in regional or national trauma organizations. Examples of these organizations include, but are not limited to, the following: (1) Society of Trauma Nurses; (2) American Association of Critical Care Nurses; (3) Emergency Nurses Association; (4) EAST (associate member); (5) Society of Critical Care Medicine; (6) American Burn Association; and (7) trauma organizations of various trauma nursing specialties.

The TPM works in close collaboration with the TMD and complements the director's efforts. A constructive, mutually supportive relationship between these key leaders is important to the success of the program.

In Level I and II trauma centers, the TPM must be full-time and dedicated to the trauma program (CD 5–23). The TPM is usually a registered nurse and is responsible for the organization of services and systems necessary for a multidisciplinary approach to providing care to injured patients. The TPM, in particular, assumes day-to-day responsibility for process and performance improvement activities as they relate to nursing and ancillary personnel and assists the TMD in carrying out the same functions for the physicians. Ultimate accountability for all activities of the trauma program resides with the TMD. The role of the TPM in the educational, clinical, research, administrative, and outreach activities of the trauma program is determined by the needs of the TMD and the institution.

Administrative and budgetary support needed for the TPM depends on the size of the program. A comparable level of secretarial and clinical nursing personnel helps fulfill needs for outreach, concurrent performance improvement, and discharge planning. The registry staff, injury prevention coordinator, and trauma nurse clinician(s) should be supervised by the TPM. Table 4 outlines the expectations pertaining to TPM commitment at each trauma center level.

Table 4 Trauma Program Manager Commitment

Level	Require TPM	Full-time and dedicated	Separate pediatric TPM or coordinator
Level I trauma center	Yes	Yes	No
Level II trauma center	Yes	Yes*	No
Level III and IV trauma centers	Yes	No	No
Pediatric Level I trauma center	Yes	Yes	No
Pediatric Level II trauma center	Yes	Yes*	No
Level I trauma center and Level I pediatric trauma center	Yes	Yes	Yes
Level I trauma center and Level II pediatric trauma center	Yes	Yes	Yes
Level II trauma center and Level II pediatric trauma center	Yes	Yes**	No**

*It is expected that a TPM is 1 FTE in a Level II trauma center and may also serve as the prevention coordinator.

**In a Level II trauma center and Level II pediatric trauma center, the roles of both TPM and pediatric TPM may be fulfilled by the same person.

The TPM must show evidence of educational preparation, with a minimum of 16 hours (internal or external) of trauma-related continuing education per year and clinical experience in the care of injured patients (CD 5–24). There should be a written job description that defines sufficient authority to do the job and clearly outlines the responsibilities of the individual. Qualifications and activities should include the following:

- **Clinical activities:** Coordinate management across the continuum of trauma care, which includes the planning and implementation of clinical protocols and practice management guidelines, monitoring care of in-hospital patients, and serving as a resource for clinical practice.

- **Education responsibilities:** Provide for intrafacility and regional professional staff development, participate in case review, implement practice guidelines, and direct community trauma education and prevention programs.
- **Performance improvement:** Monitor clinical processes and outcomes and system issues related to the quality of care provided; develop quality filters, audits, and case reviews; identify trends and sentinel events; and help outline remedial actions while maintaining confidentiality.
- **Administration:** Manage, as appropriate, the operational, personnel, and financial aspects of the trauma program. Serve as a liaison to administration, and represent the trauma program on various hospital and community committees to enhance and foster optimal trauma care.
- **Supervision of the trauma registry:** Supervise collection, coding, scoring, and developing processes for validation of data. Design the registry to facilitate performance improvement activities, trend reports, and research while protecting confidentiality.
- **Consultant and liaison:** Stabilize the complex network of the many disciplines that work in concert to provide high-quality care. Serve as an internal resource for staff in all departments, and act as a liaison for EMS agencies.
- **Research:** Have an active involvement in research projects and the analysis and distribution of findings. Facilitate protocol design for accurate data collection, feedback, and analysis.
- **Community and national involvement in trauma care systems:** Participate in the development of trauma care systems at the community, state, provincial, or national levels.

The Trauma Registrar

The trauma registrar is an important member of the trauma team. Additional information is provided in Chapter 15, Trauma Registry.

Performance Improvement Support Personnel

In addition to the registrar or registrars, the trauma program may utilize other personnel for concurrent data abstracting, analysis, and report development. If additional support is necessary, these personnel should report to the TPM. Additional information is provided in Chapter 16, Performance Improvement and Patient Safety.

Performance Improvement and Patient Safety Program: Multidisciplinary Trauma Peer Review Committee

The trauma center's PIPS program must have a multidisciplinary trauma peer review committee chaired by the TMD (CD 5–25). The exact format of the committee may be hospital-specific, but it must be multidisciplinary, consisting of hospital and medical staff members, prehospital personnel, and other system-related personnel.

This committee assesses, addresses, and corrects global trauma program and system issues. The committee has a defined process in place, includes all program-related services, meets regularly, takes attendance, has minutes, and works to correct overall program deficiencies to continue to optimize patient care. Chapter 16, Performance Improvement and Patient Safety, covers the operations of this committee in greater detail.

Supplemental Readings

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Clinical Functions: General Surgery

The general surgeon is the foundation of a trauma hospital's trauma program. The director of the trauma service is a general surgeon who oversees administrative aspects of the trauma program. The general surgeon leads the trauma team and is responsible for the overall care of trauma patients, including coordinating care with other specialties and maintaining continuity of care. The general surgeon is called on not only to evaluate and treat the patient but also to interpret and reconcile the recommendations of team members and consultants to optimize patient care (see Chapter 5, Hospital Organization and the Trauma Program).

The general surgeon serves as the leader of the resuscitation team and is expected to participate in the initial evaluation and resuscitation of seriously injured patients. This individual should supervise the care of patients with multisystem injuries. The general surgeon coordinates all aspects of treatment, including resuscitation, operation, critical care, recuperation, and rehabilitation or discharge.

The specialty of acute care surgery (trauma, emergency general surgery, surgical critical care) is developing and evolving. The American College of Surgeons Committee on Trauma recognizes that the general surgeon on call for trauma may also provide care for patients who present with urgent and emergent surgical problems. General surgeons on call for trauma are encouraged to participate in these important aspects of surgical care. The operative treatment of patients with urgent and emergent conditions serves to maintain and enhance the essential skills of the general surgeon required for high-quality trauma care. Moreover, management of these patients in the critical care setting provides additional opportunities to the general surgeon to hone intensive care unit skills. The trauma performance improvement program should monitor the provision of care for surgical patients and ensure that it does not interfere with the care of injured patients. An acceptable balance between clinical workload and available resources is essential.

Qualifications

General surgeons caring for trauma patients must meet certain requirements, as described herein (CD 6–1). These requirements may be considered to be in four categories: current board certification, clinical involvement, performance improvement and patient safety (PIPS), and continuing education.

Board Certification

Basic to qualification for trauma care for any surgeon is current board certification in general surgery by the American Board of Surgery, the American Osteopathic Association's American Osteopathic Board of Surgery, or the Royal College of Physicians and Surgeons of Canada. Board certification or eligibility for certification by the American Board of Surgery according to current requirements or the alternate pathway is essential for general surgeons who take trauma call in Level I, II, and III trauma centers (CD 6–2).

Certification may take several years after a residency approved by the Accreditation Council for Graduate Medical Education (ACGME) or appropriate Canadian boards. If a physician has not been certified within the time frame by the certifying board after successful completion of an ACGME or Canadian residency, the surgeon is not eligible for inclusion on the trauma team. Such a surgeon may be included when given recognition as a fellow by a major professional organization (for example, the American College of Surgeons).

Alternate Criteria (CD 6–3) for Non–Board-Certified Surgeons in Level I, II, or III Trauma Centers

General surgeons who have trained outside the United States or Canada may be eligible to participate in the trauma program through an alternate pathway procedure. For a current description of alternate pathway criteria for general surgery recognition, see *www.facs.org/quality-programs/trauma/vrc/resources*.

Clinical Involvement

In a hospital committed to trauma care, surgeons with special expertise in trauma should be identified. Qualified surgeons should be regularly involved in the care of injured patients. Participation in the organization of trauma protocols, trauma teams, trauma call rosters, and trauma rounds provides clear indicators of commitment to excellence in trauma patient care. It is important for trauma surgeons to maintain their surgical skills. Trauma surgeons must have privileges in general surgery (CD 6–4). To maintain operative skills, general surgeons should participate in elective and emergency general surgery.

In Level I and II trauma centers, the trauma surgeon on call must be dedicated to a single trauma center while on duty (CD 6–5). In addition, a published backup call schedule for trauma surgery must be available (CD 6–6).

For Level I, II, and III trauma centers, it is expected that the trauma surgeon be in the emergency department on patient arrival, with adequate notification from the field. For Level I and II trauma centers, the maximum acceptable response time is 15 minutes; for Level III and Level IV trauma centers, the maximum acceptable response time is 30 minutes. Response time will be tracked from patient arrival rather than from notification or activation. An 80 percent attendance threshold must be met for the highest-level activations (CD 2–8). Acceptable examples of activation criteria are available in Tables 2 and 3 in Chapter 5, Hospital Organization and the Trauma Program. For Level I, II, and III trauma centers, the attending surgeon is expected to be present in the operating room for all operations. A mechanism for documenting this presence is essential (CD 6–7).

Performance Improvement and Patient Safety

In Level I, II, and III trauma centers, there must be a multidisciplinary trauma peer review committee chaired by the trauma medical director (CD 5-25) and representatives from general surgery (CD 6-8), and liaisons from orthopaedic surgery (CD 9-16), emergency medicine (CD 7-11), ICU (CD 11-62), and anesthesia (CD 11-13); for Level I and II trauma centers, representatives from neurosurgery (CD 8-13) and radiology (CD 11-39) are required. The purpose of this committee is to improve trauma care by reviewing selected deaths, complications, and sentinel events with the objective of identification of issues and appropriate responses.

General surgery participation at the multidisciplinary trauma peer review committee is essential because the general surgeon is the foundation for trauma care in the trauma program. Each member of the group of general surgeons must attend at least 50 percent of the multidisciplinary trauma peer review committee meetings (CD 6–8).

Continuing Education

All general surgeons on the trauma team must have successfully completed the Advanced Trauma Life Support® (ATLS®) course at least once (CD 6–9). Active participation as an instructor for the ATLS course is desirable and should be encouraged.

It is important that all members of the trauma team be knowledgeable about current practices in trauma care. In Level I and II trauma centers, external continuing medical education (CME) is the recommended method of keeping current. The trauma medical director must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related CME (CD 5–7). Programs given by visiting professors or invited speakers are considered outside education.

It is important that other general surgeons who take trauma call be knowledgeable and current in the care of injured patients. In Level I and II trauma centers, this requirement must be met by the acquisition of 16 hours of CME per year on average or by demonstrating participation in an internal educational process (IEP) conducted by the trauma program based on the principles of practice-based learning and the PIPS program (CD 6–10).

Examples of internal CME include the following: in-service, case-based learning; educational conferences; grand rounds; internal trauma symposia; and in-house publications disseminating information gained from a local conference or an individual's recent participation (through trained analysis) reviewing a trauma center. The IEP should include presentations and discussions on a quarterly basis as a minimum. Ideally, this would be case-based learning that identifies issues through the PIPS process with appropriate dissemination to the trauma team. These presentations should be documented in the performance improvement process. The total hours acquired through an IEP should be functionally equivalent to 16 hours of CME annually.

Supplemental Readings

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Clinical Functions: Emergency Medicine

Emergency medicine and emergency physicians are important components of the trauma system and trauma team. Optimal patient care demands that trauma surgeons and emergency physicians have a good working relationship, with clearly defined areas of responsibility in the care of severely injured and low-acuity injured patients. These responsibilities and capabilities vary from hospital to hospital. Emergency physicians and trauma surgeons should have input into the development of prehospital trauma protocols, decisions involving the field triage of patients, and hospital trauma protocols. Proficiency in the care of injured patients is determined by many factors, some of which are commitment, experience, continuing education, ongoing credentialing, and current board certification.

Levels of Care

The emergency departments of Level I, II, and III trauma centers must have a designated emergency physician director supported by an appropriate number of additional physicians to ensure immediate care for injured patients (CD 7–1). A surgeon who is in charge of the surgical side of the emergency department may fulfill the designated emergency physician director role. An emergency physician must be present in the department at all times in Level I and Level II trauma centers (CD 7–2). Occasionally, in a Level III trauma center, it is necessary for the physician to leave the emergency department for short periods to address in-house emergencies. Such cases and their frequency must be reviewed by the performance improvement and patient safety (PIPS) program to ensure that this practice does not adversely affect the care of patients in the emergency department (CD 7–3). In institutions in which there are emergency medicine residency training programs, supervision must be provided by an in-house attending emergency physician 24 hours per day (CD 7–4).

The initial assessment and evaluation of severely injured trauma patients should begin with emergency medical services dispatch (EMD) and prehospital systems of care and should seamlessly transition through the emergency department and hospital phases of care. The emergency physicians and trauma surgeons should work closely to ensure appropriate and timely activation of the trauma team to allow surgeon presence prior to the arrival of a severely injured patient. Upon patient arrival, an EMS "time-out" should be performed to ensure accurate transmission of patient information. The emergency physician may begin initial assessment and treatment before the trauma surgeon arrives. Performance of diagnostic and resuscitative procedures may be shared, especially in training institutions. These roles and responsibilities must be defined, agreed on, and approved by the director of the trauma service (CD 7–5).

In rural hospitals, emergency department coverage varies according to the resources of the community. Ideally, a physician should be designated as the emergency department director. It is recommended that physicians providing care to injured patients have current Advanced Trauma Life Support® (ATLS®) training. It also is suggested that these smaller hospitals establish links with larger institutions that can help support a system of trauma care in their community. To facilitate this support, the Rural Trauma Committee of the American College of Surgeons Committee on Trauma has developed the Rural Trauma Team Development Course© (RTTDC©), designed to help smaller and rural hospitals maximize the use of existing resources to

develop trauma teams and to coordinate responses to major injury. The course is based on team-building concepts that identify specific roles and responsibilities for all assets in the community. In smaller facilities, there will be specific roles for prehospital care providers and nonclinical personnel. RTTDC courses should be offered as part of the outreach and education functions of regional trauma centers. The use of regional trauma center personnel in the training helps build trust and understanding, as well as improves communication, resulting in a smoother and more timely interfacility transfer process for those trauma patients whose needs exceed the capabilities of the smaller facility. (Additional information is included in Chapter 13, Rural Trauma Care.)

Qualifications

Physicians providing emergency medical coverage need to meet certain requirements. These requirements fall into three categories: current board certification, clinical involvement, and education. Compliance with these requirements is the responsibility of the trauma director and the emergency medicine director.

Board Certification

Basic to qualification for trauma care for any physician is current board certification in a specialty recognized by the American Board of Medical Specialties, the American Osteopathic Association, or the Royal College of Physicians and Surgeons of Canada. Board certification or eligibility for certification by the appropriate emergency medicine board according to current requirements or the alternate pathway is essential for physicians staffing the emergency department and caring for trauma patients in Level I, II, and III trauma centers (CD 7–6).

Certification may take several years after a residency approved by the Accreditation Council for Graduate Medical Education (ACGME), the American Osteopathic Association's American Osteopathic Board of Surgery, or appropriate Canadian boards. If a physician has not been certified within the time frame by the certifying board after successful completion of an ACGME or Canadian residency, the physician is not eligible for inclusion on the trauma team. Such a physician may be included when given recognition as a fellow by a major professional organization (for example, the American College of Emergency Physicians).

Alternate Criteria (CD 6–3) for Non–Board-Certified Emergency Medicine Physicians in Level I, II, and III Trauma Centers

Emergency medicine physicians who have trained outside the United States or Canada may be eligible to participate in the trauma program through an alternate pathway procedure. For a current description of alternate pathway criteria for emergency medicine physician recognition, see *www.facs.org/quality-programs/trauma/vrc/resources.*

Clinical Involvement

Emergency physicians on the call panel must be regularly involved in the care of injured patients (CD 7–7). Participation in the organization of trauma protocols, peer review meetings, and trauma resuscitations is a clear indicator of commitment to excellence in trauma patient care.

Performance Improvement and Patient Safety

Continuous PIPS is an important component of the trauma program. The emergency department should conduct its own PIPS program. As a component of this program, the emergency department should review its own cases and develop ongoing processes to assess care. Concurrent reviews of previously identified problems should be developed at all levels of care. Reports should be submitted to the trauma program's PIPS director for review (see Chapter 16, Performance Improvement and Patient Safety). A representative from the emergency department must participate in the prehospital PIPS program (CD 7–8). A designated emergency physician liaison must be available to the trauma director for PIPS issues that occur in the emergency department (CD 7–9). As part of the trauma PIPS program, a designated emergency physician liaison should be responsible for all emergency department audits, critiques, and mortality reviews of patients who are treated in the emergency department. Similarly, emergency physicians should be included when trauma patients are reviewed by the surgical staff. Emergency physicians must participate actively in the overall trauma PIPS program and the multidisciplinary trauma peer review committee (CD 7–10). The emergency medicine liaison on the multidisciplinary trauma peer review committee must attend a minimum of 50 percent of the committee meetings (CD 7–11).

Continuing Education

It is important that all members of the trauma team be knowledgeable about current practices in trauma care. External continuing medical education (CME) is the recommended method of keeping current. In Level I and II trauma centers, the liaison from emergency medicine must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related CME (CD 7–12). Programs given by visiting professors or invited speakers are considered outside education. In addition, it is important that other emergency physicians who participate on the trauma team also be knowledgeable and current in the care of injured patients. This requirement may be met by documenting the acquisition of 16 hours of trauma-related CME per year on average or by demonstrating participation in an internal educational process (IEP) conducted by the trauma program based on the principles of practice-based learning and the PIPS program (CD 7–13).

Examples of internal CME include the following: in-service, case-based learning; educational conferences; grand rounds; internal trauma symposia; and in-house publications disseminating information gained from a local conference or an individual's recent participation (through trained analysis) reviewing a trauma center. The IEP should include presentations and discussions on a quarterly basis as a minimum. Ideally, this would be case-based learning that identifies issues through the PIPS process with appropriate dissemination to the trauma team. These presentations should be documented in the performance improvement process. The total hours acquired through an IEP should be functionally equivalent to 16 hours of CME annually.

ATLS Status

Successful completion of, and current, ATLS status is an optimal standard for emergency physicians who participate in the initial assessment and resuscitation of injured patients. In Level I, II, and III trauma centers, all board-certified emergency physicians or those eligible for certification by an appropriate emergency medicine board according to their current requirements must have successfully completed the ATLS course at least once (CD 7–14). Physicians who are certified by boards other than emergency medicine who treat trauma patients in the emergency department are required to have current ATLS status (CD 7–15).

Supplemental Readings

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Clinical Functions: Neurosurgery

Neurotrauma is a serious public health problem. Traumatic brain injury (TBI) accounts for almost 40 percent of all deaths from acute trauma. Occurring at a rate of 150 cases per 100,000 population per year, TBI leads to more than 500,000 hospitalizations and results in more than 175,000 significant disabilities and death. The incidence of spinal cord injury is 40 injuries per 1 million people per year, with significant disabling neurologic sequelae in more than 50 percent of cases.

There has been a significant decline in TBI mortality during the past three decades as the understanding of the mechanism of secondary injury has grown. Contemporary multicenter clinical trials enrolling selected patients are currently reporting mortality rates as low as 17 percent. One of the central concepts that has emerged from clinical and laboratory research is that all neurologic damage does not occur at the moment of insult; the damage evolves over the ensuing hours and days. It has been shown that secondary injury may be ameliorated or prevented by prompt, careful attention to the details of patient management, including avoidance of hypoxia and hypotension, rapid removal of intracranial mass lesions, and treatment of elevated intracranial pressure. These interventions should begin as soon as possible after injury. Neurosurgeons taking trauma call should be contemporary and compliant with the clinical care parameters established in various published neurotrauma guidelines, such as Guidelines for the Management of Traumatic Brain Injury; Guidelines for the Surgical Treatment of Traumatic Brain Injury; Guidelines for the Treatment of Penetrating Brain Injury; Guidelines for the Acute Management of Severe Traumatic Brain Injury in Infants, Children, and Adolescents; and Guidelines for the Management of Cervical Spine and Spinal Cord Injury.

Organization

The active participation of neurosurgeons is crucial to the successful planning and implementation of a trauma system and to the success of individual trauma centers. The realities of neurosurgical availability should be taken into careful consideration early in the trauma center verification process. Not every facility that desires trauma center verification will have sufficient neurosurgical resources to care for patients with neurotrauma. Proper system development requires that neurosurgeons, independently or through organized state societies, realistically appraise their availability, resources, and commitment. They should provide appropriate advice and input on how many trauma centers can be adequately supported by the neurosurgeons in a given community or within a specific regional trauma system.

Availability of Neurosurgeons

Neurotrauma care should be organized and, ideally, led by a neurosurgeon who is highly experienced and devoted to the neurosurgical care of injured patients. If this surgeon is not the director of the neurosurgery service, a neurological surgeon liaison must be designated (CD 8–1). Neurotrauma care must be continuously available for all TBI and spinal cord injury patients and must be present and respond within 30 minutes based on institutional-specific criteria (CD 8–2). It is acceptable for institutions to credential both neurosurgeons and orthopaedic surgeons to treat spine injuries or to share spine call. The trauma center must provide a reliable,

published neurotrauma call schedule with formally arranged contingency plans in case the capability of the neurosurgeon, hospital, or system to care for neurotrauma patients is overwhelmed (CD 8–3). A published neurosurgeon backup call schedule is the best method to meet this requirement. However, because of the significant shortage of neurosurgeons in many hospitals and regions of the country, other creative methods to ensure timely and appropriate care may be used. For example, in trauma centers with accredited neurosurgical residency training programs, a senior postgraduate in year 4 or a higher neurosurgery resident may serve as the backup. The center must have a predefined and thoroughly developed neurotrauma diversion plan that is implemented when the neurosurgeon on call becomes encumbered (CD 8–4).

A predefined, thoroughly developed neurotrauma diversion plan must include the following:

- Emergency medical services notification of neurosurgery advisory status/diversion.
- A thorough review of each instance by the performance improvement and patient safety (PIPS) program.
- Monitoring of the efficacy of the process by the PIPS program.

A formal, published contingency plan must be in place for times in which a neurosurgeon is encumbered upon the arrival of a neurotrauma case (CD 8–5). The contingency plan must include the following:

- A credentialing process to allow the trauma surgeon to provide initial evaluation and stabilization of the neurotrauma patient.
- Transfer agreements with a similar or higher-level verified trauma center.
- Direct contact with the accepting facility to arrange for expeditious transfer or ongoing monitoring support.
- Monitoring of the efficacy of the process by the PIPS program.

If one neurosurgeon covers two centers within the same limited geographic area, there must be a published backup schedule (CD 8-6). In addition, the performance improvement process must demonstrate that appropriate and timely care is provided (CD 8–6).

For Level III trauma centers or rural centers, the trauma surgeon may be trained by the neurosurgical liaison from the receiving Level I or II center and periodically credentialed in the initial evaluation of patients with neurotrauma, interpretation of computed tomography scans, and brain injury resuscitation. In such situations, the trauma surgeon must be capable of managing neurotrauma patients until neurosurgical coverage becomes available or until the patient is sufficiently stable for transport to a facility where neurosurgery coverage is available.

The emergency department response for neurotrauma care should be clearly defined by the trauma program. Level III trauma centers generally will have limited or no neurosurgical coverage. A Level III trauma center must have a plan approved by the trauma medical director that determines which types of neurosurgical injuries may remain and which should be transferred (CD 8–7). A Level III trauma center with a neurosurgeon may elect to retain a patient with a less severe TBI. The neurosurgeon at a Level III trauma center may also determine it necessary to emergently evacuate an epidural hematoma with impending herniation prior to transferring the patient to a higher-level trauma center. In general, all patients requiring intracranial pressure

monitoring and patients with more significant traumatic brain injuries should be transferred to a higher-level trauma center. Transfer agreements must exist with appropriate Level I and Level II trauma centers (CD 8–8). In all cases, whether patients are admitted or transferred, the care must be timely, appropriate, and monitored by the PIPS program (CD 8–9).

Table 1 illustrates the expected neurosurgical coverage for Level I, II, and III trauma centers.

Table 1 Neurosurgical Functions and Responsibilities

Trauma Center	Neurosurgery Liaison	Neurosurgeon	Emergency Coverage	Initial Evaluation	Backup
Level I	Board certified in neurosurgery	Board certified in neurosurgery or meets requirement for alternate pathway	Immediately available 24 hours per day	Neurosurgeon, senior neurosurgery resident, trauma surgeon, EM physician, midlevel provider	Neurosurgeon, senior neurosurgery resident, or transfer agreement
Level II	Board certified in neurosurgery	Board certified in neurosurgery or meets requirement for alternate pathway	Immediately available 24 hours per day	Neurosurgeon, senior neurosurgery resident, trauma surgeon, EM physician, midlevel provider	Neurosurgeon, senior neurosurgery resident, or transfer agreement
Level III	Not required; board certified in neurosurgery if neurosurgical care is provided	Not required; board certified in neurosurgery or meets requirement for alternate pathway if neurosurgical care is provided	Not required	Trauma surgeon, EM physician, midlevel provider	Transfer agreement

Specific Qualifications for Neurosurgeon Board Certification

Basic to qualification for trauma care for any surgeon is current board certification in a surgical specialty recognized by the American Board of Medical Specialties, the American Osteopathic Association's American Osteopathic Board of Surgery, or a Canadian board. Acceptable certifying boards for neurosurgeons include the American Board of Neurological Surgery, the American Osteopathic Association, and the Royal College of Physicians and Surgeons of Canada. Board certification or eligibility for certification by an appropriate neurosurgical board according to the current requirements or the alternate pathway is essential for neurosurgeons who take trauma call in Level I, II, or III trauma centers (CD 8–10).

Certification may take several years after a residency approved by the Accreditation Council for Graduate Medical Education (ACGME) or Canadian boards. If a neurosurgeon has not been certified within the time frame by the certifying board after successful completion of an ACGME or Canadian residency, the neurosurgeon is not eligible for inclusion on the trauma team. Such a neurosurgeon may be included when recognized as a fellow by a major professional organization (for example, the American College of Surgeons).

Alternate Criteria (CD 6–3) for Non–Board-Certified Neurosurgeons in Level I, II, and III Trauma Centers

Neurosurgeons who have trained outside the United States or Canada may be eligible to participate in the trauma program through an alternate pathway procedure. For a current description of alternate pathway criteria for neurosurgical recognition, see *www.facs.org/quality-programs/trauma/vrc/resources*.

Clinical Involvement

Qualified neurosurgeons should be regularly involved in the care of patients with head and spinal cord injuries and must be credentialed by the hospital with general neurosurgical privileges (CD 8–11). In a hospital committed to trauma care, neurosurgeons with special expertise in trauma should be identified. Participation in the organization of trauma protocols, trauma teams, trauma call rosters, trauma systems, and trauma rounds clearly indicates commitment to excellence in trauma patient care.

Performance Improvement and Patient Safety

The neurosurgeons should have regular meetings (at least quarterly), which should include a neurotrauma-specific PIPS process under the aegis of the multidisciplinary trauma PIPS program. In conjunction with the trauma team, the neurosurgical team should develop, distribute, and regularly update written treatment protocols for the care of patients with neurotrauma injuries, particularly patients requiring multiple specialty care. Examples would include timeliness of placement of intracranial pressure monitors, management of increased intracranial pressure, timeliness of operative intervention, and compliance with current Brain Trauma Foundation guidelines.

The neurosurgery service must participate actively in the overall trauma PIPS program (CD 8–12). The neurosurgery liaison on the multidisciplinary trauma peer review committee must attend a minimum of 50 percent of the committee's meetings (CD 8–13). Level III centers with any emergent neurosurgical cases must also have the participation of neurosurgery on the multidisciplinary trauma peer review committee (CD 8-13). In addition, the neurosurgical trauma program should review its own cases and develop ongoing processes to assess care. Concurrent reviews of previously identified problems should be developed at all levels of care. Reports should be submitted to the trauma PIPS program for review (see Chapter 16, Performance Improvement and Patient Safety).

Continuing Education

It is important that all members of the trauma team be knowledgeable about current practices in trauma care. External continuing medical education (CME) is the recommended method of keeping current. The liaison representative from neurosurgery must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related CME (CD 8–14). Programs given by visiting professors or invited speakers are considered outside education. In addition, it is important for the other neurosurgeons participating in trauma call to be knowledgeable and current in the care of injured patients. This requirement may be documented by the acquisition of 16 hours of trauma CME per year, on average, or through an internal educational process (IEP) conducted by the trauma program and the neurosurgical liaison based on the principles of practice-based learning and the PIPS program (CD 8–15).

Examples of internal CME include the following: in-service, case-based learning; educational conferences; grand rounds; internal trauma symposia; and in-house publications disseminating information gained from a local conference or an individual's recent participation (through trained analysis) reviewing a trauma center. The IEP should include presentations and discussions on a quarterly basis as a minimum. Ideally, this education would be case-based learning that identifies issues through the PIPS process with appropriate dissemination to the trauma team. These presentations should be documented in the performance improvement process. The total hours acquired through an IEP should be functionally equivalent to 16 hours of CME annually.

All members of the trauma team must be knowledgeable about current practices in neurotrauma care and the best evidence for the care of the neurotrauma patient, including head, spine/spinal cord, and peripheral nerve injury. Use of the recommendations from the Brain Trauma Foundation Guidelines for topics such as adult and pediatric head injury, prehospital management, surgical management, penetrating injury, and acute spine and spinal cord injury is strongly recommended for all trauma centers.

Supplemental Readings

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Clinical Functions: Orthopaedic Surgery

More than half of all hospitalized trauma patients have one or more musculoskeletal injuries that could be life or limb threatening or that might result in significant functional impairment. An estimated 200,000 adolescents and adults younger than 65 years are hospitalized each year in the United States for the management of lower extremity fractures. These injuries are the leading cause of all trauma admissions in that age group.

Patients with isolated simple fractures with low-grade soft tissue injuries are appropriately treated in any well-equipped hospital by orthopaedic surgeons committed to quality fracture care. Patients who have multiple fractures, fractures associated with multiple injuries, complex fractures (including pelvic, acetabular, intraarticular, and spinal column fractures), and high-grade soft tissue injuries are appropriate candidates for musculoskeletal trauma care in a Level I or II trauma center.

The more complex the spectrum of injury, the more important the decision-making process becomes. For example, prompt stabilization of proximal long bone fractures and spinal fractures can decrease inflammatory mediator production, catecholamine release, analgesic requirements, morbidity rate, and hospital costs. It is important to categorize patients as to their physiologic insult, anatomic injuries, and response to resuscitation to plan the appropriate fracture management. For example, a patient with an unstable pelvic fracture with significant bleeding and potential intraabdominal hemorrhage requires rapid and coordinated consultation among many specialty services. The team decides the priority of laparotomy; angiography; and spinal, pelvic, and long bone fracture stabilization. Such patients are best managed by experienced personnel with significant resources and protocols at Level I or II trauma centers. Musculoskeletal trauma usually requires a prolonged recovery phase because of the extended healing time of the soft tissue and bony injuries. Early established and continuing physical, psychological, and vocational rehabilitation maximizes functional and physiological outcomes.

Musculoskeletal Trauma

Patient Types

Patients with musculoskeletal injury can be classified into three distinct types that affect resource utilization. The first type is a patient with an isolated, closed, simple musculoskeletal injury unassociated with any other fracture or potential injury. An emergency department physician appropriately performs the acute injury assessment, with timely referral to an orthopaedic surgical specialist. Surgical intervention is determined on an elective basis. Trauma team involvement is not a requirement.

The second type of musculoskeletal injury patients has multiple fractures of major long bones and joints or significant injury potential. Because of the potential for missed life-threatening injuries, such patients require assessment by the trauma team. After resuscitation and the exclusion of other potential injuries and/or contraindications to proceeding with early, aggressive fracture stabilization, the orthopaedic surgical service may assume care of the patient in the postoperative period.

The third type of patients with musculoskeletal injury have multiple fractures of major long bones, joints, and/or the spinal column associated with additional injuries. These are the multiply injured fracture patients. Such patients require skillful decision making by the trauma team. Therefore, injury prioritization may modify standard fracture care. These patients usually require the resources available at a Level I or II trauma center.

Orthopaedic Surgical Team Members

The orthopaedic surgeon's responsibility to the trauma team begins with the initial evaluation of the patient in the emergency department. In conjunction with the trauma team leader, the orthopaedic surgeon on call is responsible for the development and coordination of the management strategy for all axial and appendicular musculoskeletal injuries, including the determination of patient weight bearing and activity status so that the overall goals of patient care are not forgotten. After the acute treatment phase, the orthopaedic surgeon frequently is delegated the responsibilities of rehabilitation, co-coordinating transfers, referral to rehabilitation services, and providing long-term follow-up care for fracture-related problems.

Allied Team Members

Optimal musculoskeletal management requires that the orthopaedic surgeon be supported and assisted by a team of skilled individuals who can assist with tasks such as traction, casting, daily patient management, operative care, rehabilitation, and documentation. Well-trained radiologic technologists and operating room staff are important to the smooth running of an efficient musculoskeletal trauma system. Because of their skills and training in the management of the acute and rehabilitation phases of musculoskeletal trauma, physical and occupational therapists and rehabilitation specialists are essential at Level I and II trauma centers (CD 9–1). Social workers and discharge planners facilitate the transition of care from the acute care setting to home or a definitive recovery environment.

Facilities

Modern operative musculoskeletal injury care depends on the coordination of three synergistic resources: a well-trained staff, a well-equipped hospital, and a readily available operating room. Operating rooms must be promptly available to allow for emergency operations on musculoskeletal injuries, such as open fracture debridement and stabilization, external fixator placement, and compartment decompression (CD 9–2). However, the majority of surgical fracture care can be conducted on a semiurgent or elective basis. It is necessary to provide timely operating room access for semiurgent and elective surgical treatment of musculoskeletal injuries that do not require emergency care during the off-hours. This access should include allocation of sufficient operating room time to complete operative orthopaedic trauma care in a timely manner.

A functional orthopaedic trauma service requires flexibility in the operating room and staff scheduling. In Level I and II trauma centers, a system must be organized so that musculoskeletal trauma cases can be scheduled without undue delay and not at inappropriate hours that might conflict with more urgent surgery

or other elective procedures (CD 9–3). Individual solutions to such potential scheduling problems may be necessary in each trauma center. In centers where the trauma volume demands daily availability, ideally a designated operating room will be provided to the orthopaedic trauma service with protected start times so that these cases can be handled in an efficient manner. These solutions need to be monitored to determine the effective use of time.

Musculoskeletal Trauma Care in Trauma Centers

An orthopaedic surgeon should participate in service-related activities, especially activities related to performance improvement and development of institutional protocols for systematic evaluation and management of common injuries. A minimum on-call experience should ensure the maintenance of skills of the orthopaedic surgeon in the evaluation and management of orthopaedic injuries. Level I, II, and III trauma centers must have an orthopaedic surgeon who is identified as the liaison to the trauma program (CD 9–4). This orthopaedic surgeon should be included in the initial planning of the program and should maintain ongoing involvement in the program's organization.

Level I and II Trauma Centers

In a Level I trauma center, the orthopaedic care must be overseen by an individual who has completed a fellowship in orthopaedic traumatology approved by the Orthopaedic Trauma Association (OTA) (CD 9–5). In Pediatric Level I trauma centers this requirement may be met by having formal transfer agreements that specify which cases will be transferred for high-level orthopaedic oversight and ensuring that all such transfers (or potential transfers) are reviewed as part of the performance improvement process (CD 9-5). In Level II trauma centers, the care of musculoskeletal trauma patients should be overseen by an orthopaedic surgeon who is highly experienced and devoted to the orthopaedic care of injured patients. The orthopaedic team works in concert with the trauma service in the coordinated management of patients with musculoskeletal injuries. The orthopaedic team leader should serve as a liaison to the trauma program or should designate another qualified orthopaedic surgeon to fill that role.

Under the auspices of the trauma medical director, the orthopaedic liaison should guide orthopaedic trauma care in the following ways: (1) developing a list of surgeon qualifications for participation in trauma call at the center and ensuring that all participating surgeons meet those criteria; (2) cooperating with the nursing administration to support the nursing needs of orthopaedic trauma patients; (3) developing orthopaedic treatment protocols; (4) ensuring orthopaedic participation in the trauma program's performance improvement and patient safety (PIPS) process; (5) organizing the orthopaedic trauma call schedule; (6) coordinating interservice communication and efficient management of patients with musculoskeletal injury; and (7) performing other duties as necessary. The need for more specialty-trained surgeons depends on the volume and priorities of the service.

Orthopaedic team members must have dedicated call at their institution or have an effective backup call system (CD 9–6). They must be available in the trauma resuscitation area within 30 minutes after consultation has been requested by the surgical trauma team leader for multiply injured patients (CD 9–7) based on institution-specific criteria. The performance improvement process must ensure that care is timely and appropriate (CD 9–8). An orthopaedic resident at postgraduate year 4 or higher or an orthopaedic trauma fellow may act as a temporary consultant, as long as this participation is acceptable to the surgical trauma team leader. If the on-call orthopaedic surgeon is unable to respond promptly, a backup consultant on-call surgeon must be available (CD 9–9). The design of this system is the responsibility of the orthopaedic trauma liaison but must be approved by the trauma program director (CD 9–10). The trauma center must provide all the necessary resources for modern musculoskeletal trauma care, including instruments, equipment, and personnel, along with readily available operating rooms for musculoskeletal trauma procedures (CD 2–3). The best method for providing a readily available operating room is to have a designated orthopaedic fracture room. It is acceptable to document sufficient available unblocked operating time to accommodate these cases.

Level III Trauma Centers

Level III facilities vary significantly in the staff and resources that they can commit to musculoskeletal trauma care, but they must have an orthopaedic surgeon on call and promptly available 24 hours a day (CD 9–11). A Level III facility with an orthopaedic surgeon can provide timely musculoskeletal care management of major long bone fractures, but articular fracture management should be carried out only if the appropriate resources are available. The orthopaedic staff at a Level III facility should be realistic about its capabilities and develop a working relationship and transfer guidelines with higher-level institutions. If the orthopaedic surgeon is not dedicated to a single facility while on call, then a published backup schedule is required (CD 9–12). The PIPS process must review the appropriateness of the decision to transfer or retain major orthopaedic trauma cases (CD 9–13).

Performance Improvement

The orthopaedic team should have regular meetings (at least quarterly), which may include an orthopaedic-specific PIPS process under the aegis of the multidisciplinary trauma PIPS program. In conjunction with the trauma team, the orthopaedic team should develop, distribute, and regularly update written treatment protocols for the care of patients with severe musculoskeletal injuries, particularly patients requiring multiple specialty care. Examples would include patients with open fractures, patients with fractures with neurologic and vascular injury, and multisystem trauma patients with unstable pelvic ring and/or long bone fractures.

There must be protocols in Level I and II centers for the following: (1) the type and severity of pelvic and acetabular fractures that will be treated at the institutions, as well as those that will be transferred out for care; (2) the timing and sequence for the treatment of long bone fractures in multiply injured patients; and (3) the washout time for open fractures. These protocols must be included as part of the PIPS process (CD 9–14).

The orthopaedic service must participate actively with the overall trauma PIPS program and the multidisciplinary trauma peer review committee (CD 9–15). The orthopaedic liaison to the trauma PIPS program must attend a minimum of 50 percent of the multidisciplinary trauma peer review committee meetings (CD 9–16).

Rehabilitation

The goal of rehabilitation is to return an injured individual to society with the maximum function consistent with his or her injuries. This goal is best accomplished by using a cooperative team approach between the surgeon responsible for the acute management of the patient and the rehabilitative specialist. For skeletal injuries, rehabilitation protocols should be adjusted to individual patient needs and supervised by the surgeon responsible for the management of the injured patient. The overall rehabilitation program should be managed by a rehabilitation specialist and the appropriate allied health personnel. Rehabilitation protocols should be commenced at the time the patient enters the hospital and continue until discharge from the system. The return to full activity after major musculoskeletal injury often requires a year or more.

Optimal rehabilitation systems for trauma patients are still developing. Regional rehabilitation centers specializing in the physical and vocational rehabilitation of multiply injured patients should be developed to assist patients and society in the most efficient return to function.

Pain Management

Pain management of injured patients begins during the initial phases of care. It is important to establish an appropriate regimen, because injured patients are prone to develop a dependency on pain medications owing to the prolonged nature of recovery. Early fracture stabilization provides an effective method of providing relief of pain during the acute phase of hospitalization. Appropriate consultation with pain and rehabilitation services to cooperatively ensure that the patient's pain is relieved throughout care is optimal.

Geriatric Trauma

As the population ages, the number of older patients with injury is increasing. This increase creates two problems. A significant problem is that elderly patients have substantial comorbidities that affect care and outcome. The routine involvement of appropriate medical specialists to evaluate and manage the elderly patient's comorbid conditions is desirable. Moreover, a well-coordinated, multidisciplinary approach that acknowledges the unique challenges associated with the elderly injured patient is encouraged. The second problem is that the stabilization of fractures in osteoporotic bone leads to increased complication rates. Specialized programs for the care and rehabilitation of older patients will need to be developed, along with improved techniques for fracture care in osteoporotic bone. To attempt to lessen the impact of this problem, effective programs for the prevention and treatment of osteoporosis are needed.

Specific Qualifications for Orthopaedic Surgeons

Board Certification

Basic to qualification for trauma care for any surgeon is current board certification in a surgical specialty recognized by the American Board of Medical Specialties, the American Osteopathic Association's American Osteopathic Board of Surgery, or a Canadian board. Acceptable certifying boards for orthopaedic specialists include the American Board of Orthopaedic Surgery, the American Osteopathic Association, and the Royal College of Physicians and Surgeons of Canada. Board certification or eligibility for certification by an appropriate orthopaedic board according to the current requirements or the alternate pathway is essential for orthopaedic surgeons who take trauma call in Level I, II, and III trauma centers (CD 9–17).

Certification may take several years after a residency approved by the Accreditation Council for Graduate Medical Education (ACGME) or Canadian boards. If an orthopaedic surgeon has not been certified within the time frame by the certifying board after successful completion of an ACGME or Canadian residency, the surgeon is not eligible for inclusion on the trauma team. Such a surgeon may be included when given recognition as a fellow by a major professional organization (for example, the American College of Surgeons).

Alternate Criteria (CD 6–3) for Non–Board-Certified Orthopaedic Surgeons in a Level I, II, or III Trauma Center

Orthopaedic surgeons who have trained outside the United States or Canada may be eligible to participate in a trauma program through an alternate pathway procedure. For a current description of alternate pathway criteria for orthopaedic surgical recognition, see *www.facs.org/quality-programs/trauma/vrc/resources.*

Continuing Education

The background of orthopaedic surgeons should reflect an interest in, and a commitment to, trauma care. Formal orthopaedic trauma fellowships, training in orthopaedic surgery on an active trauma service, and combat experience as an orthopaedic surgeon constitute prime examples of such interest. Active participation as an instructor for the American College of Surgeons Advanced Trauma Life Support® (ATLS®) course clearly demonstrates educational involvement in trauma. It is helpful, but not required, for orthopaedic surgeons on the trauma team to successfully complete an ATLS® student course. Participation in specialty-sponsored educational fracture and trauma courses also is valuable.

The orthopaedic surgical liaison to the trauma program at Level I and II centers must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related continuing medical education (CME) (CD 9–18). In addition, it is important for the other members of the orthopaedic trauma team to be knowledgeable about, and current in, the care of injured patients. This requirement may be documented by the acquisition of 16 hours of trauma CME per year, on average, or through an internal educational process (IEP) conducted by the trauma program and the orthopaedic liaison based on the principles of practice-based learning and the PIPS program (CD 9–19).

Examples of internal CME include the following: in-service, case-based learning; educational conferences; grand rounds; internal trauma symposia; and in-house publications disseminating information gained from a local conference or an individual's recent participation (through trained analysis) reviewing a trauma center. The IEP should include presentations and discussions on a quarterly basis as a minimum. Ideally, this education would be case-based learning that identifies issues through the PIPS process with appropriate dissemination to the trauma team. These presentations should be documented in the performance improvement process. The total hours acquired through an IEP should be functionally equivalent to 16 hours of CME annually.

Supplemental Readings

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Pediatric Trauma Care

More children die of injury than of all other causes combined. For injured children who survive, severe disability may become a lifelong problem requiring long-term care and further increasing the financial burden on society. Effective care of injured children requires a comprehensive and inclusive approach that recognizes childhood injury as a major public health problem, identifies effective strategies for prevention, improves systems of emergency medical care for children, and provides the highest quality of pediatric trauma care, including rehabilitation care available at every level of trauma system organization. Injured children require special resources in any trauma center dedicated to their care. All trauma systems should consider the unique needs of injured children and develop appropriate plans to ensure that these needs are met.

Epidemiologic Considerations

Regardless of age, injured children most commonly die of, or are disabled by, central nervous system injury. Age-related patterns of injury are identifiable. The pediatric population can be divided into several groups.

Infants (birth to 12 months), toddlers (1–3 years), and preschoolers (3–5 years) are at greatest risk from falls. Because they have proportionately larger heads and hence a higher center of gravity, children of these ages sustain a higher proportion of traumatic brain injuries. These children, especially infants and toddlers, are also at risk of child maltreatment, with death from maltreatment being the third leading cause of mortality for children between 1 and 4 years of age.

School-aged children (6–12 years) are most commonly victims of unintentional trauma, especially motor vehicle crash–related trauma, as pedestrians, bicyclists, or unrestrained passengers. These children also sustain a large number of traumatic brain injuries, often in association with other injuries, including injuries to the chest, abdomen, and axial skeleton.

Adolescents (aged 13–19 years) are in transition from childhood to adulthood and require care plans that combine the psychological requirements of a child with the physical needs of an adult. These children engage in many risk-taking behaviors such as alcohol and drug use, as well as distracted driving, and are at high risk of homicide and suicide.

The aforementioned differences in the mechanisms and patterns of injury observed in early childhood, late childhood, and adolescence, together with the immature anatomic features and developing physiologic functions of pediatric patients, result in the need for a unique response to major trauma, which in turn drives the need for specialized pediatric resources.

Hospital Resources

The hospital resources for trauma centers are described in Chapter 2, Descriptions of Trauma Center Levels and Their Roles in a Trauma System. Many injured pediatric patients have special needs that are optimally provided in the environment of a children's hospital with demonstrated expertise in, and commitment to, pediatric care and trauma care. Throughout this chapter, the term *children's hospital* is understood to mean a freestanding children's hospital or a separate administrative entity within a larger general hospital organization, such as a children's hospital within a hospital or a full-service general hospital with comprehensive pediatric inpatient subspecialty services similar to those found in a freestanding children's hospital or a children's hospital within a hospital.

The main characteristic required of any hospital that cares for injured children is the dedication of the resources necessary to provide for the specialized needs of the pediatric trauma population. Because of the limited number and geographic distribution of children's hospitals, not all severely injured pediatric patients have access to these institutions. Other hospitals, therefore, are needed to provide these resources to the communities and systems of trauma care in areas where specialized pediatric resources are not available. Whatever the available pediatric resources, it is vital that the trauma surgeon and other members of the trauma team be committed to pediatric trauma care and that all members of the trauma team who care for injured children be properly trained and specifically credentialed by the hospital to provide pediatric trauma care. All hospitals in a trauma system should establish working relationships with one another to provide pediatric trauma care appropriate to the needs of injured children.

Pediatric trauma centers need specialized pediatric resources typically available in children's hospitals and therefore usually are located in such hospitals. Geographic areas with access to pediatric trauma centers should work to integrate these hospitals into their regional trauma systems through invited participation and appropriate field triage and interfacility transport of the most critically injured children to these hospitals. When a pediatric trauma center is not available, its role should be carried out by an adult trauma center that fulfills the requirements for provision of optimal trauma care to children.

Pediatric Trauma Center

Pediatric trauma centers are expected to assume a leadership role in the care of injured children within their respective local, regional, and state trauma systems. They provide comprehensive pediatric trauma care for the most severely injured children within their geographic areas and should interact effectively with all other hospitals that provide care for injured children in those areas. In addition, they should establish close working relationships with other hospitals that provide pediatric care or trauma care to advocate for the needs of injured pediatric patients throughout the community and system of trauma care.

Hospitals that pursue verification as pediatric trauma centers must meet the same resource requirements as adult trauma centers, in addition to pediatric resource requirements (CD 2–3) (Table 1). A pediatric trauma center should have a sufficient volume of institutional experience with major pediatric injuries to maintain the

clinical skills of pediatric trauma team members. A Level I pediatric trauma center must annually admit 200 or more injured children younger than 15 years (CD 10–1). A Level II pediatric trauma center must annually admit 100 or more injured children younger than 15 years (CD 10–2). These admissions may include inpatient or 23-hour observations but should exclude patients admitted for drowning, poisoning, foreign bodies, asphyxiation, or suffocation or patients who are dead on arrival to the facility. Facilities should also exclude from the registry those patients with known or suspected physical or sexual abuse for whom the admission is not injury related but rather for evaluation by social services. In the absence of an admitting burn service, burn patients should be included in the registry. All Level I and II pediatric trauma centers must have a dedicated pediatric trauma program manager (CD 10–3) and a pediatric trauma registrar (CD 10–4). In a Level I pediatric trauma center, the pediatric trauma program manager must be a full-time position dedicated to the pediatric trauma service (CD 10–5). In a Level II pediatric trauma center, the pediatric trauma program manager should be dedicated to the pediatric trauma service but need not be full-time and may also serve as the prevention coordinator or registrar.

Table 1 Additional Requirements for Pediatric Trauma Centers and Adult and Pediatric Trauma Centers (in addition to requirements at adult centers)

Freestanding children's hospital or comprehensive pediatric care unit within general hospital organization	Peds LI	Peds LII
Pediatric trauma service	E	E
Pediatric surgeon as pediatric medical director	E	D
Pediatric surgeon	E (At least 2)	E- (At least 1)
Pediatric emergency medicine physicians	E	E
Pediatric critical care medicine physicians	E	E
Other surgical specialists with pediatric specialty experience	E	E
Pediatric-specific trauma continuing medical education for pediatric medical director and liaisons	E	E
Pediatric emergency department area	E	E
Pediatric intensive care unit	E	E
Pediatric acute care unit	E	E
Pediatric rehabilitation	E	E
Pediatric resuscitation equipment in all appropriate patient care areas	E	E
Pediatric trauma program manager	E	E
Pediatric trauma registrar	E	E
Child life and family support programs	E	E
Pediatric social work child protective services	E	E
Child maltreatment assessment capability	E	E
Injury prevention and community outreach programs (pediatric trauma education programs)	E	E
Pediatric trauma research	E	D
Minimum number of annual trauma admissions of children younger than 15 years	200	100
Pediatric trauma performance improvement program	E	E

All pediatric trauma centers must have a pediatric trauma performance improvement and patient safety (PIPS) program (CD 10–6). In addition, all pediatric trauma centers must have the following programs: (1) pediatric rehabilitation, (2) child life and family support programs, (3) pediatric social work, (4) child protective services, (5) pediatric injury prevention, (6) community outreach, and (7) education of health professionals and the general public in the care of pediatric trauma patients (CD 10–7).

Level I and II pediatric trauma centers must have a mechanism in place to assess children for maltreatment (CD 10–8). Screening, treatment, and referral guidelines should be standardized for children injured as a result of maltreatment. All patients who have acute injury as the reason for hospital admission should be assessed by the trauma team and admitted to the appropriate surgical service.

Level I pediatric trauma centers must have identifiable pediatric trauma research (CD 10–9). The pediatric Level I center's research requirement is equivalent to that of adult Level I trauma centers (CD 10–10). In combined Level I adult and pediatric centers, half of the research requirement must be pediatric research (CD 10–11).

Pediatric Physician Resources

Physicians providing care in a pediatric trauma center should regularly provide care to a pediatric population. A Level I pediatric trauma center must have at least two surgeons who are board certified or eligible for certification by the American Board of Surgery according to current requirements in pediatric surgery (CD 10–12). On staff, there must be one board-certified surgeon or one surgeon eligible for certification by an appropriate orthopaedic board (see Chapter 9, Clinical Functions: Orthopaedic Surgery) according to the current requirements of that board who also has had pediatric fellowship training (CD 10–13). Additionally, there must be on staff at least one board-certified surgeon or one surgeon eligible for certification by an appropriate neurosurgical board (see Chapter 8, Clinical Functions: Neurosurgery) according to current requirements of that board who also has had pediatric fellowship training (CD 10–14). There must be one additional board-certified orthopaedic surgeon or surgeon eligible for certification by an appropriate orthopaedic board according to the current requirements of that board (CD 10–15), as well as one additional board-certified neurosurgeon or surgeon eligible for certification by an appropriate neurosurgical board according to the current requirements of that board, who is identified with demonstrated interests and skills in pediatric trauma care (CD 10–16). There must be two physicians who are board certified or eligible for certification in pediatric critical care medicine, according to current requirements in pediatric critical care medicine; or in pediatric surgery and surgical critical care by the American Board of Surgery (CD 10–17). There must be two physicians who are board certified or eligible for certification by an appropriate emergency medicine board according to current requirements in pediatric emergency medicine (CD 10–18). An acceptable method for satisfying this criterion is board certification in emergency medicine and pediatrics. The pediatric intensive care unit (CD 10–19) and the pediatric section of the emergency department (CD 10–20) must be staffed by individuals credentialed by the hospital to provide pediatric trauma care in their respective areas.

In a Level II pediatric trauma center, there must be at least one pediatric surgeon who is board-certified or eligible for certification by the American Board of Surgery according to current requirements in pediatric surgery (CD 10–21). There must be one surgeon who is board-certified or eligible for certification by an appropriate orthopaedic board (CD 10–22) and one surgeon who is board-certified or eligible for certification by an appropriate neurosurgical board (CD 10–23) identified with demonstrated interests and skills in pediatric trauma care. The pediatric intensive care unit (CD 10–19) and the pediatric section of the emergency department (CD 10–20) must be staffed by individuals credentialed by the hospital to provide pediatric care in their respective areas.

Pediatric Trauma Team

In a Level I pediatric trauma center, the pediatric trauma medical director must be board certified or eligible for certification by the American Board of Surgery according to current requirements for pediatric surgery or, alternatively, a pediatric surgeon who is a Fellow of the American College of Surgeons with a special interest in pediatric trauma care. This individual must participate in trauma call (CD 10–24).

In a Level II pediatric trauma center, the pediatric trauma medical director should be a board-certified pediatric surgeon or a surgeon eligible for certification by the American Board of Surgery according to current requirements for pediatric surgeons. This individual must be a board-certified general surgeon or general surgeon eligible for certification by the American Board of Surgery according to current requirements qualified to serve on the pediatric trauma team as defined in the following paragraph (CD 10–25).

In Level I and II pediatric trauma centers, all individuals on the pediatric trauma team should have pediatric board certification in their respective specialties. When the number of pediatric surgeons on staff is too few to sustain the pediatric trauma panel, general surgeons who are board certified or eligible for certification by the American Board of Surgery according to current requirements may serve on the pediatric trauma team. In this circumstance, they must be credentialed by the hospital to provide pediatric trauma care, be members of the adult trauma panel, and be approved by the pediatric trauma medical director (CD 10–26).

In a hospital that cares for pediatric patients only, a pediatric surgical resident who is board certified or eligible for certification by the American Board of Surgery according to current requirements for general surgery, and taking further training in pediatric surgery, may provide the initial response for the highest-level trauma activation until the pediatric trauma surgeon is available. At a minimum, a Level I pediatric trauma center must have continuous rotations in trauma surgery for senior residents (Clinical PGY 3–5) who are part of an Accreditation Council for Graduate Medical Education accredited program (CD 10–27). At a minimum, these rotations should include residency programs in all of the following specialties: general surgery, orthopaedic surgery, emergency medicine, and neurosurgery. They may also include support of a pediatric surgical fellowship (CD 10–28).

In Level I and II pediatric trauma centers, other specialists (in anesthesiology, neurosurgery, orthopaedic surgery, emergency medicine, radiology, and rehabilitation) providing care to injured children who are not pediatric-trained providers also should have sufficient training and experience in pediatric trauma care and be knowledgeable about current management of pediatric trauma in their specialty. The program must make specialty-specific pediatric education available for these specialists (CD 10–29). This education may be demonstrated by documenting an annual update by pediatric specialists to the non–pediatric-trained providers. This update may be external or internal.

Pediatric Trauma Service

An organized pediatric trauma service led by a pediatric trauma medical director must be present in Level I and II pediatric trauma centers (CD 10–30). The pediatric trauma service should devise a plan to ensure that all pediatric patients sustaining major trauma are fully evaluated by the pediatric trauma team and that all appropriate pediatric trauma team members respond at the time they are needed. A surgeon from the pediatric trauma team should respond to the pediatric emergency department for all injured children who require major resuscitation (Table 2). Pediatric trauma patients with serious injuries should be admitted to the pediatric trauma service. Pediatric trauma patients with single-system injury should be admitted to, or evaluated by, the pediatric trauma service but may be transferred or admitted to the appropriate surgical subspecialty service once they have been evaluated and their conditions stabilized.

Table 2 Minimum Criteria for Full Pediatric Trauma Team Activation

- Age-specific hypotension: Systolic blood pressure less than 70 mm Hg + (2 x age in years)
- Gunshot wounds to the neck, chest, or abdomen or extremities proximal to the elbow/knee
- Glasgow Coma Scale score of less than 9 or deteriorating by 2, with a mechanism attributed to trauma
- Transfer patients from other hospitals who are receiving blood to maintain vital signs
- Intubated patients transferred from the scene OR patients who have respiratory compromise or are in need of an emergent airway OR intubated patients who are transferred from another facility with ongoing respiratory compromise
- Emergency physician's discretion

Active collaboration with other surgical and pediatric subspecialists, such as neurological surgeons, orthopaedic surgeons, pediatric emergency medicine physicians, and pediatric critical care medicine physicians, is strongly encouraged but cannot substitute for the ongoing direction of the pediatric trauma service. The pediatric trauma service must maintain oversight of the patient's management while the patient is in the intensive care unit (CD 10–31). The trauma service should work collaboratively with the pediatric critical care providers, although all significant therapeutic decisions must be approved by the trauma service, and the service must be made aware of all significant clinical changes (CD 10–32). The surgical director of

the pediatric intensive care unit must participate actively in the administration of the unit, as evidenced by the development of pathways and protocols for care of surgical patients in the intensive care unit and in unit-based performance improvement and should be board certified in surgical critical care (CD 10–33). Pediatric surgeons or trauma surgeons with pediatric privileges must be included in all aspects of the care of injured children admitted to an intensive care unit (CD 10–34).

Adult and Pediatric Trauma Center

It is conceivable that a medical center may be verified as a Level I adult trauma center and a Level II pediatric trauma center, or vice versa, if it meets the criteria for each.

Adult Trauma Centers Treating Injured Children

Pediatric trauma centers should be used to the fullest extent feasible. However, pediatric resources may be scarce in some communities. In such areas, adult trauma centers, of necessity, may serve as the primary pediatric resource for the region and therefore may need to provide care for injured children. Any adult trauma center that annually admits 100 or more injured children younger than 15 years must fulfill the following additional criteria demonstrating its capability to care for the injured child (CD 2–23). The trauma surgeons must be credentialed for pediatric trauma care by the hospital's credentialing body (CD 2–23). Criteria may include Pediatric Advanced Life Support (PALS) certification, annual pediatric trauma continuing medical education (CME), or pediatric-specific content covered in the internal education process.

There must be a pediatric emergency department area, a pediatric intensive care area, appropriate resuscitation equipment, and a pediatric-specific trauma PIPS program (CD 2–24). For adult trauma centers admitting fewer than 100 injured children younger than 15 years per year, these resources are desirable. These hospitals, however, must review the care of all injured children through their PIPS programs (CD 2–25).

Performance Improvement and Patient Safety

Regardless of the type of hospital or designation, system performance for pediatric patients, at a minimum, should be measured by analysis of mortality, morbidity, and functional status (see Chapter 16, Performance Improvement and Patient Safety). Pediatric process and outcome measures that encompass prehospital, hospital, and posthospital care should be tracked concurrently and reviewed periodically (Table 3). Level I and II pediatric trauma centers must submit data to the National Trauma Data Bank® (NTDB®) (CD 10–35). Local trauma center data should be benchmarked with national pediatric trauma data from a large registry, such as the NTDB® or Pediatric Trauma Quality Improvement Program (TQIP).

Table 3 Examples of Pediatric Process and Outcomes Measures

Process or Outcome Measure	Definition	Purpose
Missed intubation	More than one attempt to place endotracheal tube appropriately	Efficiency of airway care is the defining variable in outcome for severely injured children. Who, when, what, and how many attempts were required for successful control of the airway are objective measures of system performance.
Unplanned extubation	Unintentional extubation by patient or provider	Failure to maintain the airway can be life threatening. This indicator reflects adequacy of pediatric critical care nursing care.
Extubation within 24 hours of rapid-sequence intubation (excluding operative procedures)	Patient who can be extubated less than 24 hours after drug- assisted intubation, excluding operative procedure	This measure is the objective monitoring for the appropriateness of using rapid-sequence intubation, an intrinsically dangerous process. Patients who can be extubated within 24 hours may not have required chemical paralysis and intubation in the first place.
Hypocapnia and/or hypercapnia	Overventilation or underventilation, especially in the first 12 hours after injury	These measures are a reflection of efficacy/precision of care in the critical first 12 hours after initial stabilization.
Resuscitation volume problems	Infusion of more than 50 mL/kg during the first 2 hours in a child with normal initial vital signs	Judicious fluid management requires careful titration of filling pressures with oxygen-carrying capacity. Inordinate volumes of crystalloid, especially in the absence of clinical findings of hypoperfusion, will potentially exacerbate fluid sequestration in the brain and/or lung. This indicator reflects appropriate attention to clinical detail and accurate recording.
Vascular access problems	Any acquisition of vascular access that takes longer than 5 minutes to accomplish, especially if intraosseous infusion is not used	This indicator is an objective measure of preparation and facility in the accomplishment of a critical, size-related component of pediatric resuscitation.
Unplanned operation following nonoperative management	Any operation for control of hemorrhage in a patient being managed nonoperatively	This indicator is an objective measure of the appropriateness of nonoperative management.
Unplanned hypothermia	Core temperature less than 35°C for more than 2 hours	Although mild hypothermia has been associated with improved outcomes following brain injury, moderate to severe hypothermia causes a variety of hematologic and metabolic derangements and must be avoided in children.
Nosocomial pneumonia	Pneumonia	Pneumonia is a major cause of avoidable morbidity and cost. Recognition of pneumonia is especially important in children without evidence of pulmonary injury or aspiration.
Missed injury	Any injury related to the initial traumatic event diagnosed more than 24 hours after admission	This indicator is an objective measure of the specificity and accuracy of the initial assessment.

There must be a trauma peer review committee chaired by the pediatric trauma medical director with participation by the pediatric/general surgeons and liaisons from pediatric/general surgery, orthopaedic surgery, neurosurgery, emergency medicine, pediatric critical care medicine, anesthesia, and radiology to improve trauma care by reviewing selected deaths, complications, and sentinel events with the objectives of identification of issues and appropriate responses (CD 10–36). The aforementioned representatives must attend at least 50 percent of the trauma peer review meetings, and their attendance must be documented (CD 10–37). All pediatric and general surgeons on the pediatric trauma panel treating children must attend at least 50 percent of the trauma peer review meetings (CD 10–38).

Important Consideration

In the pediatric population, the use of nonradiation imaging should be carefully considered. Nonradiation imaging is preferred over exposing patients to radiation. When the appropriate clinical situation arises and radiation imaging is required, the dose should be decreased to the minimal amount necessary to obtain high-quality diagnostic images.

Education in Pediatric Trauma and Resuscitation

It is important that all members of the trauma team in trauma centers caring for injured children be knowledgeable about current practices in pediatric trauma care, including pediatric resuscitation. In Level I and II adult and/or pediatric trauma centers, verifiable external CME is one method of keeping current. The other method is through an internal education process driven by the PIPS process. In Level I and II pediatric trauma centers, the pediatric trauma medical director and the liaisons from neurosurgery, orthopaedic surgery, emergency medicine, and critical care medicine must each accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external CME, of which at least 12 hours (in 3 years) must be related to clinical pediatric trauma care (CD 10–39). Attending programs given by visiting professors or invited speakers is considered outside education. Verifiable external CME should include structured educational programs in pediatric resuscitation, such as the PALS course of the American Heart Association and the American Academy of Pediatrics or the Advanced Pediatric Life Support course of the American Academy of Pediatrics and American College of Emergency Physicians, in addition to the Advanced Trauma Life Support® (ATLS®) course of the American College of Surgeons.

The other general surgeons, orthopaedic surgeons, neurosurgeons, emergency medicine physicians, and critical medicine care physicians who take trauma call in Level I and II pediatric trauma centers also must be knowledgeable and current in the care of injured patients. This requirement may be met by documenting the acquisition of 16 hours of CME per year, on average, or by demonstrating participation in an internal educational process (IEP) conducted by the trauma program based on the principles of practice-based learning and the PIPS program (CD 10–40).

Examples of IEP include the following: in-service, case-based learning; educational conferences; grand rounds; internal trauma symposia; in-house publications disseminating information gained from local conferences; or an individual's recent participation (through structured analysis) in reviewing a trauma center. The IEP should include presentations and discussions on a quarterly basis as a minimum. Ideally, this education would be case-based learning that identifies issues through the PIPS process, with appropriate dissemination to the trauma team. These presentations should be documented in the performance improvement process. The total hours acquired through an IEP should be functionally equivalent to 16 hours of CME annually.

Regional Care of Injured Children: Patient Triage and Transfer

Triage criteria (see Chapter 4, Interhospital Transfer) are designed to identify the children at greatest risk for death or disability and who should be considered for expeditious transfer to a Level I or II trauma center. Pediatric patients younger than 15 years who meet these criteria and therefore are at risk for rapid deterioration in their conditions and/or who may require early operation should be considered for expeditious transfer to a pediatric trauma center, where available. The Pediatric Trauma Score and Revised Trauma Score are additional adjuncts to the clinical assessment of injured children. Referral to a pediatric trauma center should be protocol driven and continuously monitored by the PIPS process.

Supplemental Readings

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Collaborative Clinical Services

Injured patients may need care by specialists in addition to the care provided by general surgeons, emergency physicians, orthopaedic surgeons, or neurosurgeons. A trauma center's effectiveness is enhanced by the commitment of these additional personnel. These specialists should be promptly available and qualified in their areas of expertise. *Promptly available* is defined as available within 30 minutes of notification.

Anesthesiology

Anesthesiology services are critical in the management of severely injured patients and must be available within 30 minutes for emergency operations (CD 11–1) and for managing airway problems (CD 11–2). Although anesthesia services may be based primarily in the operating room, the responsibilities of anesthesiology may extend into other areas of the hospital. Examples include establishing airway control, assisting with resuscitation, providing preoperative and postoperative cardiorespiratory support, and assisting with pain control.

Level I and II Trauma Centers

The anesthetic care of injured patients in a Level I or II trauma center must be organized and supervised by an anesthesiologist who is highly experienced and committed to the care of injured patients and who serves as the designated liaison to the trauma program (CD 11–3). Anesthesia services in Level I and II trauma centers must be available in-house 24 hours a day (CD 11–4). Anesthesia requirements may be fulfilled by anesthesiology senior residents or certified registered nurse anesthetists (CRNAs) who are capable of assessing emergency situations in trauma patients and of providing any indicated treatment, including initiation of surgical anesthesia. When anesthesiology senior residents or CRNAs are used to fulfill availability requirements, the attending anesthesiologist on call must be advised, available within 30 minutes at all times, and present for all operations (CD 11–5). The availability of anesthesia services and delays in airway control or operations must be documented by the hospital performance improvement and patient safety (PIPS) process (CD 11–6).

Level III Trauma Center

In Level III hospitals, in-house anesthesia services are not required, but anesthesiologists or CRNAs must be available within 30 minutes (CD 11–7). In Level III trauma centers without in-house anesthesia services, protocols must be in place to ensure the timely arrival at the bedside by the anesthesia provider within 30 minutes of notification and request (CD 11–8). Under these circumstances, the presence of a physician skilled in emergency airway management must be documented (CD 11–9). In Level III facilities, operative anesthesia may also be provided by a CRNA under on-site physician supervision. The availability of anesthesia services and delays in airway control or operations must be documented by the hospital PIPS process (CD 11–6).

Qualifications

All anesthesiologists taking call must have successfully completed an anesthesia residency program (CD 11–10). Furthermore, in Level I and II trauma centers, anesthesiologists taking call must be currently board certified or eligible for certification by an appropriate anesthesia board according to current requirements in anesthesiology (CD 11–11). In Level I and II facilities, at least one anesthesiologist should put forth a specific effort and commitment to education in trauma-related anesthesia and educate other anesthesiologists and the entire trauma team.

Basic to qualification for trauma care for any anesthesiologist is current board certification in anesthesiology. Acceptable certifying boards for anesthesiologists include the American Board of Anesthesiology, the American Osteopathic Association, and the Royal College of Physicians and Surgeons of Canada. Board certification or eligibility for certification is essential for anesthesiologists who take trauma call in Level I and II trauma centers (CD 11–11).

Certification may take several years after a residency approved by the Accreditation Council for Graduate Medical Education (ACGME) or Canadian boards. If an anesthesiologist has not been certified within the time frame specified by the certifying board after successful completion of an ACGME or Canadian residency, the anesthesiologist is not eligible for inclusion on the trauma team.

Performance Improvement and Patient Safety

In Level I, II, and III trauma centers, a qualified and dedicated physician anesthesiologist must be designated as the liaison to the trauma program (CD 11–3), and participation in the trauma PIPS program by the anesthesia liaison is essential (CD 11–12). The anesthesiology liaison to the trauma program must attend at least 50 percent of the multidisciplinary peer review meetings, with documentation by the trauma PIPS program (see Chapter 16, Performance Improvement and Patient Safety) (CD 11–13).

Operating Room

Personnel

An operating room must be adequately staffed and available within 15 minutes at Level I and II trauma centers (CD 11–14). This criterion is met by having a complete operating room team in the hospital at all times in order for the injured patient to receive expeditious operative care. In Level I and II trauma centers, if the first operating room is occupied, an adequately staffed additional room must be available (CD 11–15).

Availability of the operating room personnel and timeliness of starting operations must be continuously evaluated by the trauma PIPS process, and measures must be implemented to ensure optimal care (CD 11–16).

In Level III trauma centers, an operating room must be adequately staffed and available within 30 minutes (CD 11–17). This criterion may be met by a team on call from outside the hospital, depending on the patient population served, prehospital communications, the volume of urgent cases, and other relevant factors. If an on-call team is used, the availability of operating room personnel and the timeliness of starting operations must be continuously evaluated by the trauma PIPS process, and measures must be implemented to ensure optimal care (CD 11–18).

Equipment

Level I, II, and III trauma centers should have the necessary operating room equipment for the patient populations they serve. All trauma centers must have rapid fluid infusers, thermal control equipment for patients and resuscitation fluids, intraoperative radiologic capabilities, equipment for fracture fixation, and equipment for bronchoscopy and gastrointestinal endoscopy (CD 11–19). Level I and II trauma centers and Level III trauma centers that provide neurosurgical services must have the necessary equipment to perform a craniotomy (CD 11–20). Only Level III trauma centers that do not offer neurosurgery services are not required to have craniotomy equipment. Level I trauma centers must have cardiothoracic surgery capabilities available 24 hours per day and should have cardiopulmonary bypass equipment (CD 11–21). In Level I and Level II trauma centers, if cardiopulmonary bypass equipment is not immediately available, a contingency plan, including immediate transfer to an appropriate center and 100 percent performance improvement review of all patients transferred, must be in place (CD 11–22). Level I trauma centers must have an operating microscope available 24 hours per day (CD 11–23).

Postanesthesia Care Unit

Postoperative recovery care of trauma patients may occur in the postanesthesia care unit (PACU) or intensive care unit (ICU), depending on the patient's needs. At Level I, II, and III trauma centers, a PACU with qualified nurses must be available 24 hours per day to provide care for the patient if needed during the recovery phase (CD 11–24). If this availability requirement is met with a team on call from outside the hospital, the availability of the PACU nurses and compliance with this requirement must be documented by the PIPS program (CD 11–25). The PACU must have the necessary equipment to monitor and resuscitate patients, consistent with the process of care designated by the institution (CD 11–26). The PIPS program, at a minimum, must address the need for pulse oximetry, end-tidal carbon dioxide detection, arterial pressure monitoring, pulmonary artery catheterization, patient rewarming, and intracranial pressure monitoring (CD 11–27).

Radiology

Radiology services are critical in the management of severely injured patients. The trauma center must have policies designed to ensure that trauma patients who may require resuscitation and monitoring are accompanied by appropriately trained providers during transportation to, and while in, the radiology department (CD 11–28).

Conventional radiography must be available in all trauma centers 24 hours per day (CD 11–29). Computed tomography (CT) must be available in Levels I, II, and III trauma centers 24 hours per day (CD 11–30). An in-house radiology technologist and CT technologist are required at Level I and II trauma centers (CD 11–31).

In Level I, II, and III trauma centers, qualified radiologists must be available within 30 minutes in person or by teleradiology for the interpretation of radiographs (CD 11–32). In Level I and II trauma centers, qualified radiologists must be available within 30 minutes to perform complex imaging studies or interventional procedures (CD 11–33). In Level I, II, and III trauma centers, diagnostic information must be communicated in a written or electronic form and in a timely manner (CD 11–34).

Critical information deemed to immediately affect patient care must be verbally communicated to the trauma team in a timely manner (CD 11–35). The preliminary report must be permanently recorded. The final report must accurately reflect the chronology and content of communications with the trauma team, including changes between the preliminary and final interpretations (CD 11–36). Changes in interpretation between preliminary and final reports, as well as missed injuries, must be monitored through the PIPS program (CD 11–37).

In Level I and II facilities, a radiologist must be appointed as liaison to the trauma program (CD 11–38). The radiologist liaison must attend at least 50 percent of peer review meetings and should educate and guide the entire trauma team in the appropriate use of radiologic services (CD 11–39). The process and outcome measures to support the PIPS program should be defined collaboratively and should include system or individual case factors that materially affect time for treatment, patient morbidity or mortality, and efficient resource use. In Level I and II trauma centers, participation in the trauma PIPS program process by the radiology liaison is essential (CD 11–40). At a minimum, radiologists must be involved in protocol development and trend analysis that relate to diagnostic imaging (CD 11–41). Level I and II facilities must have a mechanism in place to view radiographic imaging from referring hospitals within their catchment area (CD 11–42). Radiologists should be available within 30 minutes to read and interpret such images. In Level III centers, it is desirable for radiologists to be involved in the PIPS program, when available.

Qualifications

Basic to qualification for trauma care for any radiologist is current board certification in radiology. Acceptable certifying boards for radiologists include the American Board of Radiology, American Osteopathic Association, and the Royal College of Physicians and Surgeons of Canada. Board certification or eligibility for certification by an appropriate radiology board according to current requirements is essential for radiologists who take trauma call in Level I and II trauma centers (CD 11–43).

Certification may take several years after a residency approved by the ACGME or Canadian boards. If a radiologist has not been certified within the time frame specified by the certifying board after successful completion of an ACGME or Canadian residency, the radiologist is not eligible for inclusion on the trauma team. Such a radiologist may be included when recognized as a fellow by a major professional organization (for example, the American Society of Emergency Radiology).

Radiation Safety

In recent years, increased attention has been given to the potential long-term risks of ionizing radiation received from diagnostic imaging studies such as CT scanning, nuclear medicine examinations, and radiography. Articles attempting to quantify the long-term risk of cancer development from single or multiple diagnostic imaging examinations (especially CT) have appeared in many medical journals and have been reported in the popular press. It is important to understand that these are risk estimates based on multiple assumptions and applied to populations of patients. While the precise radiation dose and the precise risk to a specific patient from a specific examination cannot be determined, it is important to understand that there is likely at least a small increased risk of cancer from diagnostic imaging radiation, especially from relatively higher-dose examinations such as CT scans. However, the diagnostic information from CT scans can provide great benefit to the injured patient for whom rapid patient management decisions are made with high confidence and accuracy.

Radiation dose can be minimized in two important ways:

- A study should be performed only for a valid clinical indication and when the expected information from the study will help determine patient management. Total body imaging without clinical indication and multiple repeated examinations are not indicated or warranted. Predetermined protocols should be designed with some attention to radiation dose and the potential necessity for repetition.

- The radiology department should work to optimize the technical parameters of each examination so that the lowest radiation dose possible is used for each patient while still producing high-quality diagnostic images. Alternatives should be strongly considered for all patients, especially pediatric patients. Strategies that carefully consider the risk of injury vs. the risk of radiation exposure may lead to reducing CT scanning for certain body regions in pediatric patients. As an example, blunt thoracic aortic injury is more common in elderly patients than in infants and small children, yet the risk from radiation exposure is higher in infants and children. The development of guidelines and protocols that take these factors into consideration, particularly for chest and cervical spine CT scanning, should be strongly considered.

Interventional radiologic procedures and sonography must be available 24 hours per day at Level I and II trauma centers (CD 11–44). Magnetic resonance imaging (MRI) capability must be available 24 hours per day at Level I and II trauma centers (CD 11–45). The MRI technologist may respond from outside the hospital; however, the PIPS program must document and review arrival within 1 hour of this individual's being called. This time should meet current clinical guidelines (CD 11–46). In Level III centers, if the CT technologist takes call from outside the hospital, the PIPS program must document the technologist's time of arrival at the hospital (CD 11–47).

ICU Organization and Physician Responsibility

In a Level I trauma center, a surgically directed ICU physician team must be led by a surgeon boarded in surgical critical care, and critically ill trauma patients should be cared for in a designated ICU (CD 11–48). A surgeon with current board certification in surgical critical care must be designated as the ICU director (CD 11–49). The ICU must be staffed with a dedicated ICU physician team led by the ICU director (CD 11–50). The ICU team may be staffed by critical care physicians from different specialties but must remain surgically directed, as noted above (CD 11–49). The ICU physicians should all be currently board certified or eligible for certification by the American Board of Surgery according to current requirements in critical care. Appropriately trained physicians must be available in-house within 15 minutes to provide care for the ICU patients 24 hours per day (CD 11–51). This coverage may be performed by an appropriately supervised senior surgery resident or an in-house trauma attending credentialed to provide critical care. If the trauma attending provides coverage, a backup ICU attending must be identified and readily available (CD 11–52). This backup coverage can be provided by the backup trauma surgeon (see Table 1).

Table 1 ICU Coverage Constellations by Level

Trauma Center	ICU Team	ICU Director	Coverage	Emergency Coverage	Backup Required
Level I	Unit must be surgically directed and dedicated	Director must be currently board certified in surgical critical care	In-house 24 hours per day (postgraduate year 4 or attending surgeon)	In-house 24 hours per day	May be provided by a backup trauma surgeon
Level II	Trauma surgeon must retain responsibility for the patient and coordinate all therapeutic decisions	Director or co-director must be a surgeon, who should be currently board certified in surgical critical care	Available within 15 minutes (credentialed provider)	In-house 24 hours per day	May be provided by a backup trauma surgeon
Level III	Trauma surgeon must retain responsibility for the patient and coordinate all therapeutic decisions	Director or co-director must be a surgeon	Available within 30 minutes (credentialed provider)	In-house 24 hours per day (may be ED physician)*	—

* The response of an emergency department (ED) physician outside the ED must be monitored and reviewed through the performance improvement and patient safety program (CD 11–59).

In Level II and III trauma centers, a surgeon must serve as co-director or director of the ICU and be actively involved in, and responsible for, setting policies and administrative decisions related to trauma ICU patients (CD 11–53). In a Level II facility, the ICU director or co-director should be currently board certified or eligibility for certification in surgical critical care. In Level II and III facilities, the ICU director or co-director must be a surgeon who is currently board certified or eligible for certification by the current standard requirements (CD 11–54). In Level II trauma centers, physician coverage of critically ill trauma patients must be available within 15 minutes, 24 hours per day, for interventions by a credentialed provider (CD 11–55). In Level III trauma centers, physician coverage of the ICU must be available within 30 minutes, with a formal plan in place for emergency coverage (CD 11–56). The coverage for emergencies is not intended to replace the primary surgeon in caring for the patient in the ICU; it is to ensure that the patient's immediate needs are met while the primary surgeon is being contacted. In Level III trauma centers, the PIPS program must review all ICU admissions and transfers of ICU patients to ensure that appropriate patients are being selected to remain at the Level III center vs. being transferred to a higher level of care (CD 11–57).

In Level I, II, and III trauma centers, the trauma surgeon must retain responsibility for the patient and coordinate all therapeutic decisions (CD 11–58). Many of the daily care requirements can be collaboratively managed by a dedicated ICU team, but the trauma surgeon must be kept informed and concur with major therapeutic and management decisions made by the ICU team (CD 11–59). For all levels of trauma centers, the PIPS program must document that timely and appropriate ICU care and coverage are being provided (CD 11–60). In all Level I, II, and III trauma centers, the timely response of credentialed providers to the ICU must be continuously monitored as part of the PIPS program (CD 11–60).

There must be a designated ICU liaison to the trauma service (CD 11–61). This liaison must attend at least 50 percent of the multidisciplinary peer review meetings, with documentation by the trauma PIPS program (CD 11–62). The ICU liaison to the trauma program at Level I and II centers must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related continuing medical education (CME) (CD 11–63). In addition, it is important that the other members of the ICU trauma team be knowledgeable about, and current in, the care of injured patients. This requirement must be documented by the acquisition of 16 hours of trauma CME per year, on average, or through an internal educational process (IEP) conducted by the trauma program and the ICU liaison based on the principles of practice-based learning and the PIPS program (CD 11–64).

Examples of internal CME include the following: in-service, case-based learning; educational conferences; grand rounds; internal trauma symposia; and in-house publications disseminating information gained from a local conference or an individual's recent participation (through trained analysis) reviewing a trauma center. The IEP should include presentations and discussions on a quarterly basis as a minimum. Ideally, this would be case-based learning that identifies issues through the PIPS process with appropriate dissemination to the trauma team. These presentations should be documented in the performance improvement process. The total hours acquired through an IEP should be functionally equivalent to 16 hours of CME.

ICU Nursing Care and Equipment

At Level I, II, and III trauma centers, qualified critical care nurses must be available 24 hours per day to provide care for patients during the ICU phase (CD 11–65). The patient-to-nurse ratio in the ICU must not exceed two to one (CD 11–66). Trauma-specific educational opportunities and programs should be made available to the critical care nursing staff. The ICU must have the necessary equipment to monitor and resuscitate patients (CD 11–67). This equipment should include, but not be limited to, the capability for continuous cardiac rhythm monitoring, pulse oximetry, capnography, arterial pressure monitoring, pulmonary artery catheterization, rapid transfusion, and patient rewarming. Intracranial pressure monitoring equipment must be available in Level I and II trauma centers and in Level III trauma centers with neurosurgical coverage that admit neurotrauma patients (CD 11–68).

Primary Care Physicians and Pediatricians

The patient's personal physician is important to an injured patient of any age. The primary care physician or pediatrician is helpful in providing information about the patient's history, dealing with long-term problems, and meeting the family's psychosocial health needs. Primary care physicians are also important to provide continuity of care throughout the patient's recovery period and return to health. The immediate presence of the primary care physician is not a requirement, however.

When a committed general surgeon has assumed responsibility for the trauma program in a Level III hospital, he or she should be aware of primary care physicians with an interest in trauma as a potentially valuable resource. Depending on the local circumstances, a primary care physician may serve as a member of the trauma team or the trauma committee or as a surgical assistant for emergencies, or the physician may simply provide continuity of care and serve as a liaison with the family. Trauma patients must not be admitted or transferred by a primary care physician without the knowledge and consent of the trauma service, and the PIPS program should monitor adherence to this guideline (CD 11–69).

Other Surgical Specialists

Many surgical specialists may be needed to properly serve trauma patients. Level I facilities are prepared to manage the most complex trauma patients and must have available a full spectrum of surgical specialists, including specialists in orthopaedic surgery, neurosurgery, cardiac surgery, thoracic surgery, vascular surgery, hand surgery, microvascular surgery, plastic surgery, obstetric and gynecologic surgery, ophthalmology, otolaryngology, and urology (CD 11–70). A multidisciplinary approach is beneficial for the treatment of complex cranial facial injuries. This team should consist of specialists in otorhinolaryngology, oral maxillofacial surgery, plastic surgery, and ophthalmology. Level II centers must have the surgical specialists described for Level I trauma centers and should provide cardiac surgery (CD 11–71). Level III trauma centers must have the availability and commitment of orthopaedic surgeons (CD 11–72). Individuals from other surgical specialties committed to the care of injured patients are desirable at Level III centers.

For all patients being transferred for specialty care, such as burn care, microvascular surgery, cardiopulmonary bypass capability, complex ophthalmologic surgery, or high-complexity pelvic fractures, agreements with a similar or higher-qualified verified trauma center should be in place. If this approach is used, a clear plan for expeditious critical care transport, follow-up, and performance monitoring is required (CD 8–5). If complex cases are being transferred out, a contingency plan should be in place and must include the following:

- A credentialing process to allow the trauma surgeon to provide initial evaluation and stabilization of the patient.
- Transfer agreements with similar or higher-verified trauma centers.
- Direct contact with the accepting facility to arrange for expeditious transfer or ongoing monitoring support.
- Monitoring of the efficacy of the process by the PIPS programs.

Medical Consultants

The complexity of the management of many seriously injured patients may require support from medical specialists, with the trauma surgeon maintaining overall responsibility for the care of the trauma patient. It is appropriate for patients whose trauma issues have been resolved to be transferred to another service for treatment of medical co-morbidities. In Level I and II trauma centers, medical specialists on staff must include specialists in cardiology, internal medicine, gastroenterology, infectious disease, pulmonary medicine, and nephrology and their respective support teams (for example, respiratory therapy, a dialysis team, and nutrition support) (CD 11–73). In a Level III facility, internal medicine specialists must be available on the medical staff (CD 11–74). An organized approach to end-of-life issues involving participation by palliative medicine physicians can be beneficial and should be available at Level I and II centers (Table 2).

Table 2 Medical Specialty Requirements

Trauma Center Level	Internal Medicine	Pulmonology	Cardiology	Gastroenterology	Infectious Disease	Nephrology
I	x	x	x	x	x	x
II	x	x	x	x	x	x
III	x	*	*	*	*	**

X On staff, available within 30 minutes.
* Consultation available within 30 minutes from the internist for problems related to these areas.
** A dialysis transfer agreement must be in place.

Support Services

Several support services are required to care for trauma patients. In Level I and II trauma centers, a respiratory therapist must be available in the hospital 24 hours per day (CD 11–75). In Level III centers, there must be a respiratory therapist on call 24 hours per day (CD 11–76). Acute hemodialysis must be available in Level I and II trauma centers (CD 11–77). Level III trauma centers that do not have dialysis capabilities must have a transfer agreement in place (CD 11–78). Nutrition support services must be available in Level I and II centers (CD 11–79).

Clinical Laboratory

In trauma centers of all levels, laboratory services must be available 24 hours per day for the standard analyses of blood, urine, and other body fluids, including microsampling when appropriate (CD 11–80). The blood bank must be capable of blood typing and cross-matching (CD 11–81). For Level I and II centers, the blood bank must have an adequate in-house supply of red blood cells, fresh frozen plasma, platelets, cryoprecipitate, and appropriate coagulation factors to meet the needs of injured patients (CD 11–82). In Level III centers, the blood bank must have an adequate supply of packed red blood cells and fresh frozen plasma available within 15 minutes (CD 11–83). Trauma centers of all levels must have a massive transfusion protocol developed collaboratively between the trauma service and the blood bank (CD 11–84). Coagulation studies, blood gas analysis, and microbiology studies must be available 24 hours per day (CD 11–85). Thromboelastography should be available at Level I and II trauma centers.

Social Work

Medical social workers are an integral part of the multidisciplinary team caring for trauma patients and should be available 24 hours a day, 7 days a week at Level I and II trauma centers. They should have at least a master's degree and be licensed or certified (for example, licensed master social worker [LMSW]). Additional counseling training is often helpful, but if social workers do not have it, psychologists or psychiatrists to provide evaluations and counseling should also be available.

Advanced Practitioners

Nurse practitioners and physician assistants are frequently used to manage trauma patients and may be incorporated into specialized teams engaged in trauma care. At Level I trauma centers, advanced practitioners often supplement the coverage provided by resident staff. In Level II, III, and IV trauma centers, where residents are not required for verification, advanced practitioners may play an important role in the care of trauma patients. Autonomy of practice, prescriptive authority, and other operational aspects of practice for these providers (for example, credentialing and billing) vary by state, by individual hospital bylaws, and by provider type.

It is the responsibility of the trauma medical director to establish the roles and responsibilities for advanced practitioners participating in the trauma program. The level of involvement must account for state law governing practice of advanced practitioners, hospital policy, and individual scope of practice. Advanced practitioners who participate in the initial evaluation of trauma patients must demonstrate currency as an Advanced Trauma Life Support® provider (CD 11–86). The trauma program must also demonstrate appropriate orientation, credentialing processes, and skill maintenance for advanced practitioners, as witnessed by an annual review by the trauma medical director (CD 11–87). Advanced practitioners should participate in the trauma PIPS program.

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Rehabilitation

The rehabilitation of injured patients should begin the first hospital day. Acute care should be consistent with preservation of optimal functional recovery. The ultimate goal of trauma care is to restore the patient to preinjury status. Not only is this effort best for the patient; it also is less costly. When rehabilitation results in independent patient function, there is a 90 percent cost saving compared with costs for custodial care and repeated hospitalizations.

The Rehabilitation Team

Rehabilitation requires input from an organized multidisciplinary team. A physician with special interest and training in physical medicine and rehabilitation (a physiatrist) most often assumes leadership of the rehabilitation team. Physicians in the disciplines of general surgery, neurosurgery, or orthopaedics may take a leadership role, providing they have the level of skill, training, and dedication necessary to perform their duties.

Each patient should be assessed for rehabilitation needs. Patients requiring rehabilitation should have a detailed evaluation by the rehabilitation team as early as possible in their hospitalization. The purpose of this evaluation is to set realistic goals and to determine, to the extent possible, the potential for rehabilitation benefit. Rehabilitation requires a major commitment by both the patient and the program to be successful. It is appropriate to make plans early on to determine the needs for specific components of therapy.

Rehabilitation of all functional deficits is not always simultaneous. For example, orthopaedic rehabilitation may necessarily precede neurologic rehabilitation. Neurologic injuries should not preclude therapy for other body systems. Physical therapy is provided at the bedside well in advance of the return of significant neurologic function to minimize the complications of prolonged immobilization.

Rehabilitation Assessment Systems or Quality-of-Life Assessment

All patients should undergo objective functional outcome measurements that are compatible with a regionally determined outcome standard. Such measures include, among others, the Functional Independence Measure (FIM), the Short Form-36 (SF-36), and the Quality of Well-being (QWB) index.

Additional Needs of a Rehabilitation Program

Nutritional Support

Nutritional evaluation and therapy are adjuncts to a good rehabilitation program. Minimizing weight loss assists patients in recovering from their injuries. Assessment of nutritional needs and follow-up to ensure that patients are receiving adequate nutritional support are necessary. Many injuries cause significant nitrogen loss, which cannot be prevented in the acute phase. Support with adequate protein and caloric intake is necessary to prevent excessive loss of protein and body mass.

Pain Control

A pain service is a valuable part of the rehabilitation team. Patients with posttraumatic sequelae such as reflex sympathetic dystrophy, phantom pain, and chronic limb spasticity following spinal cord injury will benefit from pain control.

The Joint Commission's pain relief standards, established in 2001, require that hospitals have a plan regarding how these standards will be met. Under these standards, a patient has the right to appropriate pain assessment and management, which requires a tool to routinely assess and document pain relief. See *www.jointcommission.org/topics/pain_management.aspx* for the latest version of the pain control standards.

Psychiatry, Psychology, and Posttraumatic Stress Disorder Intervention

The disciplines of psychology and psychiatry are important to the trauma center's acute care and rehabilitation teams. Epidemiologic investigation at U.S. trauma centers demonstrates that approximately 20–40 percent of injured trauma survivors experience high levels of posttraumatic stress disorder (PTSD) and/or depressive symptoms during the year following injury. A series of investigations now demonstrate a strong relationship between the symptoms of PTSD, depression, and functional impairments after injury. In a nationwide U.S. study, PTSD and depression made an independent dose-related contribution to the inability to return to work within 12 months after injury hospitalization for 67 percent of individuals with one of the disorders and 78 percent of individuals with both disorders. Untreated PTSD and depression are also associated with increased health care and societal costs.

Early screening and referral for psychotherapy and pharmacologic treatment of PTSD and related co-morbid depression following injury have the potential to improve symptomatic and functional outcomes. The incorporation of routine trauma center–based screening and intervention for PTSD and depression is an area that could benefit from the ongoing integration of emerging data and evolving expert opinion.

PTSD requires an etiologic agent from outside the individual (that is, the traumatic event) rather than an inherent individual weakness (that is, a traumatic neurosis). The operational definition of *trauma* is key to understanding PTSD. Initially, catastrophic events were used as models; more recently, injuries of many types have been shown to induce symptoms consistent with PTSD. The diagnostic criteria for PTSD and a 17-point PTSD checklist are provided at *www.facs.org/quality-programs/trauma/vrc/resources*.

A plan to evaluate, support, and treat PTSD should be considered in any comprehensive rehabilitation program for injured patients. Recent estimates place PTSD prevalence rates at 5 and 10 percent among American men and women, respectively. This topic is important to trauma centers in critical incident stress debriefing, which is thought to be an important part of recovery following a civilian disaster. Whether early interventions decrease PTSD in caregivers or patients is unknown.

Because the relationship between PTSD and depression is clear, routine screening for depression following injury is prudent. The PHQ-9 Patient Depression Questionnaire, a simple self-assessment tool for patients, is provided at *www.facs.org/quality-programs/trauma/vrc/resources.*

Support Groups

Support groups dealing with certain types of injury may be important sources of rehabilitation information for patients and family members alike. In addition, family support of injured patients undergoing rehabilitation is critical. Provisions should be made to allow the family to participate in the rehabilitation process. This participation is particularly important because many of the techniques used during acute rehabilitation will be continued when the patient returns home.

Support groups, including 12-step programs, exist for patients with alcohol and drug abuse and addiction. Peer intervention and referral may be useful in encouraging participation in such support groups. Long-term participation in such groups has been shown to decrease the likelihood of relapse. Listings of local support groups for abusers of alcohol and other drugs are available locally.

Support groups also exist for patients with PTSD. Although these groups have not been specifically shown to reduce symptoms of PTSD, they do provide other benefits by allowing participants to realize that others are going through similar challenges, identifying ways to handle day-to-day issues, and rebuilding trust.

Finally, support groups are helpful in achieving maximal recovery for brain-injured and spinal cord–injured patients. Local, regional, and national groups are available, and most of these groups provide free information. The identification of local groups is helpful to patients with brain and spinal cord injuries.

Specific Rehabilitation Programs

Optimal rehabilitation systems for trauma patients are still developing. Regional rehabilitation centers specializing in the physical and vocational rehabilitation of multiply injured patients should be developed to assist patients and society in the most efficient return to function.

Brain Injury

Patients with brain injury require many levels of rehabilitation. The type and length of rehabilitation needed vary greatly and depend on the location and type of brain injury, initial symptoms, age, co-morbidities, general health, and associated injuries. Rehabilitation should start as soon as possible with simple physical therapy. Specialized brain rehabilitation interventions are more likely to be needed as brain injury severity increases. A coordinated, multidisciplinary approach is the most effective means of helping brain-injured patients progress and recover as quickly as possible. Specialized neurorehabilitation programs are useful. An effective rehabilitation program includes family members and local support groups.

Specific intervention might include a neuropsychological assessment, physical therapy, occupational therapy, speech therapy, nutritional assessment, and psychological support. Speech therapists may help with swallowing problems and their effect on nutritional health. Psychological assessment may need to address posttraumatic stress syndromes. Special medical problems should be referred to appropriate medical and surgical specialists.

The goal of acute care of brain-injured patients should be to enter them into a long-term brain rehabilitation program, when needed.

Spinal Cord Injury

Spinal cord injury rehabilitation is another specialized area of rehabilitation medicine that a trauma center should incorporate into its care plans. Although the acute care of patients with spinal cord injuries is important, long-term care should begin at the same time. Proper skin care, respiratory care, ventilator use, nutrition, and urinary and bowel care are all part of spinal cord injury rehabilitation.

Orthopaedic Injury

Musculoskeletal injuries are among the most common forms of trauma and are the predominant cause of workers compensation claims. Orthopaedic rehabilitation tends to focus on the orthopaedic injury, but studies indicate that the injury itself is a small part of rehabilitation for these patients. As with other injuries, a complete program of rehabilitation that includes assessment of age, socioeconomic status, preinjury health, and social support is necessary. These findings emphasize that rehabilitation, like every part of trauma care, is a multidisciplinary practice and cannot be done effectively by one group alone.

The goal of rehabilitation is to return an injured individual to society with the maximum function consistent with his or her injuries. To meet this goal, orthopaedic rehabilitation frequently uses the following services: (1) occupational therapy, (2) physical therapy, (3) prosthetics, and (4) orthotics. The goal is best accomplished by a cooperative team approach between the surgeon responsible for the acute management of the patient and the rehabilitative specialist. For skeletal injuries, rehabilitation protocols should be adjusted to individual patient needs and be supervised by the surgeon responsible for the management of the patient. Patients' weight bearing and range of motion limitations as set by the orthopedic surgeon should be clearly communicated on a daily basis and at the time of discharge.

The overall rehabilitation program should be managed by a rehabilitation specialist and appropriate allied health personnel. Rehabilitation protocols should begin at the time the patient enters the hospital and continue after discharge, as indicated. The return to full activity after major musculoskeletal injury often requires a year or more.

Geriatric Population

An age-defined model of geriatric care is most commonly used. It is based on chronologic age as the screening variable for selecting patients. The cutoff age varies between 65 and 85 years. Regardless of definition, the U.S. population is aging. The proportion of the population older than 65 years is predicted to reach 20 percent by 2050. Elderly patients present many challenges to any trauma system and have higher mortality and morbidity than comparably injured younger patients. Improving outcomes for this age group requires functional rehabilitation plans suitable for elderly patients.

The goals of rehabilitation for elderly patients after injury may not be the same as for younger patients. The ability to return to independence in the basic activities of daily living is often the end point of the rehabilitative efforts. These efforts include patient-centered care that focuses on the activities of daily living. Environmental changes also may be needed to support functional independence. The patients' social support systems also should be assessed. Specific outpatient geriatric programs should be included.

Pediatric Population

Facilities and organizations tailored to the pediatric population are the ideal environment for rehabilitation of injured children. A concerted effort should be made to allow children to continue schoolwork even when they are confined to a hospital or home. Valuable adjuncts for homebound patients are the availability of teachers or technological alternatives.

These types of programs, like rehabilitation programs for individuals with brain and spinal cord injuries, usually require preplanning. Transfer agreements should be in place.

The Hospital Facility

In Level I and II trauma centers, rehabilitation services must be available within the hospital's physical facilities or as a freestanding rehabilitation hospital, in which case the hospital must have transfer agreements (CD 12–1). In any case, a clear understanding of rehabilitation capabilities should be incorporated into the trauma program. Rehabilitation needs in the critical care unit are sometimes overlooked. In ventilated patients, for example, physical therapy to maintain joint flexibility and some muscle strength should be emphasized. Proper ventilator management with defined weaning and extubation protocols is often overlooked as a rehabilitation issue for injured patients.

Rehabilitation consultation services, occupational therapy, speech therapy, physical therapy, and social services are often needed in the critical care phase and must be available in Level I and II trauma centers (CD 12–2). The time of discharge from the intensive care unit is too late to begin rehabilitation services.

Physical therapy (CD 12–3) and social services (CD 12–4) must be provided in Level I, II, and III trauma centers. Occupational therapy (CD 12–5) and speech therapy (CD 12–6) must be provided in Level I and II centers. In Level I and II trauma centers, these services must be available during the acute phase of care, including intensive care (CD 12–7). Policies for proper transfer into a rehabilitation facility and proper follow-up after discharge from the rehabilitation facility should be a component of all trauma programs. Inclusion of these data in the performance improvement process of the trauma program should be considered. Physical therapy should be available every day in Level I and II trauma centers to facilitate outcomes and reduce length of stay.

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Rural Trauma Care

A trauma system is deemed rural when the optimal care of injured patients is delayed or limited by geography, weather, distance, or resources. One of the difficulties with rural trauma care is that there is a low volume of patients, who quite often have high-acuity injuries. Optimal care demands consistent and frequent trauma education and training, yet the low-volume nature of rural trauma makes financial expenditures for such training less cost effective. Organizing scheduled time for staff to participate in education programs can also be difficult because of the limited numbers of health care providers in rural facilities. The use of telemedicine, teleconferencing, Web conferencing, and other Internet-based educational programs is increasing access to trauma education in rural areas. Additionally, telemedicine provides opportunities for real-time consultation between rural health care providers and surgeons or other experts at higher-level trauma centers.

Falls are the most common mechanism of injury in rural areas. Injuries caused by motor vehicle crashes are also frequent. Nationally, one-quarter of such injuries occur in the rural environment but account for two-thirds of the vehicular deaths. In addition, four of the top five occupations with the highest death rates are rural in nature: commercial fishing, logging, farming/ranching, and mining.

Penetrating injuries are rarer in rural settings compared with the urban environment. However, morbidity and mortality are high, as these injuries frequently involve large-caliber, high-velocity weapons. Additionally, these wounds are often self inflicted (suicide) at close range.

Because of the isolated areas in which injury occurs, there are many potential causes for delay that contribute to increased rates of morbidity and mortality. Causes of delay in treatment are discussed in the Rural Trauma Team Development Course© (RTTDC©).

The basic principles of trauma care in urban and rural areas are the same, with Advanced Trauma Life Support® (ATLS®) providing the foundation for the initial care of trauma patients and the development of an inclusive trauma system building the framework for comprehensive inclusion and integration of resources. The RTTDC has been developed in an effort to address problems unique to the rural environment.

Optimal care of the rural trauma patient involves a rapid expert prehospital response, prompt transport to the most appropriate health care facility or trauma center where proper application of ATLS principles are implemented, and when needed, expeditious transport or transfer to a definitive trauma center. The trauma system ensures rapid transportation of patients to the highest appropriate level of care.

Emergency medicine physicians, family medicine physicians, or midlevel practitioners provide initial trauma care in Level IV trauma centers, critical access hospitals, and many community hospitals. Collaboration and communication with Level I, II, and III trauma centers in the region are critical. Direct contact of the physician or midlevel provider with a physician at the receiving hospital is essential (CD 4–1). Transfer guidelines and agreements between facilities are crucial and must be developed after evaluating the capabilities of rural

hospitals and medical transport agencies (CD 2–13). All transfers must be evaluated as part of the receiving trauma center's performance improvement and patient safety (PIPS) process (CD 4–3), and feedback should be provided to the transferring center. (See Chapter 4, Interhospital Transfer.)

Because of the low-volume, high-acuity nature of rural trauma, it is crucial to maintain continuing education and evaluation in the system. A trauma registry that supports timely review evaluates trauma care across the continuum and helps to identify weaknesses in the trauma system. The primary responsibility for ongoing education often rests with Level I and II trauma centers within a rural region. These regional resource centers should provide ongoing educational programs to rural Level III and IV centers.

Additionally, rural trauma centers and hospitals should be engaged in regional performance improvement activities, again often relying on regional Level I, II, and III trauma centers to help lead that effort.

The Prehospital Setting

The prehospital setting in rural areas can be a source of significant challenge. Injuries occur in areas where access is extremely difficult, and prolonged extraction or mobilization of search and rescue teams may be required. Crashes along rural roads may not be witnessed or immediately discovered. In spite of ever improving cellular telephone coverage and the fact that more than 95 percent of counties have some E9-1-1 phase I capabilities (cellular phone numbers are automatically transmitted and calls are routed to the appropriate answering point based on tower location), radio and cellular communications remain a challenge in some rural, frontier, and wilderness areas.

Maintaining skills in rural areas where trauma is less frequently encountered is difficult, especially for volunteer emergency medical services (EMS) systems. To retain rural volunteers, attempts should be made to make training as convenient as possible. Innovative educational programs that include asynchronous learning (e-learning and mobile learning) and telehealth resources may offer exciting new ways to improve and maintain the skill levels of rural EMS practitioners. Governmental and regional health care system support is important for successful rural efforts to provide prehospital care. Prehospital systems should be based on the ATLS® principles, as promulgated by Prehospital Trauma Life Support (PHTLS)© and International Trauma Life Support (ITLS).

In addition, a qualified medical director for prehospital services adds consistency, value, and judgment to training and performance improvement. With the increased use of telehealth, the feasibility of regional or statewide standardization and coordination with EMS medical directors makes it possible to raise the standard of care in the rural prehospital setting. It is also important that the current system, which depends on local medical directors, include upgrading of medical director training programs. The inclusion of regional or state prehospital medical director positions as a part of the state trauma system increases the ability to improve the medical direction in rural trauma care.

Interhospital/Interfacility Transfer

The time and distance involved in the transport of an injured rural patient to a trauma center are associated with delays in definitive care. Therefore, initial stabilization and resuscitation at receiving facilities are frequently necessary. A well-organized trauma system involving the coordination of trauma receiving facilities within a region provides effective and safe care. The barriers of geography and weather may hinder rapid transport by either ground or air. A rural facility should evaluate its resources and capabilities and have in place a plan for the prompt transfer of patients when appropriate. Coordination of transport within a region should be a system responsibility. Modes of transportation, personnel, and equipment should be well defined in advance. Decisions and arrangements for transfer should be made as soon as it is known that the needs of a patient exceed local resources. Life-threatening conditions identified during the primary survey should be addressed prior to transfer when the resources to do so are available. The decision to transfer a patient should be based on clinical assessment and be made promptly or immediately. Interventions prior to transfer depend on the transferring facilities. A collaborative agreement between the rural facility and the closest receiving trauma center is important in identifying and resolving PIPS issues.

Rural hospitals face the problem of obtaining interpretation of imaging studies. Rural facilities often need to transfer patients outside the community to centers that can offer a higher level of care. Therefore, it is recommended that imaging protocols be acceptable to both referring and receiving hospitals to prevent the unnecessary repetition of radiographic studies. Teleradiology and radiology picture, archiving, and collection (PAC) systems are useful and should be considered for image sharing by centers that serve rural populations. Level I and II centers must be able to read images from referring centers (CD 11–41).

The Rural Trauma System

Optimal care of the injured patient in a rural setting necessitates the development of an inclusive trauma system in which all facilities involved in the initial care of injured patients are included and their roles defined. This involvement may range from a Level I or II trauma center that serves a rural area to a small clinic located in an isolated area. All components of the system should have their roles identified. In addition, the roles of each component should be specifically designed to optimize patient care.

The optimal care of trauma patients in rural areas involves an effective relationship with state and regional governmental agencies. Participation by all health care facilities in the state or region promotes a successful rural system. Level I or II trauma centers in adjoining states may also play a significant role when establishing a system that provides optimal care. Involving these out-of-state facilities early in the process of system development is an important consideration for success.

The American College of Surgeons Committee on Trauma (ACS-COT) offers a multidisciplinary consultation program that reviews trauma systems. The consultations are designed to help improve a system at any phase of its development. (Additional information may be found in Chapter 1, Regional Trauma Systems: Optimal Elements, Integration, and Assessment, and at *www.facs.org/quality-programs/trauma/tsepc/resources*.)

Because of the regional nature of some rural trauma problems, the establishment of regional trauma advisory committees facilitates identification of problems and their appropriate solutions. Statewide oversight of these committees should help maintain appropriate levels of involvement and quality of care. An important component of the inclusive trauma system is ongoing education by Level I and II trauma centers for facilities in their relevant catchment areas.

Trauma centers should establish a relationship that provides continuing education and assistance in the trauma performance improvement process for small hospitals and rural physicians. To facilitate this effort, the rural trauma committee of the ACS-COT has developed the RTTDC.© This course is designed to help rural facilities develop their trauma teams, coordinate their response to major injuries, and initiate early transfer to definitive care. Level I and II trauma centers serving rural communities should provide RTTDC © training as outreach. RTTDC © training also leads to improved communication and strengthened relationships among the centers.

The Level II trauma center is the lead institution in many settings and, in fact, is often the highest-level hospital in rural areas. The rural Level II trauma center should contribute to improving the quality and level of care in its entire region through education and outreach. The criteria for trauma center verification are identical for rural and urban centers.

Level III centers represent acute care facilities that provide initial resuscitation of trauma patients, immediate operative intervention to control hemorrhage (such as a damage control laparotomy), and in the case of identified critical injuries, stabilization before transfer to a higher level of care. A significant percentage of patients will remain at Level III trauma centers if their injuries do not require transfer and local resources are adequate. Level III trauma centers should also be involved in the ongoing education and support of the more rural facilities in their region, particularly if they represent the highest-level resource in the region.

Level IV facilities face a lack of surgical coverage. These centers form the bedrock of the rural health care system and are staffed with advanced practice clinicians (nurse practitioners and physician assistants). Resources are not abundant, but with organization and training, these facilities can deliver effective trauma care and must be included in the trauma system. The ACS criteria for Level IV trauma centers are provided in tabular form at the ACS website at *www.facs.org/quality-programs/trauma/vrc/resources.*

Some states identify Level V trauma facilities. They represent trauma receiving centers that may be available on only a part-time basis, such as a ski area clinic that is seasonal and may be open only during daylight hours even during ski season. To provide optimal care, Level IV and V facilities need to have institutional support, a dedicated and well-trained trauma team, appropriate equipment, and a structured performance improvement process. Details pertaining to LIV criteria can be found at *www.facs.org/quality-programs/trauma/vrc/resources.* These facilities are needed in very sparsely populated areas to stabilize and initiate the early transfer of trauma patients based on ATLS® and RTTDC © principles.

Trauma Registry

The foundation for evaluation of a trauma system is the establishment and maintenance of a trauma registry (CD 15–1). The effectiveness of the delivery of care to the trauma patient and the overall coordination throughout an inclusive system require the compilation of data regarding injured patients and their outcomes. For injury prevention and to fully evaluate the overall scope of injury within a trauma region, it is often necessary to link different sources of data in addition to the trauma registry. It is valuable to have every injury entered into the collective database to provide sufficient numbers for performance improvement and program analysis. Trauma registries should be used for improving patient care, evaluating the adequacy of the system, and assessing uniformity through the various regions within the trauma system. Injury prevention, provider education, effective communication, and smooth flow of patient transfer from scene to receiving hospital and ultimately to definitive care must be ensured.

It is only through ongoing evaluation of trauma registries and other data that performance improvement can be facilitated. Rural trauma centers and other acute care facilities should transmit trauma registry and injury care data to a regional or statewide repository.

Performance Improvement and Patient Safety

Trauma care, whether urban or rural, relies on a robust performance improvement program as defined in Chapter 16, Performance Improvement and Patient Safety. It is only through the constant evaluation of care and seeking opportunities for improvement that trauma care can be improved. The rural setting presents challenges that trauma care in a more urban environment does not face. The facility will not have the resources that are available at a Level I or II trauma center; however, meaningful evaluation and improvement of care can still occur with a review of trauma patients cared for at the facility. This review can be facilitated by the use of the hospital's trauma registry. The frequency of this review will be based on volume of patients seen. Issues that must be reviewed will revolve predominately around: (1) system and process issues such as documentation and communication; (2) clinical care, including identification and treatment of immediate life-threatening injuries (ATLS); and (3) transfer decisions (CD 16–10).

It is important that the rural facility and the Level I and II centers establish an excellent working relationship, especially with regard to transferred patients' outcomes and the planning and implementation of the rural system. A system-wide trauma registry will facilitate this process. Teleconferencing for the performance improvement conference is one way to learn of patient outcome results. (See Chapter 16, Performance Improvement and Patient Safety, for more detailed information regarding performance improvement.)

Providing trauma care in rural areas presents unique challenges. The best possible care for patients must be achieved with a cooperative and inclusive program that clearly defines the role of each facility within the system (CD 1–1).

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Guidelines for Trauma Centers Caring for Burn Patients

Burn Center Verification is overseen by the American Burn Association (ABA) Verification Committee with the endorsement of the American College of Surgeons Committee on Trauma (ACS-COT). The criteria for Burn Center Verification (and criterion deficiencies) are subject to change in a much more fluid fashion than is possible with the publication of this chapter. The ABA, in agreement with the ACS-COT, thus presents in this chapter the *principles* required for the operation of burn centers.

The ABA/ACS verification was developed to externally validate quality of care by U.S. burn centers. Increasingly, the process will emphasize outcomes, in addition to evaluating infrastructure and process. The ABA verification website includes the specific requirements for verification, including criterion deficiencies. (Click on the "Verification" tab at *www.ameriburn.org*.)

Each year in the United States, burn injuries result in more than 500,000 hospital emergency department visits and approximately 50,000 acute admissions. Most burn injuries are relatively minor, and patients are discharged following outpatient treatment at the initial medical facility. Of the patients who require hospitalization, approximately 20,000 are admitted directly or by referral to hospitals with specialized multidisciplinary programs dedicated to the treatment of burn injuries. These service capabilities, along with the setting in which they are provided, are termed *burn centers*. The guidelines in this chapter, developed in partnership with the ABA, define the burn care system, organizational structure, personnel, program, and physical facility involved in establishing the eligibility of a hospital to be identified as a burn center.

Trauma centers that do not have a burn center within the same hospital should establish communication and collaboration with a regional burn center and assess, stabilize, and arrange safe transport for seriously burned patients. Assessment should follow Advanced Burn Life Support® (ABLS®) and Advanced Trauma Life Support® (ATLS®) guidelines. The burn center should be contacted and the potential necessity for transfer discussed with the senior burn surgeon. In the absence of other injuries, the condition of burn patients usually is easily stabilized, and patients can withstand early long-distance transport with resuscitation en route.
Trauma centers that refer burn patients to a designated burn center must have in place written transfer agreements with the referral burn center (CD 14–1). It should be the responsibility of the trauma center and the burn center director to keep the transfer agreement current. Collaborative arrangements for the transfer of patients from other hospital units, such as a trauma unit or a surgical intensive care unit, should include protocols for transfer and acceptance.

Burn patients who are treated by the trauma service and who meet other inclusion criteria, such as length of stay, should be included in the trauma registry and counted among the total trauma population. Burn patients who are transferred externally to a burn center or internally to a burn service should not be included in the trauma registry or be counted in the total trauma population.

Burn Center Referral Criteria

A burn center may treat adults, children, or both. Burn injuries that should be referred to a burn center include the following:

- Partial-thickness burns of greater than 10 percent of the total body surface area.
- Burns that involve the face, hands, feet, genitalia, perineum, or major joints.
- Third-degree burns in any age group.
- Electrical burns, including lightning injury.
- Chemical burns.
- Inhalation injury.
- Burn injury in patients with preexisting medical disorders that could complicate management, prolong recovery, or affect mortality.
- Burns and concomitant trauma (such as fractures) when the burn injury poses the greatest risk of morbidity or mortality. If the trauma poses the greater immediate risk, the patient's condition may be stabilized initially in a trauma center before transfer to a burn center. Physician judgment will be necessary in such situations and should be in concert with the regional medical control plan and triage protocols.
- Burns in children; children with burns should be transferred to a burn center verified to treat children. In the absence of a regional pediatric burn center, an adult burn center may serve as a second option for the management of pediatric burns.
- Burn injury in patients who will require special social, emotional, or rehabilitative intervention.

Guidelines for the Operation of Burn Centers

Burn Care System

A *burn care system* should be considered a coordinated component of an emergency medical services system that encompasses one or more burn centers and features communication links to, and triage–transfer protocols among, health care facilities, prehospital personnel, and transportation services. Within this comprehensive emergency medical system, trauma and burn centers should work together in a coordinated way to develop educational and performance improvement and patient safety (PIPS) programs that benefit injured patients. To fulfill this requirement of coordinated care, there must be commitment from the administration of the burn center, and the hospital should maintain accreditation with the Joint Commission or alternative accrediting agency. As evidence of this commitment, the burn center should have written guidelines for the triage, treatment, and transfer of burn patients from other facilities.

The burn center must also demonstrate commitment to the development of, and participation in, regional mass casualty/disaster coordination. This burn center commitment must include providing education to the community regarding the early treatment of burn care, such as sponsoring ABLS® courses.

Organizational Infrastructure

The burn center must maintain policies and procedures that document the structure, staffing, and operation of the organization to verify the administration and staffing of the center. These policies and procedures should identify criteria for admission, use of burn beds by other services, criteria for discharge and follow-up, transfer policies, and care for inpatient burn patients outside the burn unit.

The burn center must also maintain a database of its admissions. At a minimum, verification requires that the burn center submit to the ABA's National Burn Repository a de-identified minimal data set (available on the ABA website) for all admissions. This process is easily accomplished with the ABA's TRACS system, but it may be accomplished through other databases. It is required that all patients admitted to the burn center for acute care be included in this database. Additionally, it is recommended that burn centers use their local registry to track outcomes and regularly review these data to identify areas for improvement.

Verification requires a large enough number of admissions to maintain clinical competency (for medical staff, nursing, and therapy) in the critical care nature of burn patients. This requirement means that the burn center must admit and maintain a census that indicates continuous exposure to complex burn care. Because a burn center may be verified as either an adult, pediatric, or combined adult and pediatric center, the burn center must have sufficient experience with each type of patient (adult and pediatric) that staff members have the clinical skills necessary to treat patients in the extremes of age. To be verified as an adult center, the burn program must admit and maintain an adequate census of adults; for pediatric burn centers, the program must admit and maintain a census indicative of experience in dealing with young children (younger than 4 years) and older children with extensive burns. Exact volume requirements are available on the ABA website. With the national trend toward outpatient burn management, experience with outpatient burns, and especially same-day surgery, fulfills some of these volume requirements. However, even burn centers with a robust outpatient burn program must demonstrate adequate experience with critical care inpatient burn patients.

Medical Personnel

Burn Center Director

The burn center director must be granted the necessary authority to direct and coordinate all services for patients admitted to the burn center. The director must maintain current board certification in surgery or plastic surgery and preferably have current board certification in critical care; additionally, the burn center director either must have completed a burn fellowship or must have at least 2 years of clinical burn experience. The burn center director is responsible for creating and maintaining policies and procedures related to most activities involved in the care of burn patients. The burn center director must ensure that medical care conforms to burn center protocols. The specific requirements are covered at the ABA website. The burn center director should demonstrate dedication to the burn program and expertise in the management of burn care by managing an adequate number of burn patients and performing a large enough number of burn

surgical operations. As leader of the burn program, the director should be involved with burn-related research or intellectual pursuits. The burn center director must demonstrate engagement in community outreach and regional burn education programs such as ABLS.

Some burn centers, especially outside the United States, have a successful model of care in which the burn center director is the provider who oversees surgical care and a dedicated burn intensivist oversees much of the medical management. This system is allowable as long as the model represents a coordinated team approach to care that includes participation in all burn-related activities, including education, process, and PIPS efforts. Consulting a separate critical care or medical care team to manage patients does not meet the requirements for a verified burn center.

Attending Burn Surgeons

The burn center director may appoint qualified attending staff burn surgeons to participate in the care of patients on the burn service. The attending surgeons must be qualified (based on board certification or the standards established in Chapter 6, Clinical Functions: General Surgery). These surgeons must also demonstrate expertise in the care of burn patients by completing a burn fellowship or by having at least 2 years of experience in the management of burns within the past 5 years. They must participate in the care of an adequate number of patients and maintain an adequate amount of continuing medical education.

Burn Service Coverage

The burn center must have 24-hour continuous coverage and timely attending surgeon backup. An on-call schedule must be maintained. In addition to call coverage, the burn center should have readily available consultants of multiple specialties (as indicated on the ABA website).

Nursing Personnel

Nurse Manager

A nurse manager qualified to manage the nursing program of the burn center must have sufficient experience in burns and nursing leadership to lead the staff. As evidence of the nurse manager's leadership, there should be an organizational chart indicating his or her role in the burn program. The nurse manager should be an active participant in burn-related clinical, education, and PIPS activities. These requirements can be addressed by attending regional, national, or international burn meetings; being an ABLS instructor; and being involved in the ABA.

Nursing Staff

The burn center should have qualified nurses to take care of the burn patients. Nurse staffing grids should be dictated by a patient care plan. Commitment to maintaining competencies related to burn and wound care should include a burn orientation program and ongoing burn-related educational modules. Staff should receive burn-related continuing education yearly.

Rehabilitation Personnel

Because rehabilitation is so important for the functional recovery of burn patients, an organized rehabilitation program with patient-specific goals is essential. This program requires a sufficient number of licensed physical therapists (PTs) and occupational therapists (OTs) who cover the burn rehabilitation needs of the burn unit. Both PT and OT coverage is required, and speech therapy is ideal. The PTs and OTs must be licensed, and working in the burn program must be their primary role. They must maintain continuing education and participate in burn-related education.

Other Personnel

Because burn care requires an organized and coordinated multidisciplinary team effort, many specialties contribute to the program. Some of the key ancillary team members are the following:

- Physician extenders
- Pediatricians (mandatory for pediatric burn centers)
- Physiatrists
- Social workers
- Nutritional services personnel
- Pharmacy personnel
- Respiratory care services personnel
- Clinical psychiatry or psychology personnel
- Peer support personnel
- Child life or recreational therapy personnel (mandatory for pediatric burn centers)
- Continuity of care program members

More extensive details are provided on the ABA website; click on the "Verification" tab at *www.ameriburn.org.*

Performance Improvement and Patient Safety Program

All burn centers must demonstrate evidence of an active multidisciplinary PIPS program. The burn center director is responsible for running the PIPS program. However, a multidisciplinary committee that includes independent peer review must oversee the performance program and must meet at least monthly to identify opportunities for improvement, take corrective actions, and resolve problems in a timely manner. There must be clear evidence of loop closure.

There must be at least monthly morbidity and mortality conferences with the participation of physicians other than those involved in the immediate care of burn patients. All significant complications and all deaths must be discussed. Recommendations for improvement as indications of loop closure must be documented as warranted. All records of the conference must be maintained.

There should be a multidisciplinary weekly patient care conference to discuss patient care needs. These conferences should include all of the team disciplines and must document the patient progress and transition of care.

The burn center must perform an annual audit of outcomes, including severity of burns, mortality, incidence of complications, and length of hospitalization. Other recommended data review includes tracking longer-term patient outcomes such as ability to return to work or school, as well as reviewing burn center financials.

Other Programs

Educational Programs

The burn center must provide educational programs for the medical and other staff. If residents and fellows rotate on the burn service, an educational plan must also exist for them.

Infection Control Program

The burn center must demonstrate a commitment to minimizing hospital-acquired infections. The center must have an effective means of isolation consistent with the principles of universal precautions and barrier techniques to decrease the risk of cross-infection and cross-contamination. Ongoing review of nosocomial infections must be available to the burn team.

Burn Prevention Program

The burn center must have an active burn prevention program to promote burn awareness to the community.

Research Program

The burn center must participate in some form of research related to burn care. This research could include robust PIPS initiatives that are used to educate the staff internally. The burn center director must be involved in this process; ideally, nursing and therapy leadership also participate in these efforts.

Configuration and Equipment

The burn center must maintain a specialized nursing unit dedicated to acute burn care. The center must be used primarily for patients with burn injuries or wounds with needs similar to those of major burn wounds. There must be at least four beds with intensive care qualifications. It is expected that the burn center have the equipment necessary to manage burn patients (see the ABA website). There must be operating suites that allow for the appropriate and timely surgical treatment of burn patients. Anesthesia support for critically ill burn patients must also be evident.

There should appropriate protocols and interactions with the emergency department of the hospital.

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Trauma Registry

A trauma registry is a disease-specific data collection composed of a file of uniform data elements that describe the injury event, demographics, prehospital information, diagnosis, care, outcomes, and costs of treatment of injured patients. The trauma registrar is a vital and integral part of the trauma team. It is important that the trauma registrar, trauma program manager, and trauma medical director work closely together on an ongoing basis.

Trauma registry data must be collected and analyzed by every trauma center (CD 15–1). The trauma registry is an important management tool that contains detailed, reliable, and readily accessible information needed to operate a trauma center. Data should be aggregated and analyzed by the agency that directs the trauma system at the city, county, or state level. Finally, these data must be collected in compliance with the National Trauma Data Standard (NTDS) and submitted to the National Trauma Data Bank® (NTDB®) every year in a timely fashion so that they can be aggregated and analyzed at the national level (CD 15–2). At a minimum, trauma centers and state agencies should collect the NTDS data set. Trauma centers and state agencies are encouraged to collect the full Abbreviated Injury Scale (AIS)© classification for each patient included in the registry. Beginning with 2015 admissions, participating centers will be required to collect and transmit data compliant with the AIS 05/08 update to the American College of Surgeons (ACS) as part of their NTDB/Trauma Quality Improvement Program® (TQIP®) data. The NTDB® has made an effort to work with trauma registry vendors to make sure that trauma registry programs are compatible with the NTDS, as well as to work with hospitals to provide support throughout the data submission process. In addition, the NTDB® is undergoing the process of becoming Health Level 7 (HL7) approved, which will establish the NTDS as the international standard for trauma data collection. Minor modifications that will occur in data elements during the HL7 process will be handled as part of the NTDS update process and will have little impact on individual trauma registries. Similarly, the NTDB® is equipped to handle the transition to International Classification of Disease v.10 Clinical Modification (ICD10-CM).

The relationship between the hospital's electronic medical records and the trauma registry continues to evolve. Clearly, efforts to limit redundant data entry should be explored. However, it is imperative that the data populating the trauma registry be as accurate, valid, and reliable as possible.

The exact inclusion and exclusion criteria used to select patients for entry into a trauma registry vary across hospitals. Some trauma centers, trauma systems, and state agencies modify the inclusion and exclusion criteria to address the specific needs of their patient populations. See *www.ntdsdictionary.org/dataelements/datasetdictionary.html* for specific criteria and data elements required by the NTDB®. Please note that compliance with the NTDS data collection requirement is defined as passing the data validation rule section as part of NTDB® data submission.

Uses of a Trauma Registry

A trauma registry contains the detailed, reliable, and readily accessible information needed to operate a trauma center. The data in a trauma registry can be used in a variety of ways. The following sections describe uses that improve the care of injured patients across the continuum from injury prevention to outcomes measurement. In addition, the need for all trauma centers to participate in data aggregation at the local, state, and national levels is addressed. This participation improves trauma systems, shapes public policy, and provides the opportunity for trauma centers to compare their outcomes with regional and national benchmarks.

Performance Improvement

Hospitals committed to serving patients with injuries are eager to provide the best care possible. The trauma registry is essential to the performance improvement and patient safety (PIPS) program and must be used to support the PIPS process (CD 15–3). Every trauma center should be able to show that the trauma registry is used to objectively review the care provided to individual patients and to identify variations in the processes and outcomes for groups of patients. The individual institution, regional trauma system, and national aggregate can monitor a variety of parameters, track variability, and document improvement. Examples of variables include prehospital response times; presence and timeliness of care; lengths of stay in the emergency department, intensive care unit, or hospital; incidence of complications such as nosocomial pneumonia; comparison of expected and observed deaths; and cost. These variables, in turn, can be compared with past performance or benchmarks developed from regional or national averages, such as those provided through TQIP (see Chapter 16, Performance Improvement and Patient Safety). Thus, the trauma registry is a tool to drive the performance improvement process for individual hospitals, emergency medical services systems, regional trauma systems, and the provision of injury care at the national level.

Public Health

The trauma registry is only one part of the comprehensive data system needed to describe the entire spectrum of injured patients. These data provide information about the incidence, care, cost, and outcome of injuries. These measures can be stratified further by age, sex, and ethnicity. The aggregation of trauma registry data for a specific geopolitical region to create a population-based depiction of injury as a disease process could be important information for departments of health. Many states already require submission of data to a state trauma registry. Registry data also may be used to inform public officials about trauma as a public health problem, thus serving as a basis for legislative and regulatory efforts.

It is important to acknowledge the variability of trauma system development across the United States. Many patients who sustain severe, life-threatening injuries are not treated in trauma centers. Some states require that data from all acute care facilities treating these patients be reported to a trauma registry, whereas others do not. This inconsistency makes the acquisition of accurate population-based data difficult. Ideally, all acute care facilities that treat injured patients should contribute to a trauma registry.

Injury Prevention

Trauma centers should use the trauma registry to characterize the frequency and patterns of injury in their communities (see Chapter 18, Prevention). This information will lead to the identification of high-risk groups who may benefit from injury prevention programs. Furthermore, these findings must be used to identify injury prevention priorities that are appropriate for local implementation (CD 15–4). The trauma registry should be used to monitor the impact of these interventions. This information can be used to effect changes in policy and behavior.

Trauma Systems

The needs of injured patients span the continuum of injury care, from prevention to outcomes measurement. Injured patients are present in urban, suburban, and rural environments. In addition, they can cross geographic and political boundaries. The trauma center provides only part of the overall care that injured patients require. Trauma systems are needed to implement an organized system of care that meets all the needs of injured patients. Such a system cannot exist without data collection and analysis. Individual trauma registries collect important information about the overall function of trauma systems. These data should be shared and aggregated at the local, state, and national levels to assess trauma system function. It is important that all acute care facilities treating injured patients submit data to a regional or statewide trauma registry.

Outcomes Measurement

Trauma is a major cause of death and disability in our society. Outcomes measurements describe the results of intervention and management. Positive patient outcomes result from effective and efficient systems of care. Outcomes measurement focuses on a wide variety of clinical results, including the quality of life and the level of function achieved by patients who survive trauma. The most effective use of outcomes measurement is through a rigorous process based on standardized data and risk adjustment. Such risk-adjusted benchmarking processes may occur at the regional, state, or national level. The ACS TQIP provides the opportunity for such outcomes measurement. All trauma centers must use a risk-adjusted benchmarking system to measure performance and outcomes (CD 15–5).

Resource Utilization and Cost Analysis

The trauma registry also may serve to document the resources required by a trauma program. It can facilitate reliable evaluation of treatments currently considered the standard of care, new strategies of care for injured patients, and the impact of innovative technologies. This information can be used to justify institutional and financial support of needed personnel and capital expenditures. Such analyses will become increasingly important as purchasers of health care scrutinize the costs and outcomes of individual practitioners, hospitals, and systems that provide trauma care.

Research

Research is used to advance our knowledge of injury. Valid questions can be answered only with reliable data. The trauma registry is a rich source of such data. Trauma centers are encouraged to use their trauma registry data for research. At the national level, the NTDB is the largest aggregation of trauma registry data ever assembled. These data have been provided to hundreds of researchers to answer important questions across the continuum of injury care. Many such analyses have been published in the peer-reviewed trauma literature.

Meeting Requirements for Verification and Designation

The process of trauma center verification and designation requires that trauma centers document their volume, performance, and outcomes over time. In addition, the process requires demonstration of an effective PIPS program (see Chapter 16, Performance Improvement and Patient Safety). A trauma registry is needed to demonstrate that these requirements are met. Trauma registries should be concurrent. At a minimum, 80 percent of cases must be entered within 60 days of discharge (CD 15–6).

Creating and Using a Trauma Registry

Developing a trauma registry requires significant commitment and hard work before the registry begins to approach its potential. Although some centers have designed their own computerized registries, these efforts are no longer necessary. Several effective trauma registry software packages are commercially available. These programs are designed to run on personal computers or hospital computer systems.

Through the intermittent addition of custom fields and the initiation of local performance improvement projects, a trauma registry has a tendency to grow in complexity over time, resulting in considerable expansion of the number of fields captured. To ensure that time is spent most efficiently, the fields within the registry should undergo annual review to determine which ones can be dropped and which ones should be added, as well as to ensure that definitions are consistent with the current NTDS (see *www.ntdsdictionary.org/dataelements/datasetdictionary.html*).

Trauma Registrar

It is important to acknowledge that high-quality data begin with high-quality data entry, and it is the trauma registrar who is responsible for performing this task. Most facilities have an on-site trauma registrar. The trauma registrar is a vital member of the trauma team. Trauma registrars come from diverse backgrounds such as nursing, medical records, computer science, and medical informatics, among others. Ideally, the trauma registrar works directly with the trauma team and reports to the trauma program manager. Trauma registrars should receive initial training when they start the job. They must attend or have previously attended two courses within 12 months of being hired: (1) the American Trauma Society's Trauma Registrar Course or equivalent provided by a state trauma program and (2) the Association of the Advancement of Automotive

Medicine's Injury Scaling Course (CD 15–7). A certifying examination is available through the sponsorship of the American Trauma Society's Registrar Certification Board, leading to the designation of certified specialist in trauma registries (CSTR) or equivalent. Registrars should complete a minimum of 8 hours of registry-specific continuing education per year.

The trauma registrar must demonstrate proficiency with the NTDS. Centers are encouraged to support trauma registrar training by providing educational offerings within the facility. For example, a lecture regarding organ injuries is appropriate training for registrars, because they are expected to code organ injuries, as well as the procedures performed to treat the injuries.

Off-site or contract management of the trauma registrar is not viewed by the ACS Committee on Trauma (ACS-COT) as optimal. However, if the trauma registry is managed at a remote location, the trauma program must have immediate access to those data and must be able to receive standard and custom reports in a timely fashion. If a hospital is relying on remote or contract registry staff, all recommendations and requirements with regard to the registry and registrars still must be met.

Confidentiality

Hospitals are responsible for ensuring patient and hospital confidentiality. The passage of the Health Insurance Portability and Accountability Act (HIPAA) by Congress in 1996 brought about major changes in the way internal and external data are handled at health institutions. The trauma program must ensure that appropriate measures are in place to meet the confidentiality requirements of the data (CD 15–8). All reasonable means should be used to protect against threats, hazards, and unauthorized uses or disclosures of these data. The responsible parties should ensure that all persons dealing with these data are trained in protecting the confidentiality of patients. Actions to protect confidentiality should be firmly integrated in the administration of the registry so that identifying information is available only to people who have a need to know. Facilities that submit data to the NTDB or TQIP or that are participating in trauma center verification must have a current and fully executed business associate agreement with the ACS.

Data Collection

In the planning stages of a registry, it is useful to consider the mechanisms for data collection and entry from medical records and the hospital information system. Data downloading from the hospital information system is expanding. The use of portable computers and handheld devices for data extraction and data entry is popular. It allows registrars to work concurrently from the medical record and interviews. Alternatively, a paper data form may be designed to record patient information for subsequent batch data entry. The least desirable method is postdischarge data extraction from the medical record. Once collected, these data are downloaded to the main registry. Provisions should be made to ensure timely and complete availability of prehospital care reports, operative notes, medical examiner reports, and other documents that may not always be present in the active medical record.

The amount of time and effort that will be necessary to maintain the registry should not be underestimated. A designated and well-trained trauma registrar is critical to the success of a registry. One full-time equivalent employee dedicated to the registry must be available to process the data capturing the NTDS data set for each 500–750 admitted patients annually (CD 15–9). This staffing need increases if additional data elements are collected.

Hospitals must also take into account the additional tasks, above the abstraction and entry of patient data, that are assigned to the registrar. Processes such as report generation, data analysis, research assistance, and meeting various submission requirements will decrease the time dedicated to the meticulous collection of patient data. Electronic downloads into the trauma registry also create additional tasks, as does ongoing data validation prior to data acceptance. Additional staff will be required to perform these tasks to ensure the integrity and quality of registry data that are used for prevention, PIPS, and other essential aspects of the trauma program.

Data Validation and Quality

The information provided by a trauma registry is only as valid as the data entered. Strategies for monitoring data validity are essential (CD 15–10). A scheme for internal validation helps to detect errors in data entry or coding. Many trauma registry software packages include mechanisms to ensure consistency. In addition, a plan for ensuring that the data entered are accurate and reflect the observations made on the patient should be established. One approach is to re-abstract 5 to 10 percent of patient records. The medical director, trauma program manager, and trauma registrar then can perform a systematic review of the differences to establish levels of inter-rater reliability. While the TQIP of the ACS is an extremely important process that involves extensive external data validation, TQIP participation alone does not necessarily ensure data validity across the entire spectrum of data contained in the hospital trauma registry. Ongoing review and evaluation are important to ensure the quality, reliability, and validity of local registry data.

Report Writing

A trauma registry can be valuable only if the data it contains can be transformed into useful information through the process of report writing. Trauma registry reports support decision making and guide the management of the trauma center. Most trauma registry software provides for the generation of several standard reports that summarize different ways to address specific questions or areas of concern. Most standard reports are oriented to anticipate the needs of a trauma center's PIPS program and provide the needed information. This capability should be built into the software itself or achieved by exporting the data to a separate spreadsheet, relational database, or statistical program.

The National Trauma Data Bank

The NTDB is the largest aggregation of trauma registry data ever assembled. It is committed to being the national repository for trauma center registry data. The NTDB® strives to collect data on every patient treated in every trauma center in the United States.

The goal of the NTDB is to inform the medical community, the public, and decision makers about a wide variety of issues that characterize the current state of care for injured persons in the United States. This goal has implications in many areas, including epidemiology, injury control, research, education, acute care, and resource allocation. This effort is in keeping with the mission of the ACS-COT to improve the care of injured patients through systematic efforts in prevention, care, and rehabilitation.

For details on NTDB data fields, see the NTDS data dictionary at *www.ntdsdictionary.org/dataelements/datasetdictionary.html*.

Supplemental Reading

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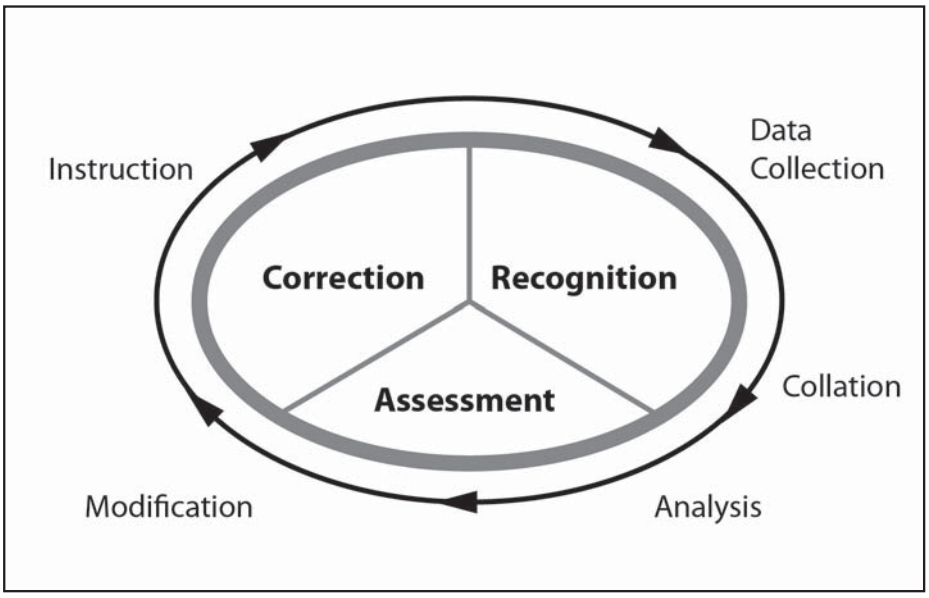
Performance Improvement and Patient Safety

This chapter describes the concept of monitoring, evaluating, and improving the performance of a trauma program. There is no precise prescription for trauma performance improvement and patient safety (PIPS). However, the American College of Surgeons Committee on Trauma (ACS-COT) calls for each trauma program to demonstrate a continuous process of monitoring, assessment, and management directed at improving care (Figure 1). These performance improvement activities are concordant with the Institute of Medicine's six quality aims for patient care: safe, effective, patient centered, timely, efficient, and equitable.

Figure 1 The Continuous Process of Performance Improvement



Operational Concepts

A trauma center should provide safe, efficient, and effective care to the injured patient. Doing so requires the authority and accountability to continuously measure, evaluate, and improve care (performance improvement). This effort should routinely reduce unnecessary variation in care and prevent adverse events (patient safety). These essential elements of a trauma program are commonly known as a *trauma PIPS program*.

Trauma centers must have a PIPS program that includes a comprehensive written plan outlining the configuration and identifying both adequate personnel to implement that plan and an operational data management system (CD 16–1). The PIPS program must be supported by a reliable method of data collection that consistently obtains the information necessary to identify opportunities for improvement (CD 15–1).

The processes of event identification and levels of review must result in the development of corrective action plans, and methods of monitoring, reevaluation, and benchmarking must be present (CD 2–17). Problem resolution, outcome improvements, and assurance of safety ("loop closure") must be readily identifiable through methods of monitoring, reevaluation, benchmarking, and documentation (CD 16–2).

Peer review must occur at regular intervals to ensure that the volume of cases is reviewed in a timely fashion (CD 2–18). The trauma PIPS program must integrate with the hospital quality and patient safety effort and have a clearly defined reporting structure and method for provision of feedback (CD 16–3). Furthermore, trauma centers should undergo external assessment at routine intervals to verify and validate the effectiveness of the trauma program and trauma care. The trauma PIPS program should integrate with local and regional trauma system performance improvement efforts. A verification process should be present to validate that the trauma PIPS program can effectively assess the quality and safety of care.

Trauma PIPS Program Configuration

Because the trauma PIPS program crosses many specialty lines, it must be empowered to address events that involve multiple disciplines and be endorsed by the hospital governing body as part of its commitment to optimal care of injured patients (CD 5–1). There must be adequate administrative support to ensure evaluation of all aspects of trauma care (CD 5–1). The trauma medical director and trauma program manager must have the authority and be empowered by the hospital governing body to lead the program (CD 5–1). Although the trauma medical director remains responsible for the overall function of the trauma program, the trauma program manager is responsible for the operational and logistical aspects of the trauma PIPS program.

Trauma Privilege Assessment

The trauma medical director must have sufficient authority to set the qualifications for the trauma service members, including individuals in specialties that are routinely involved with the care of the trauma patient (CD 5–11). Moreover, the trauma medical director must have authority to recommend changes for the trauma panel based on performance review (CD 5–11). Review should include evaluation of the practitioners' continuing education (CE), resource utilization, complications, mortality rates, and participation in evidence-based guidelines, pathways, and protocols. The granting of privileges and credentialing are departmental and medical staff functions and are overseen by the institution's board.

Trauma Specialty Liaisons

The peer review committee must be chaired by the trauma medical director (CD 5–25). In Level I, II, and III trauma centers representation from general surgery (CD 6-8), and liaisons to the trauma program from emergency medicine (CD 7–11), orthopaedics (CD 9–16), anesthesiology (CD 11–13), and critical care (CD 11–62)—and for Level I and II centers, neurosurgery (CD 8–13) and radiology (CD 11–39)—must be identified and participate actively in the trauma PIPS program with at least 50 percent attendance at multidisciplinary trauma peer review committee meetings**.** Level III centers with any emergent neurosurgical cases must have

also have the participation of neurosurgery on the multidisciplinary trauma peer review committee (CD 8–13). The 50 percent attendance is for a specific physician liaison and may not be met by having multiple different providers in the specialty in attendance. Fifty percent is the actual attendance rate and does not include excused absences or other reasons for nonattendance. In Level I and II trauma centers, the trauma medical director (CD 5–7), trauma program manager (5–24), and liaisons to the trauma program in emergency medicine (CD 7–12), orthopaedics (CD 9–18), critical care (CD 11–63), and neurosurgery (CD 8–14) must obtain 16 hours annually or 48 hours in 3 years of verifiable, external, trauma-related education (continuing medical education [CME] or CE, as appropriate to the discipline)**.** These specialty liaisons should assist the trauma medical director in organizing and managing each specialty's trauma panel, provide multidisciplinary input into the peer review of trauma care, and be responsible for the CME in trauma care of their colleagues as it relates to their specialty.

Population to Be Monitored

The trauma center must demonstrate that all trauma patients can be identified for review (CD 15–1). Although the definition of a trauma patient may vary among states and regions, the National Trauma Data Standard (NTDS) definitions of the ACS-COT are recommended for use (see the current definition at *www.ntdsdictionary.org/data elements/datasetdictionary.html*). These definitions can be supplemented by a rudimentary data set describing all patients with traumatic injury. This "denominator" helps to quantify the institution's trauma patient volume.

Trauma Registry

The trauma PIPS program must be supported by a registry and a reliable method of concurrent data collection that consistently obtains information necessary to identify opportunities for improvement (CD 15–3). Integration of the trauma registry into institutional information systems can further facilitate data gathering.

In Level I, II, and III trauma centers, the trauma registry must submit the required data elements to the National Trauma Data Bank® (NTDB®) (CD 15–2). All trauma centers must use a risk-adjusted benchmarking system to measure performance and outcomes (CD 15–5). One such national risk-adjusted benchmarking program is the Trauma Quality Improvement Program (TQIP®) of the ACS. Active participation by trauma programs and trauma surgeons demonstrates a commitment to improving performance through comparative analysis of outcomes across appropriately risk-adjusted populations. This activity is necessary to both maintenance of certification and pay for performance. Moreover, it is critical in defining value in health care: the highest-quality care provided at an affordable price.

The primary responsibility of a trauma center's PIPS program is to monitor and continually improve structures, processes, and outcomes within the institution. The PIPS program is also essential to provide leadership and participation in PIPS processes beyond the walls of the institution, including participation in external PIPS activities often associated with regional or statewide trauma advisory committees. In some cases, it will be up to the highest-level center in a region to provide the leadership to establish such processes. Trauma centers of all levels should be engaged in regional or statewide PIPS.

It is equally important to extend PIPS processes locally to include other key providers such as prehospital and flight personnel, transferring facilities, and rehabilitation in a collegial review of system issues. Such processes should go beyond one-way fault finding. A forum that includes an opportunity for professional two-way dialogue about issues affecting all parts of the system is essential for improvement. Trauma centers at all levels should participate in or initiate multidisciplinary system PIPS processes that include key stakeholders within their immediate catchment or referral areas. Confidentiality and peer protection can often be ensured if the meeting is conducted at the trauma center and appropriate safeguards are in place.

Performance Improvement and Patient Safety (PIPS)

General Principles

The meaning of *outcome* varies, depending on the perspective from which the term is viewed. The patient anticipates a complete and rapid recovery, the payor reviews the cost of care, and care providers emphasize the quality of care. No matter what the perspective, the essential goal of a trauma program is to improve the value of care to the injured patient. This concept of *value of care* can be represented by the following equation:

$$\textbf{Value of Care} = \frac{\textbf{Quality of Process} + \textbf{Quality of Outcome}}{\textbf{Cost}}$$

As shown, the value of care can be increased by improving the quality of process, improving the quality of outcome, or decreasing cost. This perspective can be helpful in directing a trauma program's PIPS initiatives. The trauma center should demonstrate active involvement in advancing this value proposition for trauma patients.

The trauma program's scope of performance evaluation extends from institution-wide variables (process review) to measures of individual practitioner performance (peer review). The determinants of how well a trauma center performs include variables that can be influenced (such as efficacy, safety, or cost of care) and variables that cannot be influenced (such as the severity of injury or preexisting co-morbidities).

Patient Safety

Trauma programs should be able to demonstrate effective patient-safety activities that minimize the incidence and impact of medical errors and maximize recovery when errors do occur. The majority of these errors do not result from individual practitioner recklessness or the actions of a particular discipline. More commonly, faulty systems, processes, and conditions lead to errors or fail to prevent them.

To successfully address these issues and improve patient safety, recognition of the following principles is essential. Trauma centers should promote a culture of patient safety that acknowledges the multidisciplinary aspect of trauma care and empowers all team members. This effort should include team-training techniques that ensure clear communication, effective coordination, and awareness of high-risk or error-prone situations in the care of the trauma patient. The trauma PIPS program should be familiar with—and where applicable, participate in—national quality and patient safety initiatives. A listing of, and links to, various quality

efforts—including the National Quality Forum, Institute of Medicine, Cochrane Review, Agency for Healthcare Research and Quality, Joint Commission, and others—can be found at *www.facs.org/quality-programs/trauma/vrc/resources.*

Clinical Practice Guidelines, Protocols, and Algorithms

Trauma programs should seek to reduce unnecessary variation in the care they provide. To achieve this goal, a trauma program must use clinical practice guidelines, protocols, and algorithms derived from evidenced-based validated resources (CD 16–4). In areas where there is an absence of such resources, consensus-based institutional guidelines should be established according to the most current available peer-reviewed literature and clinical experience and acumen. Once implemented, trauma programs should track compliance with their clinical practice guidelines, protocols, and/or algorithms and ultimately monitor them for effects on outcome. Examples of such activities include the following:

- The use of massive transfusion protocols in patients with exsanguinating hemorrhage.
- Assessment and clearance of the cervical spine.
- The management of severe traumatic brain injury.
- The reversal of oral anticoagulants, the timing of antibiotic administration, and time to the operating room for open fracture management.
- The use of venous thromboembolism prophylaxis.
- Deep vein thrombosis or pulmonary embolism events.

A current list of online resources can be found at *www.facs.org/quality-programs/trauma/vrc/resources.*

Core Process Measures and Outcomes

Fundamental to the performance improvement process is monitoring and measurement of the outcome of specific processes or procedures related to trauma care to improve efficiency, increase effectiveness, or reduce real or potential harm, as well as to improve future outcomes. Process and outcomes measures, referred to as *audit filters,* require defined criteria and metrics. They can be derived by monitoring trauma-related institutional clinical practice guidelines. In addition, mandatory core measures listed on the following page are required. All process and outcome measures must be documented within the trauma PIPS program's written plan and reviewed and updated at least annually (CD 16–5). These measures should be subjected to routine multidisciplinary trauma peer review and variances identified and further analyzed for causative factors and opportunities for improvement.

Required Trauma Center PIPS Core Measures

A. Mortality review (CD 16–6). All trauma-related mortalities must be systematically reviewed and those mortalities with opportunities for improvement identified for peer review.

1. Total trauma-related mortality rates. Outcome measures for total, pediatric (younger than 15 years), and geriatric (older than 64 years) trauma encounters should be categorized as follows:
    a. DOA (pronounced dead on arrival with no additional resuscitation efforts initiated in the emergency department).
    b. DIED (died in the emergency department despite resuscitation efforts).
    c. In-hospital (including operating room).
2. Mortality rates by Injury Severity Scale (ISS) subgroups using Table 1.

Table 1 Injury Severity Scale (ISS) Summary Table

ISS	Number	Number Admitted to Trauma Service	Number of Mortalities	Percentage Mortality
0–9				
10–15				
16–24				
≥25				
Total				

B. Trauma surgeon response to the emergency department (CD 2–9). Trauma surgeon on-call response for the highest level of activation must be continuously monitored and variances documented and reviewed for reason for delay, opportunities for improvement, and corrective actions. The minimum threshold is within 15 minutes of patient arrival for Level I and II trauma centers and within 30 minutes for Level III and IV trauma centers.

C. Trauma team activation (TTA) criteria (CD 5–13). Criteria for all levels of TTA must be defined and reviewed annually. Minimal acceptable criteria for the highest level of activation include the following in Table 2 (additional institutional criteria may also be included):

Table 2 Minimum Criteria for Full Trauma Team Activation

- Confirmed blood pressure less than 90 mm Hg at any time in adults and age-specific hypotension in children;
- Gunshot wounds to the neck, chest, or abdomen or extremities proximal to the elbow/knee;
- Glasgow Coma Scale score less than 9 with mechanism attributed to trauma;
- Transfer patients from other hospitals receiving blood to maintain vital signs;
- Intubated patients transferred from the scene, - OR -
- Patients who have respiratory compromise or are in need of an emergent airway
  - Includes intubated patients who are transferred from another facility with ongoing respiratory compromise (does not include patients intubated at another facility who are now stable from a respiratory standpoint)
- Emergency physician's discretion

D. All TTAs must be categorized by the level of response and quantified by number and percentage, as shown in Table 3 (CD 5–14, CD 5–15).

Table 3 Trauma Team Activation (TTA) Summary

Level	Number of Activations	Percentage of Total Activations
Full		
Limited		
Consultation		
Direct admits		

E. Trauma surgeon response time to other levels of TTA, and for backup call response, should be determined and monitored. Variances should be documented and reviewed for reason for delay, opportunities for improvement, and corrective actions (CD 5–16).

F. Response parameters for consultants addressing time-critical injuries (for example, epidural hematoma, open fractures, and hemodynamically unstable pelvic fractures) must be determined and monitored (CD 5–16). Variances should be documented and reviewed for reason for delay, opportunities for improvement, and corrective actions.

G. Potential overtriage and undertriage cases should be identified and reviewed monthly. A simple method to identify these cases is a matrix method evaluating patients with or without major injury for the different levels of activation. The definition of *major injury requiring the resources of the highest level of activation* is determined by the local center, often by data readily available in the trauma registry. Patients with an ISS greater than 15 for which the highest level of TTA was not

activated should be reviewed in depth. Other factors to consider in the definition of a *major trauma patient* may include those requiring blood transfusion as part of their initial resuscitation or requiring intubation, intensive care unit admission, emergent surgery or interventional catheter-based control of hemorrhage, or intracranial pressure monitoring. Rates of undertriage and overtriage can be calculated after the potential cases identified have been reviewed and validated. These rates must be monitored and reviewed quarterly (CD 16–7). Figure 2 provides a method to calculate overtriage and undertriage.

Figure 2 The Matrix Method for the Calculation of Triage Rates

	Not Major Trauma	Major Trauma	Total	Overtriage
Highest Level TTA	A	B	C	A/C x 100
Midlevel TTA	D	E	F	Undertriage =
No TTA	G	H	I	(E+H) / (F+I) x 100

H. Trauma patient admissions (NTDS definition) to a nonsurgical service is higher than 10 percent (Levels I, II, and III: CD 5–18).

$$\textbf{Percentage} = \frac{\textbf{Trauma Patient Admissions to Nonsurgical Service}}{\textbf{Total Trauma Patient Admissions}} \times 100$$

Trauma centers admitting more than 10 percent of trauma patients to nonsurgical services must assess the following criteria related to these admissions:

1. Number with a trauma consultation _____
2. Number with other surgical service consultation _____
3. Number with mechanism of injury (MOI) = same-height falls _____
4. Number with MOI = drowning, poisoning, or hanging _____
5. Number with ISS 9 or lower (and who do not meet the criteria in 3 and 4) _____

All remaining trauma patients admitted to a nonsurgical service should be subjected to individual case review to determine the rationale for admission to a nonsurgical service, adverse outcomes, and opportunities for improvement.

I. Pediatric (14 years or younger) trauma care.

1. Trauma centers admitting at least 100 pediatric trauma patients annually require a pediatric-specific trauma PIPS program (CD 10–6).
2. Trauma centers admitting fewer than 100 pediatric trauma patients annually must review each case for timeliness and appropriateness of care (CD 10–6).

3. Additional pediatric trauma care–related core measures (select one or more):
   - Management of solid organ injury.
   - Outcomes in head injury.
   - Resuscitation approach in children (fluids).
   - Deep vein thrombosis prophylaxis.
   - Child maltreatment assessment.
   - Use of invasive monitoring.
   - Radiation exposure.
   - Pain management.
   - Involvement of pediatricians/pediatric specialists.

J. Acute transfers out (CD 9–14). All trauma patients who are diverted (CD 3–4) or transferred (CD 4–3) during the acute phase of hospitalization to another trauma center, acute care hospital, or specialty hospital (for example, a burn center, replantation center, or pediatric trauma center) or patients requiring cardiopulmonary bypass or when specialty personnel are unavailable must be subjected to individual case review to determine the rationale for transfer, appropriateness of care, and opportunities for improvement. Follow-up from the center to which the patient was transferred should be obtained as part of the case review.

K. Emergency physicians covering in-house emergencies at Level III trauma centers (CD 7–3). Any instance in which the emergency department is left uncovered must be reviewed for timeliness of response and appropriateness of care for trauma patients in the emergency department at that time.

L. Trauma center diversion-bypass hours must be routinely monitored, documented, and reported, including the reason for initiating the diversion policy (CD 3–6), and must not exceed 5 percent.

$$\textbf{Percentage} = \frac{\textbf{Number of Diversion Hours}}{\textbf{8,670 Hours in a Year}} \times 100$$

This includes both diversion of patients from the primary catchment area transported by emergency medical services (EMS) and the inability to accept interfacility transfers.

M. Appropriate neurosurgical care at Level III trauma centers (CD 8–9). All cases with neurologic injury must be routinely monitored, and any case not transferred to a higher level of care must be subjected to individual case review for timeliness of response and appropriateness of care.

- All cases requiring backup to be called in or the patient to be diverted or transferred be cause of unavailability of the neurosurgeon on call must be reviewed.
- Neurotrauma care should be routinely evaluated as to compliance with the Brain Trauma Foundation guidelines (see Chapter 8, Clinical Functions: Neurosurgery).

N. Availability of the anesthesia service (CD 11–4, CD 11–7, CD 11–16, CD 11–18).

- Anesthesia service (emergency department, intensive care unit, floor, and postanesthesia care unit) must be available for the care of trauma patients
- Operating room delays involving trauma patients because of lack of anesthesia support services must be identified and reviewed to determine the reason for delay, adverse outcomes, and opportunities for improvement.

O. Delay in operating room availability (CD 11–16, CD 11–18) must be routinely monitored. Any case that is associated with a significant delay or adverse outcome must be reviewed for reasons for delay and opportunities for improvement.

P. Response times of operating room and postanesthesia care unit personnel when responding from outside the trauma center (CD 11–16, CD 11–18, CD 11–25) must be routinely monitored. Any case that exceeds the institutionally agreed upon response time and/or is associated with an adverse outcome must be reviewed for reasons for the delay and opportunities for improvement.

Q. Rate of change in interpretation of radiologic studies (CD 11–32, CD 11–37) should be categorized by RADPEER or similar criteria (describe the process/scoring metric used).

$$\text{Percentage} = \frac{\text{Imaging Studies With Change in Interpretation}}{\text{All Imaging Studies}} \times 100$$

The rate of change in interpretation of radiologic studies must be routinely monitored and reviewed with the radiology department. Identified cases should be reviewed to determine the reason for misinterpretation, adverse outcomes, and opportunities for improvement.

R. Response times of computed tomography technologist (30 minutes)/magnetic resonance imaging technologist (60 minutes)/interventional radiology team (30 minutes) when responding from outside the trauma center (CD 11–29, CD 11–30, CD 11–31, CD 11–32, CD 11–33, CD 11–34, CD 11–35, CD 11–36, CD 11–37, CD 11–46). These times must be routinely monitored, and any case that exceeds the institutionally agreed upon response time or is associated with a significant delay or an adverse outcome must be reviewed for reasons for delay and opportunities for improvement.

S. Transfers to a higher level of care within the institution (CD 16–8). These transfers must be routinely monitored, and cases identified must be reviewed to determine the rationale for transfer, adverse outcomes, and opportunities for improvement.

T. Solid organ donation rate (CD 16–9). This rate must be routinely monitored and reviewed annually. All trauma patients determined brain dead according to the institution's policy should be referred to the local/regional organ procurement agency.

$$\text{Percentage} = \frac{\text{Organ Donors}}{\text{Referrals}} \times 100$$

Cases in which referral was not made should be reviewed for rationale and opportunities for improvement.

U. Trauma registry (CD 15–6). The percentage of completed registry records within 2 months of discharge should be determined (the threshold is 80 percent).

V. Multidisciplinary trauma peer review committee attendance (Level I, II, and III, CD 5-10, CD 6-8, CD 7-11, CD 9-16, CD 11-13, CD 11-62; Level I and II, CD 8-13 and CD 11-39). Attendance should be 50 percent or greater by the trauma medical director, every general surgeon, and each specialty liaison. The 50 percent attendance level is for the specific physician liaison and may not be met by the attendance of multiple different providers in a specialty. This is the actual attendance rate and does not include excused absences or other reasons for nonattendance.

Additional Programmatic Core Measures That Will Be Requested as Part of the Prereview Questionnaire

A. Trauma center volume (CD 2–4). Trauma center volume requirements for Level I trauma centers are discussed in Chapter 2. However, it is imperative that trauma centers of all levels understand the distribution of trauma admissions within their facility.

Table 4 Volume

Service	Number of Admissions
Trauma	
Orthopaedic	
Neurosurgery	
Other	
Surgical	
Burn*	
Nonsurgical	
Total	

* Burn patients who are treated by the trauma service and meet other inclusion criteria, such as length of stay, should be included in the trauma registry and counted among the total trauma population. Burn patients who are transferred externally to a burn center, or internally to a burn service, should not be included in the trauma registry or counted in the total trauma population.

B. Trauma center payor mix. The distribution of trauma admissions by payor type, when compared to overall hospital admissions may reveal certain financial advantages or disadvantages associated with caring for injured patients.

Table 5 Payor Mix

Primary Method of Payment	All Patients (%)	Trauma Patients (%)
Commercial		
Blue Cross/Blue Shield		
Medicare		
Medicaid		
Workers' compensation		
No-fault auto		
Other government (for example, Tricare)		
Self-pay		
Not billed (for any reason)		
Other		

C. A Level I trauma center must meet admission volume requirement (one of the following):
- Admit at least 1,200 trauma patients yearly.
- Admit at least 240 admissions with an ISS higher than 15.
- Trauma admissions by service.

D. Geriatric trauma (older than 65 years).
- Number admitted with MOI = fall from standing height.
- Number of isolated hip fractures included in registry data.
- Special considerations for geriatric patient (team composition/approach).
- Anticoagulation reversal.
- Comfort/palliative care.

E. Orthopaedic surgery.
- Number of pelvis and acetabular cases performed annually.
- Number of pelvis and acetabular cases transferred out.
- Time to open reduction, internal fixation for femur fractures.
- Time to washout for all open fractures.
- Appropriateness and timing of intravenous antibiotics for all open fractures.

F. Blood bank.
- Turnaround time for massive transfusion protocol (MTP) use/times.
- Turnaround time for use of goal-directed component therapy.

G. Burn patients (if not a burn center).
- Number of burn patients admitted.
- Number of burn patients transferred in.
- Number of burn patients transferred out.

H. Vertebral column injuries.
- Number with vertebral column injuries admitted.
- Number with neurologic deficits attributed to spinal cord injury.
- Number with vertebral column and/or spinal cord injury transferred in.
- Number with vertebral column and/or spinal cord injury transferred out.

I. Other (examples).
- Adverse ventilator-associated events.
- Surgical site infection.
- Venous thromboembolism events.
- Decubitus ulcer rate.

See Table 6 for other potential performance measures.

In addition to general trauma performance indicators, there are also opportunities to examine specific departmental or system responses. Table 7 suggests some potential performance improvement indicators related to radiology.

In addition to monitoring clinical performance, trauma centers are also encouraged to measure their contributions to trauma system development, sustainment, and evolution. Although many attributes of the trauma system are beyond the direct control and impact of trauma centers, there are tangible measures of systems engagement, support, and leadership:

- Trauma program staff engagement in regional and state leadership positions.
  - Trauma medical director.
  - Trauma program manager.
  - Trauma registrar.
  - Injury prevention coordinator.
  - Performance improvement coordinator.
- Percentage of follow-back reports to referring facilities and EMS agencies.
- Engagement and participation of outside agencies (EMS, first response, injury prevention, disaster) and facilities (transferring and ancillary) in multidisciplinary peer review.
- Documented participation in trauma system advocacy through public information, media events, and eliciting government (city, county, and state) support.

Table 6 Other Recommended Outcome Measures

Mortality Rates	Measures
Adjusted trauma center mortality rate	Trauma-related deaths (excluding DOA*) ÷ total trauma admissions
Adjusted trauma service mortality rate	Trauma service mortalities (excluding DOA*) ÷ trauma service admissions
ED trauma mortality rate	ED trauma-related mortalities ÷ total trauma-related mortalities
Autopsy rate	Number of autopsies ÷ number of trauma mortalities
Mortality with opportunities for improvement	Provides a gross measure of individual or system errors that were evident in individual and aggregate cases.
Mortality without opportunities for improvement.	Provides a gross measure of in which no individual or system errors identified in individual or aggregate cases.
Morbidity/Complications (see NTDS definitions at *www.facs.org/quality-programs/trauma/vrc/resources*)	Measures
Trauma center complication rate	Number of complications ÷ number of trauma admissions
Trauma service complication rate	Number of complications ÷ number of trauma service admissions
Specific complication rate*	Number of specific complications ÷ number of trauma admissions
LOS	Measures
Total EMS time	EMS hospital arrival time – dispatch time
Total EMS scene time	EMS hospital arrival time – scene arrival time
Hospital LOS	Hospital discharge date and time – hospital arrival date and time
ED LOS	ED disposition or discharge time – ED arrival time
ICU LOS	Total number of days in any ICU (all episodes)
Ventilator days	Total number of days on mechanical ventilation

DOA indicates dead on arrival; ED, emergency department; EMS, emergency medical services; ICU, intensive care unit; LOS, length of stay; and NTDS, National Trauma Data Bank.

* Adjusted rates include DOAs using surrogate of "no response to resuscitation" (see the Glossary for definition**).**

Table 7 Examples of Potential Performance Improvement Indicators for Radiology

Diagnostic accuracy of imaging compared with outcomes
Timeliness of preliminary and final reports
Agreement of preliminary and final reports
Appropriate use of imaging using American College of Radiology appropriateness criteria
Quality assurance of interventional procedures
Timeliness of obtaining studies and procedures for critically ill patients
Adequacy of clinical information provided on radiology requisitions
Timely availability of radiology technical staff
Adherence to appropriate imaging protocols
Proper care and monitoring of trauma patients

Event Identification and Review

Sufficient mechanisms must be available to identify events for review by the trauma PIPS program (CD 16–10). These events may be brought forth from a variety of sources both concurrently and retrospectively, including, but not limited to, individual personnel reporting, morning report or daily sign-outs, case abstraction, registry surveillance, pathway and protocol variances, and patient-relations or risk management.

Levels of Review

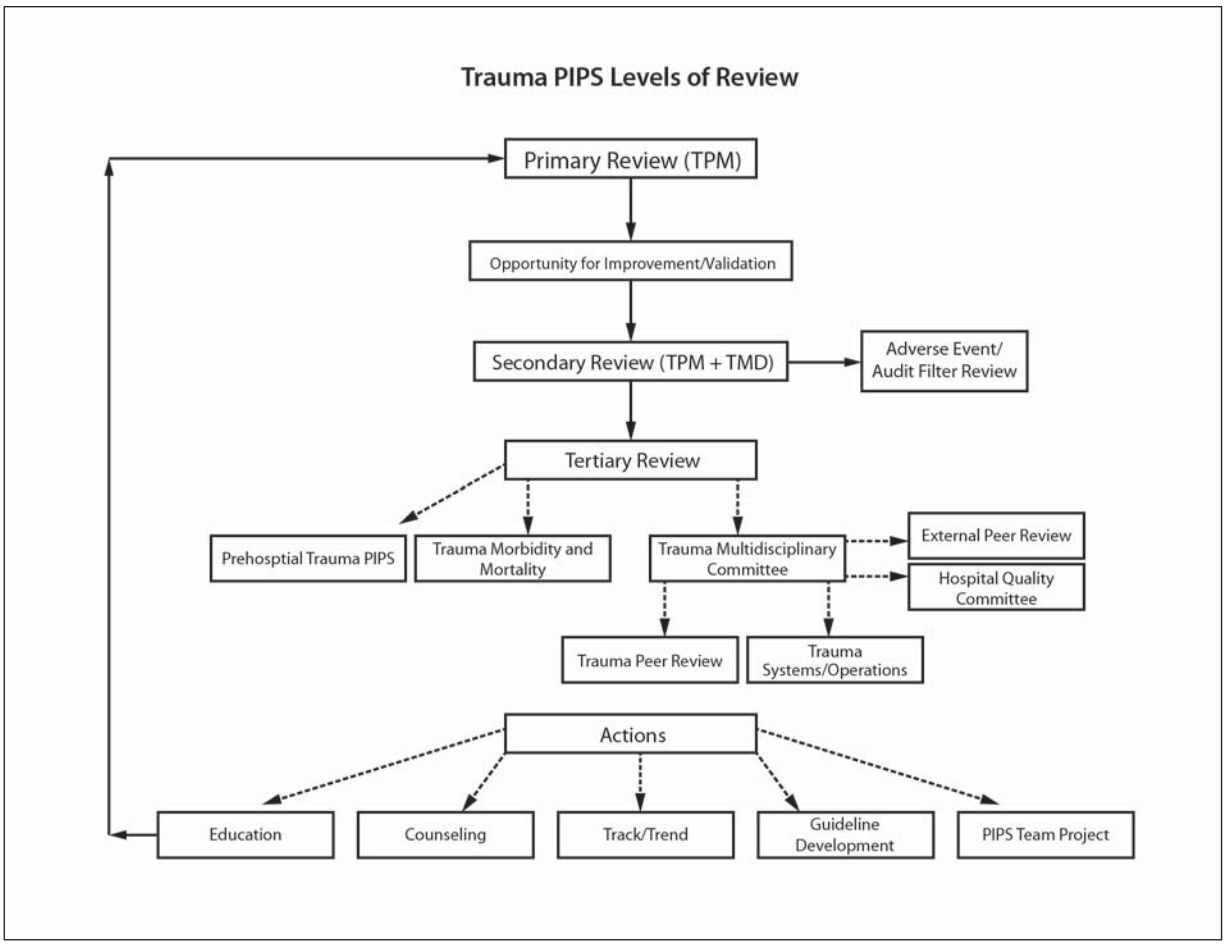
Once an event is identified, the trauma PIPS program must be able to verify and validate that event (CD 16–11). The trauma program manager or designee usually performs this function. This process constitutes the first level of review, or the *primary review*. In some instances, immediate feedback and resolution may be possible at this level. Even if event resolution occurs during the primary review, the activity should be documented for ongoing monitoring and trend analysis.

Events that require further investigation should be reviewed in a systematic fashion with the trauma medical director or designee. This process constitutes a *secondary review*. It should include review of the pertinent portions of the medical record, confirmation of all individuals involved, development of a timeline of the event, and review of any other pertinent documentation, including autopsy information, for all trauma-related mortalities, if available. Accordingly, the trauma program should have a collaborative relationship with the medical examiner or coroner responsible for the locality. Upon completion of this review, if immediate feedback and resolution are possible, the event may be resolved. If not, it should be referred for multidisciplinary committee review, including peer review (as will be described) or some other appropriate performance improvement forums capable of further analysis and event resolution.

This next step constitutes the *tertiary review*—a multidisciplinary review. The goals of multidisciplinary review are as follows: (1) review the efficacy, efficiency, and safety of the care provided by the trauma center; (2) provide focused education; and (3) provide peer review. These activities can be accomplished in a variety of formats, depending on the volume of trauma patients at a given center and the structure of the trauma performance improvement program in the context of the hospital's quality program. Moreover, this case-based learning activity is critical to individual educational programs for all providers involved.

Occasionally, a *quaternary review,* either by the hospital quality committee or external peer review, is warranted. This review may involve the examination of extraordinary cases or simply serve to validate the PIPS process. Figure 3 graphically depicts the levels of review.

Figure 3 Levels of Trauma Performance Improvement and Patient Safety (PIPS) Review



(TMD) indicates Trauma Medical Director, and (TPM) indicates Trauma Program Manager.

Prehospital Trauma PIPS Committee

All trauma centers should interface with prehospital agencies that routinely transport or transfer patients to their facility. The purpose of the prehospital trauma PIPS committee is to ensure that there is open dialogue between the prehospital agencies and the trauma center relative to prehospital patient care, handoff procedures (time out), systems issues such as radio/cellular communications, joint planning and operations, and personnel issues (prehosptial and hospital).

Mortality and Morbidity Review

All trauma deaths and unexpected outcomes should be examined in a traditional mortality and morbidity review. This initial examination helps to filter cases that need to undergo additional examination, review, discussion, intervention. and loop closure. The mortality and morbidity review often feeds cases to the multidisciplinary trauma peer review committee. This mortality and morbidity review is typically a closed venue involving immediate peers.

Multidisciplinary Trauma Systems/Operations Committee

There must be a process to address trauma program operational events (CD 16–12). Typically, this function is accomplished by a multidisciplinary trauma systems/operations committee that examines trauma-related hospital operations and includes representatives from all phases of care provided to injured patients. Besides physicians, this committee may include prehospital personnel, nurses, technicians, administrators, and other ancillary personnel. This committee should meet at least quarterly but may need to meet as often as monthly to review operational performance events. Documentation (minutes) reflects the review of operational events and, when appropriate, the analysis and proposed corrective actions (CD 16–13).

Multidisciplinary Trauma Peer Review

Trauma patient care should be evaluated initially by individual specialties within their usual departmental PIPS review structures. Mortality data, adverse events and problem trends, and selected cases involving multiple specialties must undergo multidisciplinary trauma peer review (CD 16–14).

This effort may be accomplished in a variety of formats but must involve the participation and leadership of the trauma medical director (CD 5–10); the group of general surgeons on the call panel and the liaisons from emergency medicine, orthopaedics, neurosurgery, anesthesia, critical care, and radiology (Level I, II, and III, CD 6-8, CD 7-11, CD 9-16, CD 11-13, CD 11-62; Level I and II, CD 8-13 and CD 11-39). This meeting should be held monthly, but the frequency should be determined by the trauma medical director based on the needs of the PIPS program. Each member of the committee must attend at least 50 percent of all multidisciplinary trauma peer review committee meetings (CD 16–15). Attendance may be met through teleconferencing or videoconferencing participation. The 50 percent attendance is for the specific physician liaison and may not be met by having multiple different providers from the specialty in attendance. It refers to the actual attendance rate and does not include excused absences or other reasons for nonattendance.

Ideally, other general surgeons and other nonliaison members of other specialties involved in trauma call should attend the multidisciplinary trauma peer review meeting when a case in which they participated is being discussed. When these general surgeons cannot attend the multidisciplinary trauma peer review meeting, the trauma medical director must ensure that they receive and acknowledge the receipt of critical information generated at the multidisciplinary trauma peer review meeting to close the loop (CD 16–16). This dissemination can be achieved through a personal meeting between the trauma medical director and the involved surgeon or through other forms of documented correspondence. Meeting minutes and other documentation of this peer review activity should be recorded discreetly but should chronicle a candid discussion. Trauma center personnel should be familiar and comply with state statutes governing medical peer review and the protection from discovery afforded peer review documentation.

Determination

The multidisciplinary trauma peer review committee must systematically review mortalities, significant complications, and process variances associated with unanticipated outcomes and determine opportunities for improvement (CD 16–17). Moreover, the committee should determine the definition and classification of these events in a manner consistent with the trauma center's institution-wide performance improvement program. Mutually agreed upon nomenclature to allow for integration with the institution-wide PIPS process should be used. Based on this review process, both the appropriateness and timeliness of care should be reviewed, and opportunities for improvement (for example, errors in judgment, technique, treatment, or communication, along with delays in assessment, diagnosis, technique, or treatment) should be determined and documented**.** When an error can be attributed to a single credentialed provider, use of the departmental or institutional formal medical peer review process should be considered.

Additional information pertaining to the classification of mortality can be found at *www.facs.org/quality-programs/trauma/vrc/resources.*

Corrective Action

When an opportunity for improvement is identified, appropriate corrective actions to mitigate or prevent similar future adverse events must be developed, implemented, and clearly documented by the trauma PIPS program (CD 16–18). Examples of corrective actions include the following:

- Guideline, protocol, or pathway development or revision.
- Targeted education (for example, rounds, conferences, or journal clubs).
- Additional and/or enhanced resources.
- Counseling.
- Peer review presentation.
- External review or consultation.
- Ongoing professional practice evaluation.
- Change in provider privileges.

Opportunities for improvement are often system related and interdisciplinary. The delineation of corrective actions may be complex and affect multiple departments and services institution-wide. Adequate review may require using the hospital quality committee to perform a root cause analysis of the event, departmental and/or institutional medical peer review processes, or external review. In all instances, the conclusions and results of these reviews should be documented and available to the trauma medical director and program manager.

Event Resolution (Closing the Loop)

Effective performance improvement demonstrates that a corrective action has had the desired effect as determined by continuous monitoring and evaluation. This process is referred to as *closing the loop*. An effective performance improvement program demonstrates through clear documentation that identified opportunities for improvement lead to specific interventions that result in an alteration in conditions such that similar adverse events are less likely to occur (CD 16–19). The effectiveness of these interventions should be continuously reevaluated to determine if these revisions improved the process or outcomes in care. Demonstration of consistent systematic use of a defined PIPS process is clear evidence of a commitment to the continuous pursuit of improving the care of the trauma patient.

Additional Information

The methods, language, and concepts of PIPS are evolving. Trauma program staff who are interested in developing and further refining their trauma performance improvement processes should attend the Trauma Outcomes and Performance Improvement Course (TOPIC) offered by the Society of Trauma Nurses (see *www.traumanurses.org*).

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Education and Outreach

Trauma centers are important community and regional resources. In addition to the patient care services they provide, these centers are sources of information, expertise, and public safety leadership in the treatment of major injury. Outreach programs are an integral part of trauma center services and are designed to help improve outcomes from trauma and prevent injury through the public and professional dissemination of information and the facilitation of access to the clinical and educational resources of a trauma center. The components of an outreach program may include public awareness and injury prevention education or professional education through course offerings, lectures, conferences, visitation programs, Websites, newsletters, legislative advocacy, and other means. The scope of educational and outreach programs depends on a variety of factors in a given region, including population size, type and level of trauma center, and regional needs and resources. All verified trauma centers, however, must engage in public and professional education (CD 17–1). Level I and II centers also must provide some means of referral and access to trauma center resources (CD 17–2).

Public Education

It is important that trauma center professionals participate in public education to enhance prevention efforts, disseminate awareness of trauma systems and how to access them, and build support for public policy change. The public and its elected representatives, armed with knowledge about injury, may provide the stimulus for a change in attitude and improve recognition for injury as a disease entity. Trauma-related activities and programs often are underfunded, and active public educational programs designed to increase awareness of injury as a treatable disease and a potentially preventable health problem are critical to correcting this deficiency. Legislative and media advocacy also may be useful to expand awareness of injury and the role of trauma systems in its treatment and prevention. Trauma centers should have an active role in supporting constructive public policy initiatives.

Injury prevention is the most logical approach to reducing death and disability. Many public educational programs directed toward injury prevention are available locally and nationally. Death and disability rates have decreased when prevention efforts were accompanied by legislative activities—for example, in regard to drinking and driving, seat belt use, and bicycle and motorcycle helmet use. Youth programs have been successful in many areas and have focused on drug and alcohol abuse and the prevention of gun violence.

Public awareness of the trauma system or trauma center and of how to access it may be lifesaving and limb saving. The importance of early access to care for injured patients cannot be overemphasized. Early access may be accomplished best when the public is aware of the local means of access to the prehospital system.

First aid courses and cardiopulmonary resuscitation (airway skills) classes teach basic management principles to laypersons. Good educational programs to teach simple lifesaving and limb-saving skills and how to avoid harming injured patients are needed to enhance any trauma system. Many organizations have these types of programs available and welcome the participation of trauma center and trauma system personnel.

Professional Education and Training

Principles of trauma care are introduced in medical school, nursing school, prehospital provider programs, and other allied health training programs. The Advanced Trauma Life Support® (ATLS®) course and similar educational programs have become basic trauma educational endeavors for health care professionals. The unique educational design of the ATLS® course provides the information and skills necessary for physicians during the initial phase of care of injured patients. The course has been taught to and by individuals who practice in all environments, because it provides a "language" that can be used by all members of the trauma team. This course is available nationally, as well as internationally, through the American College of Surgeons Committee on Trauma (ACS-COT). The ATLS® course is for physicians and other advanced practitioner providers, and the Trauma Evaluation and Management (TEAM) course was developed to introduce the concepts taught in ATLS® to medical students during their clinical years.

Other courses have been developed for prehospital personnel (Prehospital Trauma Life Support [PHTLS]® and International Trauma Life Support [ITLS]©), flight nurses (Transport Nurse Advanced Trauma Course [TNATC]), and emergency and trauma nurses (Trauma Nursing Core Course [TNCC™] and Advanced Trauma Care for Nurses [ATCN]). The PHTLS ©, TNATC, and ATCN courses closely parallel the ATLS®. The TNCC™ program provides guidelines and skills for emergency department nursing staff. The ATCN program contains the same ATLS® lectures, with specific skill stations designed specifically for nurses caring for trauma patients. Formal residencies, fellowships in trauma, and graduate programs benefit from the demonstrated value of these programs. The Trauma Care After Resuscitation (TCAR) course may also be appropriate for acute care, critical care, and perioperative nurses. Certification for Adult, Pediatric and Neonatal Critical Care Nurses (CCRN)® and certified emergency nurse (CEN)® certification are also useful for critical care nurses.

Residency training programs are highly desirable within a trauma system. The ACS-COT recognizes that residency programs provide a service to trauma centers, but the educational experience should be the primary focus. The residency training program should emphasize the direct supervision and teaching of residents by dedicated attending surgeons who have demonstrated an interest and expertise in trauma surgery. Trauma centers that support residency training programs and fellowships in trauma/surgical critical care/acute care surgery should have a clear, written curriculum for the development of trainee expertise and appropriate trainee supervision within the trauma program. In addition, residents should be given an introduction to the trauma service and have at least one weekly educational conference with the trauma attending staff. Trauma centers in academic medical centers or university hospitals should also offer advanced courses in trauma approaches and techniques for residents, fellows, and general surgeons taking trauma call. Examples of those courses include the Advanced Trauma Operative Management® (ATOM®) and Advanced Surgical Skills for Exposures in Trauma® (ASSET®) courses.

All residents beginning their rotation on the trauma service should attend at least one educational conference provided by an attending trauma surgeon regarding the organization of the service. Additionally, the trauma program should develop a comprehensive resident curriculum in trauma care. Successful completion of an ATLS® course fulfills this training need. At a minimum, a Level I trauma center must have continuous rotations

in trauma surgery for senior residents (Clinical PGY 4–5) that are part of an Accreditation Council for Graduate Medical Education–accredited program (CD 17–3). For pediatric Level I centers, the continuous rotation for surgical residents is extended to include clinical PGY 3 (CD 10-27). At Level I trauma centers the commitment to postgraduate training and education should include emergency medicine and the other surgical specialty residency programs. It may also include an acute care surgery fellowship consistent with the educational requirements of the American Association for the Surgery of Trauma.

In addition to the ATLS®, continuing medical education (CME) programs are important to maintain and enhance the knowledge and skills needed to care for injured patients. Cooperative arrangements with other institutions may enhance available educational programs and reduce unnecessary duplication. Postgraduate trauma education courses for nurses are available. Nurses, midlevel providers, and other allied health professionals should receive initial and recurrent trauma-specific education to ensure a high level of competency. Additional levels of training and certification (TNCC™, CCRN®) should be available to nurses working in critical areas such as the emergency department and the trauma intensive care unit. In Level I, II, and III trauma centers, the hospital must provide a mechanism to offer trauma-related education to nurses involved in trauma care (CD 17–4).

Multidisciplinary education should be ongoing in all trauma centers. Performance improvement and patient safety (PIPS) programs should be an important part of educational activities. Internal educational programs are an efficient means of providing information to the trauma team. Ideally, internal educational programs should be based on issues identified by the internal PIPS process and can provide an alternative method of trauma education without the travel and expense of outside formal CME. Such programs can take the form of lectures, panels, group discussions, videoconferencing, journal clubs, or re-creation of events in simulated environments. Participation in these internal programs should be captured and included in the credentialing process for trauma providers. Trauma centers should expend financial resources to facilitate internal and extramural educational programs.

The successful completion of the ATLS® course, at least once, is required in all levels of trauma centers for all general surgeons (CD 6-10), emergency medicine physicians (CD 7-14) and midlevel providers (CD 11-86) on the trauma team (CD 17–5). It is desirable that surgeons maintain current ATLS® status and participate as instructors in ATLS® programs. It is also desirable that surgeons involved in the care of injured patients participate in advanced trauma skills training as students and instructors. Although this advanced training can be accomplished through a variety of methods, the ACS-COT has developed two formal courses that may be used to meet this need. As mentioned previously, these courses are the ATOM® and ASSET® courses, which are complementary courses teaching advanced principals of operative trauma management and exposure.

It is important that all members of the trauma team be knowledgeable about current practices in trauma care. External CME is the recommended method of keeping current. An internal educational program gives the trauma program the opportunity to focus on specific program or institutional educational needs and requirements. The internal education program should use the PIPS process to identify opportunities for case-based learning. The trauma director (CD 5-7) and the liaison representatives from neurosurgery (CD 8-14), orthopaedic surgery (CD 9-18), emergency medicine (CD 7-12), and critical care (CD 11-63) must accrue

an average of 16 hours annually, or 48 hours in 3 years, of external trauma-related CME. Programs given by visiting professors or invited speakers are considered external CME. Other members of the general surgery (CD 6-11), neurosurgery (CD 8-15), orthopaedic surgery (CD 9-19), emergency medicine (CD 7-13), and critical care (CD 11-64) specialties who take trauma call also must be knowledgeable and current in the care of injured patients. This requirement may be met by documenting the acquisition of 16 hours of trauma-related CME per year, on average, or by demonstrating participation in an internal educational process conducted by the trauma program and the specialty liaison based on the principles of practice-based learning. Other specialists involved in trauma care are encouraged to participate in trauma-related CME activities on a regular basis.

An internal education program may be used to satisfy CME requirements for other members of the general surgery, emergency medicine, critical care, neurosurgery, and orthopaedic surgery call panels. Examples of acceptable internal education activities include the presentation or discussion of trauma-related topics in the following settings: in-service lectures, educational conferences, grand rounds lectures, an internal trauma symposium, or in-house publication and dissemination of information gained from a conference or peer-reviewed publications. The total hours acquired through the internal CME process should be functionally equivalent to 16 hours of CME.

Outreach: Engaging the Trauma Center in Regional Trauma Care and Education

Outreach involves providing trauma center expertise, information, and leadership to institutions, agencies, and individuals within a region for the purpose of improving the care of injured patients. A good outreach program allows the trauma center to serve as a regional resource for the benefit of patients and providers. The goals of an outreach program are as follows:

- To improve regional outcomes of major trauma by the dissemination of knowledge and expertise regarding the care of injured patients.
- To participate with regional agencies, organizations, and providers in improving the regional trauma care system.
- To facilitate access to trauma center resources (such as educational and/or prevention programs, performance improvement, consultation, and referrals).
- To support educational programs of regional facilities and trauma health care personnel.
- To advocate at a local and regional level for legislative efforts aimed at trauma prevention.

The extent of outreach activities depends on many elements within a regional system of care. Examples of these activities include participation on municipal, county, or state trauma advisory or planning committees and participation in regional, multi-institutional peer review committees. In addition to providing educational programs as described earlier, trauma centers, as part of their outreach programs, also should support trauma educational programs provided by other regional hospitals or agencies. This support might include visiting lectureships and participation in extramural ATLS®, PHTLS®, TNCC™, ATCN, or other educational offerings. The Rural Trauma Team Development Course® in particular provides an excellent opportunity for referring physicians and accepting trauma surgeons to meet and interact while sharing fundamental principles of resuscitation.

Regional hospitals, including trauma center and non–trauma center facilities, should have access to consultation by staff members from larger trauma centers for a variety of purposes: (1) to improve and facilitate care on a case-by-case basis, including referrals, transfers, and follow-up care, as appropriate; (2) to enhance institutional performance improvement activities, including protocol development; and (3) to facilitate the adaptation of trauma center programs, including PIPS and prevention, to other regional institutions. It falls to the regional referral trauma center (typically, Level I and II centers) to facilitate this access. Trauma centers also should promote quality and continuity of care in cases of referrals or transfers out by good communication with referring and receiving providers and the establishment of guidelines applicable to referrals and repatriation transfers.

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Prevention

Despite decades of progress in the development of trauma centers and trauma systems, injury remains the leading cause of years of potential lives lost and leaves millions of Americans chronically disabled every year. The overall cost impact estimates for intentional and unintentional injuries now approach half a trillion dollars a year. Medical costs of injury account for 12 percent of national health care expenditures. The financial, physical, and emotional impacts touch every home, school, and workplace in all of our communities.

Perhaps the most challenging aspect of the burden of injury is that it is largely preventable. Almost all other major causes of death and disability have extensive detection, intervention, and prevention programs that are well funded by public and private sources. Injury prevention efforts receive far less attention and resources than do prevention efforts focused on cancer, cardiovascular disease, and a variety of other groups of diseases. In comparing preventability with resource commitment, injury prevention efforts are often neglected, receiving far less funding than other disease prevention programs. The need for effective action and advocacy could not be more compelling.

Trauma centers must have an organized and effective approach to injury prevention and must prioritize those efforts based on local trauma registry and epidemiologic data (CD 18–1). Physicians, nurses, and other trauma center personnel have unique perspectives and equally unique opportunities to focus community efforts on effective prevention programs and, perhaps most important, to partner with injury prevention experts and resources in the community. This collaboration leads to an exchange of data and ideas that allows better analysis of the problem and its solutions.

Injury prevention is the responsibility of all trauma team members working in collaboration with the community. The organization of these efforts begins with effective leadership. Each trauma center must have someone in a leadership position who has injury prevention as part of his or her job description (CD 18–2). In Level I centers, this individual must be a prevention coordinator (separate from the trauma program manager) with a job description and salary support (CD 18–2). In Level II, III, and IV centers, this position may be filled by a trauma program manager with a specific role in prevention efforts detailed in the job description, but only if this role does not negatively affect the work product of the trauma program manager. Trauma medical directors should have a demonstrable role in injury prevention. It is also highly desirable that other trauma physicians and nurses actively participate in injury prevention efforts at Level I, II, III, and IV centers.

Effective injury prevention begins with a focus on the most common causes of injury in the community. These causes include contributing factors such as drug and alcohol abuse and behavioral health problems. The same causes are often linked with the most common mechanisms of injury presenting to the trauma center. The trauma center injury prevention program should identify the three most common causes of injury or traumatic death at the trauma center or in the community using the trauma registry or other available epidemiologic data. Program and intervention strategies then should be selected based on these data.

Traditionally, prevention efforts have focused on education, enactment and enforcement, and environmental modification. Educational prevention strategies assume that the target audience is motivated and ready to change risk-taking behavior. The essential elements of an effective trauma center injury prevention program are described in Table 1.

Table 1 Key Elements of an Effective Injury Prevention Program

- **Target the community:** Identify the primary causes of injury and death.
- **Work upstream:** Identify the root causes of injury and its contributing factors.
- **Choose preexisting proved or promising programs:** Understand that new program development, assessment, and implementation are complex and time-consuming.
- **Always partner with other organizations:** Make use of the fact that other trauma centers, prehospital providers, law enforcement agencies, schools, churches, and other organizations are interested and involved in community injury prevention efforts.
- **Embrace the media:** Learn to speak effectively, be prepared for the many opportunities that will arise, and allow trauma center leaders to become a reliable source of injury prevention information for local print and broadcast media.
- **Be politically savvy:** Realize that elected and appointed leaders can help if the trauma center understands their goals and the ways to work with them to create effective laws promoting prevention.
- **Do not forget the data:** Develop surveillance and monitoring tools to assess not only the available performance indicators of the trauma center's prevention efforts but also the prevention effectiveness.

The local or state vital records and medical examiner's reports describing causes of death, along with the data available from local and state police, help identify the incidence of injuries and high-risk behaviors. These agencies identify injuries in a manner that is often not available using the trauma registry. For instance, in many communities, suicide is one of the leading causes of nonnatural death but may not be one of the most common mechanisms leading to trauma center admissions. The trauma medical director and trauma program manager should establish a close working relationship with their local medical examiner to secure information regarding causes of traumatic death upon which injury prevention efforts can be based.

Part of every effective injury prevention effort is a focus on proximate causes. Many injuries have alcohol and drug use as an important contributing factor. Screening and brief intervention for alcohol use are required of all trauma centers. Access to firearms is another important root cause of traumatic injury. Socioeconomic and cultural, environmental, and engineering factors should also be considered. For instance, a high incidence of elderly pedestrians struck by automobiles may result from the interplay of multiple factors in certain neighborhoods in a community. Domestic violence is also linked to a variety of important contributing factors. Identifying these key contributing factors can generate opportunities to choose effective prevention programs that fit a community's needs.

It has been demonstrated that trauma centers can use the teachable moment generated by an injury to implement an effective injury prevention strategy; alcohol and/or drug abuse counseling for patients presenting to the hospital because of a substance abuse–related injury is an example of such an opportunity. Alcohol is such a significant associated factor in, and contributor to, injury that it is vital that trauma centers have a mechanism to identify patients who are problem drinkers.

Universal screening for alcohol use must be performed for all injured patients and must be documented (CD 18–3). At Level I and II trauma centers, all patients who have screened positive must receive an intervention by appropriately trained staff, and this intervention must be documented (CD 18–4). Epidemiologic data suggest high rates of problematic drug use among trauma patients who screen positive for alcohol use. Best practices include implementing screening procedures that capture drug use co-morbidity and appropriate treatment referral. The incorporation of routine screening and trauma center–based intervention for drugs of abuse is an area that could benefit from targeted research.

Programs selected for trauma center injury prevention efforts should be proved and promising programs that have been used at other trauma centers or in other relevant settings. Before embarking on an injury prevention program, a complete review of the literature and existing programs should be undertaken to ensure that programs with proved efficacy are selected. There are many examples of successful programs from local, regional, and national efforts by a variety of organizations. Lessons learned in implementing programs by adapting them to the local community invariably strengthen existing programs. Information regarding prevention programs and resources is available through the Centers for Disease Control and Prevention (*www.cdc.gov*), other trauma centers, and numerous professional organizations.

Level I and II trauma centers must implement at least two programs that address one of the major causes of injury in the community (CD 18–5). A trauma center's prevention program must include and track partnerships with other community organizations (CD 18–6). Law enforcement agencies, schools, churches, county health departments, and a variety of other organizations are often willing partners in injury prevention. As part of its participation in community-based injury prevention efforts, the trauma center should keep track of the external partnerships created. Many of these community partners have staff members with the time and expertise to effectively work in the community, and some of these organizations have injury prevention as a part of their core mission. Partnering with these organizations will allow trauma center personnel to quickly connect with community members in prevention efforts. Effective injury prevention is best accomplished through shared ownership, with multiple partners in the community working together. The trauma center injury prevention program should provide a periodic report of prevention activities, partners in the prevention efforts, and the estimated number of community members who received these services for each program implemented.

In its prevention program, the trauma center can also link with a wide variety of regional and national prevention efforts. These efforts include both government agencies and nongovernment organizations. The prevention program should join in these efforts and keep track of collaboration with these organizations and the resulting prevention efforts.

Focused and judicious cooperation with print and broadcast media also can enhance prevention opportunities.

At some point in a trauma center's prevention program development, an opportunity to work with local elected and appointed officials and to promote effective prevention legislation will arise. Most trauma centers have a government liaison who can be the initial point of contact when dealing with elected officials. Whenever possible, this person should establish contact with these officials, maintain a good working relationship, and advance pertinent advocacy positions. Participation in advocacy for injury prevention legislation should be a priority.

Table 2 outlines a suggested format for recording and reporting prevention activities.

Table 2 Suggested Recording and Reporting Elements for Trauma Center Prevention Activities

- Targeting of mechanism of injury or root cause of injury
- Date and location(s) of program event(s)
- Trauma center resources
- Personnel hours (paid and volunteered)
- Trauma center expenses
- Community partners and their personnel hours
- Other sources of financial support
- Media exposure
- Elected and appointed officials involved
- Public policy initiatives or legislation
- Number of community members reached with prevention message or service
- Available outcome data related to the prevention activity and its target

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Trauma Research and Scholarship

Research and scholarly activity are some of the capabilities that distinguish a Level I trauma center from other trauma centers. Research, the process to advance knowledge, is essential to optimize the care of injured patients. The unique combination of a large volume of severely injured patients, a core of experienced trauma surgeons, and an academic infrastructure enables Level I trauma centers to be effective and productive in research and scholarly activity.

The research portfolio of a Level I trauma center seeking American College of Surgeons (ACS) verification or regional designation should be balanced to reflect the diverse aspects of trauma care. Mechanistic questions regarding the pathophysiology of the response to injury are answered using rigorous scientific methods in basic research laboratories. Evidence-based clinical investigation, in contrast, uses large relational databases that encompass the epidemiology of injury, the impact of injury prevention programs, system configurations, standard operating procedures, and patient outcome measures, including cost-effectiveness.

This chapter outlines the fundamental components of a successful trauma research program in a Level I trauma center. It also may serve as a template for research endeavors in other trauma centers, and the components are desirable for Level II centers.

The concept of scholarship entails the following eight elements:

- Discovery
- Leadership in major trauma-related organizations
- Funding
- Dissemination of information
- Application of clinical knowledge
- Participation in clinical discussions and conferences
- Support of resident participation in scholarly activities
- Mentorship of junior faculty, residents, and fellows

There are two methods to fulfill the research and scholarship criteria for Level I verification (summarized in Tables 1 and 2):

1. For a Level I trauma center, at a minimum, a program must have 20 peer-reviewed articles published in journals included in Index Medicus or PubMed in a 3-year period (CD 19–1). These publications must result from work related to the trauma center or the trauma system in which the trauma center participates (CD 19–2). Of the 20 articles, at least one must be authored or co-authored by members of the general surgery trauma team (CD 19–3). Additionally, at least one article each from three of the following disciplines is required: (1) basic sciences, (2) neurosurgery, (3) emergency medicine, (4) orthopaedics, (5) radiology, (6) anesthesia, (7) vascular surgery, (8) plastics/maxillofacial surgery, (9) critical care, (10) cardiothoracic surgery, (11) rehabilitation, and nursing (CD 19–4). Level I pediatric

trauma centers must have identifiable pediatric trauma research. The pediatric Level I center's research requirement is equivalent to that of adult Level I trauma centers (CD 10–10). In combined Level I adult and pediatric centers, half of the research requirement must be pediatric research (CD 10–11). Similarly, adult centers may take credit for up to one-half of the required papers. Trauma-related articles authored by members of other disciplines or work done in collaboration with other trauma centers and participation in multicenter investigations may be included in the remainder.

2. In the alternate method, a Level I program must have the following (CD 19–7):

   a. A program must have 10 peer-reviewed articles published in journals included in Index Medicus or PubMed in a 3-year period. These articles must result from work related to the trauma center or the trauma system in which the trauma center participates. Of the 10 articles, at least one must be authored or co-authored by members of the general surgery trauma team, and at least one article each from three of the following disciplines is required: basic sciences as related to injury, neuro surgery, emergency medicine, orthopaedics, radiology, anesthesia, vascular surgery, plastics/maxillofacial surgery, critical care, cardiothoracic surgery, rehabilitation, and nursing. Trauma-related articles authored by members of other disciplines or work done in collaboration with other trauma centers and participation in multicenter investigations may be included in the remainder.

   b. Of the following seven trauma-related scholarly activities, four must be demonstrated:
      - Evidence of leadership in major trauma organizations, which includes membership in trauma committees of any of the regional or national trauma organizations.
      - Demonstrated peer-reviewed funding for trauma research from a recognized government or private agency or organization.
      - Evidence of dissemination of knowledge that includes review articles, book chapters, technical documents, Web-based publications, videos, editorial comments, training manuals, and trauma-related educational materials or multicenter protocol development.
      - Display of scholarly application of knowledge as evidenced by case reports or reports of clinical series in journals included in MEDLINE.
      - Participation as a visiting professor or invited lecturer at national or regional trauma conferences.
      - Support of resident participation in mentoring scholarly activity, including laboratory experiences; clinical trials; resident trauma paper competitions at the state, regional, or national level; and other resident trauma presentations.
      - Mentorship of fellows, as evidenced by the development or maintenance of a recognized trauma, critical care, or acute care surgery fellowship.

Table 1 Research Requirements for a Level I Trauma Center

Option 1

- 20 trauma-related, peer-reviewed articles in journals listed in Index Medicus or PubMed in a 3-year period
- At least one article with a general surgery author or co-author
- Trauma-related articles from at least three of the following disciplines:
  - Basic sciences
  - Neurosurgery
  - Emergency medicine
  - Orthopaedics
  - Radiology
  - Anesthesia
  - Vascular surgery
  - Plastic surgery or maxillofacial surgery
  - Critical care
  - Cardiothoracic surgery
  - Rehabilitation
  - Nursing

Option 2

- 10 trauma-related, peer-reviewed articles in journals listed in Index Medicus or PubMed in a 3-year period
- The same specialty authorship requirements as in Option 1, plus:
- Demonstration of trauma-related scholarly activity in at least 4 of the following areas:
  - Leadership in major trauma organizations
  - Peer-reviewed funding for trauma research
  - Evidence of dissemination of knowledge
  - Published trauma-related case reports
  - Visiting professorships or invited lectures
  - Resident participation in scholarly activity
  - Trauma, critical care, or acute surgery fellowship

Table 2 Research Requirements for a Pediatric Level I Trauma Center

- Requirements equivalent to Level I trauma center (see Table 1) except the following:
  - At least one article with a pediatric surgery author or co-author
  - In a combined Level I adult and pediatric trauma center, 10 of the required articles may be related to adult trauma if option 1 is used
- Regardless of whether Option 1 or Option 2 is used, l0 articles must be related to the care of injured children

The fact that most Level I trauma centers are housed in academic medical centers is not a coincidence. With the unique coexistence of expert trauma surgeons and committed basic and translational scientists, a structured research program can be accomplished.

Perhaps the most important resource is a core of trauma surgeons with interest and dedicated training in research methodology. Specifically, the Level I trauma director should have established research productivity, with regular participation in academic trauma forums such as the American Association for the Surgery of Trauma (AAST) and the ACS Committee on Trauma (ACS-COT). One of the trauma surgeons who remains clinically active in trauma care should direct formal, regularly scheduled trauma research meetings, with documentation of the ongoing activities. Trauma program managers, residents, and trauma registrars are an integral part of the research team to ensure the collection of complete and accurate data and regularly provide clinical outcome reports. Basic or translational scientists should participate in the regularly scheduled trauma research meetings, but the majority of the attendees should be trauma surgeons, surgical residents, and research fellows.

The surgical intensive care unit is an ideal environment to bridge the basic laboratory to injured patients, which underscores the imperative for a trauma surgeon to be director of the surgical intensive care unit. It is the ideal location in which to conduct comparative effectiveness research—designed to inform health care decisions by providing evidence on the effectiveness, benefits, and harms of different treatment options. The evidence is generated from research studies that compare drugs, medical devices, tests, surgeries, or ways to deliver health care (*http://effectivehealthcare.ahrq.gov/index.cfm/what-is-comparative-effectiveness-research1*).

Finally, the administration of a Level I trauma center must demonstrate support for the research program by, for example, providing basic laboratory space, sophisticated research equipment, advanced information systems, biostatiscal support, salary support for basic and translational scientists, or seed grants for less experienced faculty (CD 19–8).

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Disaster Planning and Management

Mass casualties from disasters often overwhelm local medical resources. The American College of Surgeons believes that the surgical community has an obligation to participate actively in the multidisciplinary planning for the triage and medical management of mass casualties following all disasters—natural or man-made, intentional or otherwise. Trauma centers must meet the disaster-related requirements of the Joint Commission (CD 20–1). A surgeon from the trauma panel must be a member of the hospital's disaster committee (CD 20–2). The Disaster Management and Emergency Preparedness (DMEP)© course is recommended for the trauma medical director and all trauma attending staff.

To devise a comprehensive strategy, disaster planning requires a cooperative multidisciplinary effort by local medical resources; police and fire departments; local, regional, state, and national governments; and industry. In the trauma center, disaster planning provides principles and guidelines for the organization of medical care in such events.-

Overall Considerations

The difference between multiple casualty events and mass casualty events is largely dependent on local resources. If a hospital is able to manage the number of casualties with local resources, the event is termed a *multiple casualty event.* A *mass casualty event* exists when the numbers, severity, and diversity of injuries overwhelm the local medical resources. In a Level IV facility, this criterion could be met with three or four critically injured patients from a motor vehicle crash. A multiple casualty or mass casualty event may be internal or external to the hospital, and the institution should be prepared to deal with either situation.

Management of a mass casualty event requires a paradigm shift in the care of injured patients. Instead of being able to offer each patient immediate and comprehensive treatment, care should be prioritized to optimize the use of critical resources. Triage is the first step of the process. Triage is the process of sorting or prioritizing patients into specific care categories depending on the number and severity of casualties and the resources available at that time. The accepted concept is to do "the greatest good for the greatest number," and triage is the tool that guides this concept. Triage involves only the rapid sorting of patients. Many mass casualty triage classification schemata exist.

It is important to note that patients who are dead need transport to the morgue or other designated area; however, their transport may be necessarily delayed to preserve transportation resources. They should be distinguished from expectant casualties, as the latter are still alive and may be provided care if resources permit after the patient influx ceases. Both overtriage (the assignment of patients with noncritical injuries to immediate treatment) and undertriage (the assignment of critically injured patients requiring immediate care to a delayed category) should be minimized. Overtriage inundates the limited resources with excessive numbers of patients to evaluate. Undertriage prevents necessary immediate evaluation and care of patients who need it. Repeated triage at different points in the field or hospital, coupled with adequate training of the triage officers, is essential for success. The avoidance of overtriage is a key component in the preservation of

hospital resources needed to care for the critically injured. If overtriage is unchecked, a marked decrement in surge capacity to well below predicted levels will occur, with a detrimental effect on the ability to deliver care.

Experienced prehospital personnel may initially perform disaster scene triage. In the hospital setting, it is suggested that an experienced surgeon familiar with current hospital resources, including operating room capacity, perform the triage function. Other acute care providers who routinely manage trauma (that is, emergency medicine physicians and trauma, intensive care unit, emergency department, and operating room nurses) may also function effectively in this role.

Hospitals should rapidly mobilize to increase space and resources to manage the added patient load (surge capacity). These resources include personnel, equipment, and bed space. Careful preplanning and the use of protocols are required to mobilize resources efficiently in a graduated response. Conservation of critical hospital resources is a key consideration, because the ultimate number of casualties may remain unknown for an extended period. A starting point for a hospital can be to anticipate a 20 percent increase in bed capacity. Of this increase, a case distribution of 20 percent severe, 30 percent moderate, and 50 percent mild might be expected. Up to 50 percent of these patients may need a surgical procedure at some point. Ten percent of the patients will need an immediate lifesaving surgical procedure, usually an operative procedure for bleeding control or a craniotomy. It is best to conserve health care provider resources by enforcing specific work shifts.

Drills of the response plan should be based on local risk assessment, be planned to simulate mass casualty events specific to the locale, and be conducted in conjunction with other hospitals and local emergency medical services. Hospital drills that test the individual hospital's disaster plan must be conducted at least twice a year, including actual plan activations that can substitute for drills (CD 20–3). An important component of hospital preparedness is community-wide exercises involving the interaction of the hospital with all local resources, including emergency management and public health agencies, police, search and rescue, media, and the military. Interaction and cooperation with regional and state assets are essential to a successful response.

State and National Resources

Familiarity with state and federal disaster resources is a great help in organizing a response. The governor can mobilize the National Guard. The National Disaster Medical System (NDMS) is a partnership of government and private organizations that supplements the local and state response. Federal organizations empowered to act on a national basis in response to disasters include the Federal Emergency Management Agency (FEMA) and the Department of Defense. States are mandated by FEMA to have individual disaster plans, and hospitals are integral to these plans. Although the availability of state and national support is important, the primary response to any disaster is local, making the trauma center a key entity in every disaster response. Integrating the trauma system into the disaster response is an important step in preparedness. The trauma system can serve as the consistent infrastructure for disaster response.

Hospital Disaster Planning Overview

Disaster response planning is a complex and time-consuming endeavor. A hospital disaster plan begins with a hazards vulnerability analysis. This analysis involves a projection of the most likely threats to the hospital and surrounding community. All sources of hazard—both natural and man-made, intentional or not—need to be considered. A realistic hazards vulnerability analysis that has been accomplished and agreed to by all parties provides a template against which a response plan can be developed and tested.

A hospital disaster plan includes the following: (1) prearranged agreements with the controlling regional emergency operating center and other regional disaster response agencies, including prehospital agencies, police, fire, military, utilities, the Red Cross, and the Salvation Army; (2) an organized response of the trauma center for the management of patients transported from the disaster site; (3) a disaster site triage team for identification and response, when requested by an appropriate agency; and (4) a plan for disasters arising within or near the hospital that require hospital evacuation. A plan integrated with community resources, including the community emergency preparedness office, public health departments, and the media, has the greatest likelihood of success. A medical and administrative operational team should have complete familiarity with the hospital disaster plan, and the medical staff and personnel should at least have knowledge of the plan.

The Hospital Incident Command System (HICS) is an emergency management system that uses a logical management structure. The system, based on public safety's Incident Command System, uses clearly defined responsibilities, clear channels of reporting, and common nomenclature. HICS has proved to be a valuable management tool and is becoming the standard for health care disaster response. The five primary functions included in HICS are incident command, planning, logistics, operations, and finance/administration. The medical management of casualties is only one small part of the operations section of the overall response. HICS has particular features that prepare hospitals for disaster response:

- A predictable chain of command and management
- Flexible organizational charts to allow a scalable response to specific emergencies
- Prioritized response checklists
- Accountability of position functions
- Improved documentation for increased accountability and cost recovery
- Common language to promote communication and facilitate outside assistance

Cost-effective emergency planning within HICS and all of its support material are offered to disaster planners and can be accessed at *www.emsa.ca.gov/disaster_medical_services_division_hospital_incident_command_system_resources* or by contacting the California Emergency Medical Services Authority at 916-322-4336.

All trauma centers must have a hospital disaster plan described in the hospital's policy and procedure manual or equivalent (CD 20–4). Hospital disaster plans detail the hospital's role in community emergency preparedness, implementation of specific procedures, management of key materials and activities, staff preparation, deployment and roles, management of patient care services, disaster drills, and monitoring and evaluation of hospital performance. Hospital disaster plans adhere to the principle of all-hazards planning, meaning that there should be one basic comprehensive plan to manage the many common features of all disasters, with the flexibility and resilience to adapt to the specific aspects of any given event. Having multiple plans for multiple specific events is not a workable option. The magnitude of the event will define the magnitude of the response—regional, state, or national. An individual hospital should plan not only for its expected role in a local disaster but also for participation in a disaster response within the region or adjacent regions. The plan ideally should be simple, scalable in its response, and able to deal with mass casualties. Among those causalities are special populations that need to be considered, such as but not limited to children, dialysis patients, adults and children with disabilities or special needs, and nursing home–bound or difficult-to-transport patients. Alternatives for care when transportation out is not possible are always problematic but worthy of consideration. Region-wide rather than institution-specific plans help solve this problem. Integrating the regional trauma system as the basic infrastructure for local and regional disaster response is one way to implement this plan region-wide. Surgeons are well qualified to provide in-house leadership for trauma-related disasters because they have comprehensive knowledge of the critical hospital resources most needed in disasters (that is, operating room and intensive care unit resources).

Disaster Response Drills and Exercises

Several steps are needed to test the effectiveness of response. Drills and other exercises enable identification of weak points in disaster plans, along with the development and testing of alternative approaches.

The steps in testing response effectiveness are as follows:

1. Based on local risk assessment, organize a simulation of a potential disaster. Set up the scene and provide moulaged "victims," arrange communication and transportation services, and alert community agencies. Some written exercises can be conducted to test various elements of the plan.
2. Implement the hospital disaster plan.
3. Arrange for referees to evaluate disaster drills and exercises.
4. Critique the hospital disaster response within 24 hours after each exercise.
5. Modify the disaster plan by lessons learned.
6. Repeat the hospital drill at least twice each year and the community disaster exercise at least yearly, recognizing that the response to disasters will never be perfect.

Obstacles to Optimal Patient Care

Communication is the key to optimal patient care in a disaster with mass casualties. Impaired communication may exist at the scene, in transit, within the hospital, and between hospitals. Planning circumvents unexpected problems, such as power and telephone failures, that can interfere with effective communication. Multiple levels of redundancy are required to overcome communication problems.

A system of command and control is essential. Establishment of a central authority with oversight of all sectors of the total response and operations, and with ultimate authority and responsibility for decision making and implementation of the disaster plan, is the goal of HICS. All personnel should know and understand their positions and responsibilities within the chain of command. The central authority should be predetermined in the planning process and be specified for individual hospitals, the disaster site, and the overall community response so it is clear who has the authority to initiate the disaster plan, who makes the decisions, and who terminates use of the disaster plan.

Prompt and thorough security of the hospital helps to protect patients and first responders. Preplanned hospital lockdown procedures prevent inundation by large crowds, media, and inappropriate casualties, all of which could interfere with proper casualty care.

Systematic medical care allows rapid assessment and treatment while maintaining the necessary forward flow of patients and preventing dangerous backlogs. Minimal use of unnecessary laboratory and radiology procedures, operating rooms, personnel and resources, and time is desirable to maximize care and minimize mortality for all patients.

Proper preparation and planning enable communities faced with disaster and mass casualty events to address devastation and death. The role of the trauma center in the preparation for, and management of, such events is critical.

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Solid Organ Procurement

The field of organ transplantation has seen major advances in recent decades, and organ transplantation has become the standard of care for the treatment of end-stage organ failure in medically suitable patients. However, the availability of organs for transplantation has not matched the high demand. There are tens of thousands of patients on the United Network for Organ Sharing (UNOS) waiting list for organ transplantation. At the current pace of approximately 28,000 transplantations per year, many patients who need an organ will never receive one. Every year, approximately 16 percent of patients on the waiting list (6,561 patients in 2010) die before receiving a transplant.

Approximately 75 percent of donated organs originate from deceased donors. More than 40 percent of cadaveric organ donors died because of trauma. The trauma program thus has a major role in organ donation by identifying potential organ donors, contacting organ procurement organizations (OPOs), and providing critical care to potential organ donors to prevent cardiovascular collapse before organ donation. The trauma center must have an established relationship with a recognized OPO (CD 21–1). Cardiovascular collapse is responsible for the loss of approximately 25 percent of potential organ donors. Early, aggressive monitoring and intervention may prevent or reverse cardiovascular collapse and thus improve the number and quality of donated organs. It is vital that all trauma programs be supportive of the OPO.

In 1984, the National Organ Transplant Act established the Organ Procurement and Transplantation Network to maintain a national registry and improve the organ-matching and placement process. The 1986 Omnibus Budget Reconciliation Act requires hospitals to develop policies and procedures to ensure that families are informed of the option to donate. Noncompliance endangers Medicare and Medicaid funding.

Obtaining Consent

Denial of family consent is the most common cause of loss of potential donors, followed by failure to request consent and failure to identify medically suitable donors. A dedicated team that includes representatives from the trauma program, a coordinator from the local OPO, nurses, and religious representatives addresses many of these issues surrounding consent. The primary health care team should not approach the family about organ donation but defer this conversation to the OPO representative. The trauma program, in coordination with the local OPO, should monitor the loss of potential trauma organ donors. A written policy must be in place for triggering notification of the regional OPO (CD 21–2). The notification preferably should occur before brain death declaration. The trauma center must review its organ donation rate annually (CD 16–9).

Declaration of Brain Death

The Uniform Determination of Death Act has defined the criterion for brain death as the complete and irreversible loss of function of the brain and brain stem. Although there are national guidelines regarding the clinical criteria and confirmatory studies for declaration of brain death, there is some variation among different states and trauma centers. It is essential that each trauma center (Levels I, II, III, and IV) have written protocols

defining the clinical criteria and confirmatory tests for the diagnosis of brain death (CD 21–3). Establishment of a systematic approach for a rapid declaration of death of patients who have lost function of the brain and brain stem is critical to avoid losing potential organ donors. The convenience of an individual specialist should not influence or delay the declaration of brain death.

Donation after Cardiac Death

A "donation after determination of cardiac death" donor is a potential donor who does not meet the criteria for brain death but has no hope of recovery and whose family has asked that support be withdrawn. The OPO is notified, and if the donor meets the criteria for organ donation and the family consents, the process of donation is organized. Once the team is assembled, the donor undergoes withdrawal of life support in accordance with the family's wishes, ideally in the operating room but occasionally in the intensive care unit or the postanesthesia care unit. Once cardiac arrest occurs, an additional period of time (for example, 2–5 minutes) passes, and the organ recovery team then proceeds with rapid cannulation, cooling, and organ recovery.

Management of Potential Organ Donors

Patients with traumatic brain death undergo major physiologic changes, including cardiovascular dysregulation and collapse, neurogenic pulmonary edema, diabetes insipidus, disseminated intravascular coagulopathy, and thyroxine insufficiency. Inadequate perfusion of potentially transplantable organs results in fewer organs transplanted and a less successful transplantation. Intensive monitoring and aggressive treatment remain the cornerstone for optimizing the number and quality of donated organs. In addition, experience in the complex management and ethical deliberations concerning these patients, as well as compassionate interaction with families, is valuable in the training of trauma and critical care fellows. In Level I centers with critical care fellowship programs, the fellows should be actively involved in the care of these patients. Written protocols with algorithms for the management of potential donors have an important role in preventing physiologic organ deterioration and thus in improving donation.

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Verification, Review, & Consultation Program

The American College of Surgeons' (ACS') long history of activities directed toward the improvement of trauma care was enhanced substantially in 1987 with the creation of the Verification, Review, & Consultation Program. This program validates the resources needed for high-quality care at trauma centers. The program is overseen by the Verification Review Committee (VRC) of the ACS Committee on Trauma (ACS-COT).

Resources for Optimal Care of the Injured Patient is used as a guide for the development of trauma centers throughout the United States. It is the document by which trauma centers are reviewed by ACS-approved site reviewers during consultation and verification site visits.

The designation of trauma facilities is a regulatory and bureaucratic process performed by authorized governmental or other agencies. The ACS does not designate trauma centers; instead, it verifies the presence of the resources, structures, and processes listed in *Resources for Optimal Care of the Injured Patient*. The ACS Verification, Review, & Consultation Program is designed to assist hospitals in the evaluation and improvement of trauma care and to provide objective, external review of institutional capabilities and performance. This process is accomplished by an on-site review of the hospital by a peer review team experienced in trauma care. The team assesses commitment, readiness, resources, policies, patient care, performance improvement, and other relevant features of the program as outlined in *Resources for Optimal Care of the Injured Patient*.

Consultation

The ACS-COT will provide a hospital consultation visit at the request of a hospital, community, or regulatory authority to assess trauma care and prepare for a subsequent verification review. A consultation visit follows the same format as a verification review but is most often carried out by two trauma surgeons and a trauma program manager. The focus is on providing recommendations and assistance to the facility in preparation for future verification.

Verification

Trauma center verification is the process by which the ACS confirms that a hospital is performing as a trauma center and meets the criteria contained in *Resources for Optimal Care of the Injured Patient*.

Trauma centers should have approval from the designating agency prior to application for verification, if such a requirement exists at the designating agency. In some designating jurisdictions, trauma centers are approved based on a needs assessment process. If the hospital does not fall under a designating authority, it may directly request a verification site visit.

The verification review process results in a report outlining the findings and, if successful, a certificate of verification. This certificate is valid for 3 years from the date of the initial site visit, after which a reverification site visit may be requested. The certificate for a reverification visit is valid for 3 years from the expiration date of the original verification certificate.

Outcomes of Verification

Previously, after completion of a verification or reverification site visit, a trauma center was either "verified" (granted a certificate for 3 years) or "not verified." One of the current missions of the Verification, Review, & Consultation Program is to provide guidance and recommendations for trauma programs during the site visit process while at the same time verifying that the essential criteria of a trauma center are in place. With this emphasis, the ACS-COT has added a third category as an outcome of a verification site visit: "verified with a certificate of verification for 1 year."

Type I and Type II Criteria

One of the most significant evolutions has been the identification of the essential requirements for verification of Type I and Type II criteria (or deficiencies). Type I criteria must be in place at the time of the verification site visit to achieve verification. Type II criteria are also required but are less critical. If three or fewer Type II deficiencies are present at the time of the site visit and no Type I criteria are cited, a 1-year certificate of verification is issued. During the ensuing 12 months, if the trauma center successfully corrects the deficiencies, the period of verification will be extended to 3 years from the date of the initial verification visit or, for a reverification visit, from the expiration date of the original certificate.

If any Type I deficiency or more than three Type II deficiencies are present at the time of the initial verification site visit, the hospital is not verified. A successful focused review is required to achieve verification. The focused review must occur 6–12 months from the date of the initial site visit.

During an on-site focused review, a two-surgeon team returns to the facility to determine if the deficiencies have been corrected. In general, efforts are made to ensure that one member of the original team is involved in the focused review process.

When correction of deficiencies can be demonstrated by submission of data to the ACS, the focused review can be completed without an on-site review. The trauma medical director and the hospital chief executive officer must attest to the accuracy and completeness of the submission. If the deficiencies are deemed to have been corrected as attested to in the submission, a certificate will be issued. If all deficiencies are not corrected at the time of the focused review, further extensions will not be considered. The verification visit will need to be repeated.

Multidisciplinary Review

The on-site review usually is conducted by two surgeons (a core team) from the ACS-COT. In some cases, there may be a requirement by the designating agency or a desire by the applicant that a multidisciplinary team evaluate the applicant's capability. The ACS-COT's Verification, Review, & Consultation Program can assist in this process. Two trauma surgeons lead the multidisciplinary team. Other members may include a neurosurgeon, an orthopaedic surgeon, an emergency medicine physician, a trauma program manager, or any other professional requested by the designating agency or the hospital.

The Consultation/Verification Process

Following the receipt of an application for a site visit, and after access to the prereview questionnaire (PRQ), a review team will be selected and a mutually acceptable date for the review established. The ACS-COT State Chair or Provincial Chair is notified. All site reviewers are from out of state or out of province. Trauma/general surgeon reviewers are selected from present and past members of the ACS-COT, State Chairs, Region Chiefs, and other specially qualified surgeons. The hospital is required to provide the medical records needed at the time of the site visit. A description of the medical records needed to complete the site visit will be provided to the hospital in advance of the visit and can also be found on the ACS website, at *www.facs.org/quality-programs/trauma/vrc/resources.* Case reviews are an important and essential component of the review process.

The following steps ensure consistency of the review process:

1. A hospital PRQ allows site reviewers to have a preliminary understanding of the trauma care capability and performance of the hospital and medical staff prior to the review. This questionnaire will be completed online by the trauma program and hospital staff.
2. A document titled *Conducting Verification and Consultative Reviews: A Staff and Consultant's Guide,* which describes the guidelines for a review, is provided to all site reviewers. This document is designed to ensure that reviews are conducted consistently. It defines the process of the review and the elements of appropriate conduct by the reviewers.
3. An organized agenda is prepared for the review so that all site reviews are performed in an efficient and standardized manner.
4. All site reviewers are approved by the VRC. Every site visit team has an assigned lead reviewer. These site reviewers are very experienced in trauma care and have been promoted to this position by the VRC.
5. The site visit report is written in a standardized format.
6. A final review of all reports is performed by the members of the VRC, and any discrepancies are adjudicated by the Chair of the VRC.

Site Visit Process

A prereview meeting facilitates an efficient on-site review. The site reviewers generally meet with the trauma director, the trauma program manager, subspecialty liaisons, and a hospital and nursing administrator. Other individuals may be invited if needed to clarify the PRQ and describe existing trauma center activities. The meeting is intended to include discussion of the overall trauma program, clarification of the PRQ, specific concerns, unique features of the institution, discussion of the local trauma system, and clarification of the review process. It also provides an opportunity for the site review team to highlight any/all program strengths to hospital administration.

It is beneficial to complete the review of patient charts before the prereview meeting. This format permits the site reviewers to learn a great deal about the trauma program early in the review process and adds to the value of the prereview meeting.

The on-site review requires approximately 8–10 hours. All areas of the hospital involved in trauma care may be visited. Emphasis is placed on evaluating the medical records of trauma patients and correlating patient care with the performance improvement and patient safety (PIPS) program. The visit concludes with an exit interview to discuss the site reviewers' findings and conclusions. The team leader must make it clear that the preliminary findings may be adjusted during the adjudication process.

The site reviewers then prepare a report that supports the statements made at the exit interview. This report is forwarded to the Verification, Review, & Consultation Program staff for editing and distribution to an editor and then to the VRC for consideration. The verbal report of the site reviewers at the exit interview should not be considered final. The information gathered by the site reviewers and their subsequent written report must be reviewed and approved by the VRC and VRC Chair before the report is finalized.

The VRC reviews the report and determines the presence or absence of deficiencies and whether a hospital has met the standards for verification. The VRC Chair has the authority to issue final approval. This process ensures accurate interpretation of the findings, well-documented conclusions, and consistency and professionalism in the final report. This final process may modify the conclusions of the individual site reviewers. The VRC review process ensures a consistent interpretation of the resources documented.

Confidentiality of the entire review process ensures that the series of steps will be a constructive process in which a hospital can place its trust.

If verified, a hospital will be included on a list of currently verified hospitals, available online at *www.facs.org/search/trauma-centers*.

Appeal Process

The appeals process is outlined in the Verification, Review, & Consultation Program's policy and procedures manual and is available upon written request.

Verification Performance Improvement Process

In keeping with the concept of self-evaluation for the purpose of improvement, the Verification, Review, & Consultation Program has instituted a process to ensure that the needs of hospitals are being met in a satisfactory manner. At the time the final report is sent to the hospital, an extensive questionnaire is sent to the trauma medical director and trauma program manager. This survey covers the entire review process, from the prereview meeting to the quality of the final report. Comments are solicited about the conduct of the site

reviewers, and the hospital is asked for an assessment of the total program. The Chair of the VRC, as well as Verification, Review, & Consultation Program staff, carefully review these comments. The completion of the survery is required immediately prior to the release of the final report. After all deliberation and adjudication has been completed. Survey results will not alter the findings in the report.

The feedback from the institutions participating in the review process has been extremely valuable. Favorable unsolicited comments are frequently received. Changes have been made in certain areas, such as revision of the PRQ, and on rare occasions site reviewers have been counseled or removed from the site reviewer panel. Random on-site observational analyses are conducted by Verification, Review, & Consultation Program staff. In addition, 360-degree evaluations are in process for each site reviewer, with feedback solicited from trauma center personnel, site review team members, report editors, and Verification, Review, & Consultation Program staff.

The situation that causes the greatest concern occurs when an institution is presented with information at the exit interview that differs significantly from the conclusions of the final report. This situation is particularly troublesome when additional deficiencies are identified by the VRC and appear in the final report. A concentrated effort is made at the time of the review to inform the hospital that the VRC makes the final decision regarding the composition of the report.

The Verification, Review, & Consultation Program is sensitive to the needs of hospitals—especially to needs that have been precipitated by the dynamic socioeconomic conditions prevalent in health care today. The ACS' performance improvement process has been extremely helpful in better meeting the needs of trauma centers.

Application Forms and Site Visit Information

Requests for verification or consultation information should be addressed to

American College of Surgeons
Trauma Programs
Verification, Review, & Consultation Program
633 N. Saint Clair St.
Chicago, IL 60611–3211
312-202-5134

These forms also are available from the ACS website, at *www.facs.org/quality-programs/trauma/vrc/site-packet.*

Supplemental Readings

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Ehrlich PF, McClellan WT, Wesson DE. Monitoring performance: Longterm impact of trauma verification and review. *J Am Coll Surg*. 2005;200(2):166-172.

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Criteria Quick Reference Guide

The preceding chapters of *Resources for Optimal Care of the Injured Patient* are designed to clearly define the criteria to verify that trauma centers have resources for optimal care of injured patients.	**This chapter is included as a quick reference to identify the criteria to meet the requirements as stated in each chapter.**

Chapter	Level	Criterion by Chapter and Level	Type
Chapter 1: Trauma Systems			
1	I, II, III, IV	The individual trauma centers and their health care providers are essential system resources that must be active and engaged participants (CD 1–1).	TYPE II
1	I, II, III, IV	They must function in a way that pushes trauma center–based standardization, integration, and PIPS out to the region while engaging in inclusive trauma system planning and development (CD 1–2)	TYPE II
1	I, II, III, IV	Meaningful involvement in state and regional trauma system planning, development, and operation is essential for all designated trauma centers and participating acute care facilities within a region (CD 1–3)	TYPE II
Chapter 2: Description of Trauma Centers and Their Roles in a Trauma System			
2	I, II, III, IV	This trauma center must have an integrated, concurrent performance improvement and patient safety (PIPS) program to ensure optimal care and continuous improvement in care (CD 2–1).	TYPE I
2	I, II, III	Surgical commitment is essential for a properly functioning trauma center (CD 2–2).	TYPE I
2	I, II, III, IV	Trauma centers must be able to provide the necessary human and physical resources (physical plant and equipment) to properly administer acute care consistent with their level of verification (CD 2–3).	TYPE II
2	I	A Level I trauma center must admit at least 1,200 trauma patients yearly or have 240 admissions with an Injury Severity Score of more than 15. (CD 2–4).	TYPE I
2	I, II, III	Through the trauma PIPS program and hospital policy, the trauma director must have responsibility and authority for determining each general surgeon's ability to participate on the trauma panel based on an annual review (CD 2–5).	TYPE II
2	I, II	Qualified attending surgeons must participate in major therapeutic decisions, be present in the emergency department for major resuscitations, be present at operative procedures, and be actively involved in the critical care of all seriously injured patients (CD 2–6).	TYPE I
2	I, II	A resident in postgraduate year 4 or 5 or an attending emergency physician who is part of the trauma team may be approved to begin resuscitation while awaiting the arrival of the attending surgeon but cannot independently fulfill the responsibilities of, or substitute for, the attending surgeon (CD 2–6).	TYPE I

2	I, II	The presence of such a resident or attending emergency physician may allow the attending surgeon to take call from outside the hospital. In this case, local criteria and a PIPS program must be established to define conditions requiring the attending surgeon's immediate hospital presence (CD 2–7).	TYPE II
2	I, II, III	For Level I, II and III trauma centers, it is expected that the surgeon will be in the emergency department on patient arrival, with adequate notification from the field. The maximum acceptable response time for the highest-level activation tracked from patient arrival for Level I and II trauma centers is 15 minutes, and 30 minutes for Level III trauma centers. The minimum criteria for full trauma team activation are provided in Table 2 in Chapter 5. The program must demonstrate that the surgeon's presence is in compliance at least 80 percent of the time (CD 2–8).	TYPE I
2	IV	For Level IV trauma centers, it is expected that the physician (if available) or midlevel provider will be in the emergency department on patient arrival, with adequate notification from the field. The maximum acceptable response time is 30 minutes for the highest level of activation, tracked from patient arrival. The PIPS program must demonstrate that the physician's (if available) or midlevel provider's presence is in compliance at least 80 percent of the time (CD 2–8).	TYPE I
2	I, II	The attending surgeon's immediate (within 15 minutes) arrival for patients with appropriate activation criteria must be monitored by the hospital's trauma PIPS program (CD 2–9).	TYPE I
2	I, II	The trauma surgeon on call must be dedicated to a single trauma center while on duty (CD 2–10)	TYPE II
2	I, II	In addition, a published backup call schedule for trauma surgery must be available (CD 2–11).	TYPE II
2	III	A Level III trauma center must have continuous general surgical coverage (CD 2–12).	TYPE II
2	III, IV	Well-defined transfer plans are essential (CD 2–13).	TYPE II
2	IV	Collaborative treatment and transfer guidelines reflecting the Level IV facilities' capabilities must be developed and regularly reviewed, with input from higher-level trauma centers in the region (CD 2–13).	TYPE II
2	IV	A Level IV facility must have 24-hour emergency coverage by a physician or midlevel provider (CD 2–14).	TYPE II
2	IV	The emergency department at Level IV centers must be continuously available for resuscitation with coverage by a registered nurse and physician or midlevel provider, and it must have a physician director (CD 2–15).	TYPE II
2	IV	These providers must maintain current Advanced Trauma Life Support® certification as part of their competencies in trauma (CD 2–16).	TYPE II
2	I, II, III, IV	For Level I, II, III and IV trauma centers a trauma medical director and trauma program manager knowledgeable and involved in trauma care must work together with guidance from the trauma peer review committee to identify events, develop corrective action plans, and ensure methods of monitoring, reevaluation, and benchmarking. (CD 2-17).	TYPE II

2	I, II, III, IV	Level I, II, III and IV trauma centers the multidisciplinary trauma peer review committee must meet regularly, with required attendance of medical staff active in trauma resuscitation, to review systemic and care provider issues, as well as propose improvements to the care of the injured (CD 2–18).	TYPE II
2	I, II, III, IV	Level I, II, III and IV trauma centers a PIPS program must have audit filters to review and improve pediatric and adult patient care (CD 2–19).	TYPE II
2	IV	Because of the greater need for collaboration with receiving trauma centers, the Level IV trauma center must also actively participate in regional and statewide trauma system meetings and committees that provide oversight (CD 2–20).	TYPE II
2	IV	The Level IV trauma center must also be the local trauma authority and assume the responsibility for providing training for prehospital and hospital-based providers (CD 2–21).	TYPE II
2	I, II, III, IV	Level I, II, III and IV trauma centers the facility must participate in regional disaster management plans and exercises (CD 2–22).	TYPE II
2	I, II, III	Any adult trauma center that annually admits 100 or more injured children younger than 15 years must fulfill the following additional criteria demonstrating their capability to care for injured children: trauma surgeons must be credentialed for pediatric trauma care by the hospital's credentialing body (CD 2–23).	TYPE II
2	I, II, III	There must be a pediatric emergency department area, a pediatric intensive care area, appropriate resuscitation equipment, and a pediatric-specific trauma PIPS program (CD 2–24).	TYPE II
2	I, II, III	For adult trauma centers annually admitting fewer than 100 injured children younger than 15 years, these resources are desirable. These hospitals, however, must review the care of their injured children through their PIPS program (CD 2–25).	TYPE II
Chapter 3: Prehospital Trauma Care			
3	I, II, III, IV	The trauma program must participate in the training of prehospital personnel, the development and improvement of prehospital care protocols, and performance improvement and patient safety programs (CD 3–1).	TYPE II
3	I, II, III, IV	The protocols that guide prehospital trauma care must be established by the trauma health care team, including surgeons, emergency physicians, medical directors for EMS agencies, and basic and advanced prehospital personnel (CD 3–2).	TYPE II
3	I, II, III	Rigorous multidisciplinary performance improvement is essential to evaluate overtriage and undertriage rates to attain the optimal goal of less than 5 percent undertriage (CD 3–3).	TYPE II
3	I, II, III	The trauma director must be involved in the development of the trauma center's bypass (diversion) protocol (CD 3–4).	TYPE II
3	I, II, III	The trauma surgeon must be involved in the decision regarding bypass (diversion) each time the center goes on bypass (CD 3–5).	TYPE II
3	I, II, III	The trauma center must not be on bypass (diversion) more than 5 percent of the time (CD 3–6).	TYPE II

3	I, II, III, IV	When a trauma center is required to go on bypass or to divert, the center must have a system to notify dispatch and EMS agencies (CD 3–7). The center must do the following: • Prearrange alternative destinations with transfer agreements in place • Notify other centers of divert or advisory status • Maintain a divert log • Subject all diverts and advisories to performance improvement procedures	TYPE II
Chapter 4: Interhospital Transfer			
4	I, II, III, IV	Direct physician-to-physician contact is essential (CD 4–1).	TYPE II
4	I, II, III	The decision to transfer an injured patient to a specialty care facility in an acute situation must be based solely on the needs of the patient and not on the requirements of the patient's specific provider network (for example, a health maintenance organization or a preferred provider organization) or the patient's ability to pay (CD 4–2).	TYPE II
4	I, II, III, IV	A very important aspect of interhospital transfer is an effective PIPS program that includes evaluating transport activities (CD 4–3).	TYPE II
4	I, II, III, IV	Perform a PIPS review of all transfers (CD 4–3).	TYPE II
Chapter 5: Hospital Organization and the Trauma Program			
5	I, II, III, IV	A decision by a hospital to become a trauma center requires the commitment of the institutional governing body and the medical staff (CD 5–1).	TYPE I
5	I, II, III, IV	Documentation of administrative commitment is required from the governing body and the medical staff (CD 5–1)	TYPE I
5	I, II, III	This [administrative] support must be reaffirmed continually (every 3 years) and must be current at the time of verification (CD 5–2).	TYPE II
5	I, II, III	The [medical staff] support must be reaffirmed continually (every 3 years) and must be current at the time of verification (CD 5–3).	TYPE II
5	I, II, III	The trauma program must involve multiple disciplines and transcend normal departmental hierarchies (CD 5–4).	TYPE II
5	I, II, III	The TMD must be a current board-certified general surgeon (or a general surgeon eligible for certification by the American Board of Surgery according to current requirements) or a general surgeon who is an American College of Surgeons Fellow with a special interest in trauma care and must participate in trauma call (CD 5-5).	TYPE I
5	I, II, III	The TMD must be current in Advanced Trauma Life Support® (ATLS®) (CD 5–6).	TYPE II
5	I, II	The TMD must maintain an appropriate level of trauma-related extramural continuing medical education (16 hours annually, or 48 hours in 3 years) (CD 5–7)	TYPE II
5	I, II	Membership and active participation in regional or national trauma organizations are essential for the trauma director in Level I and II trauma centers and are desirable for TMDs in Level III and IV facilities (CD 5–8).	TYPE II

5	I, II, III	The TMD must have the authority to manage all aspects of trauma care (CD 5–9).	TYPE II
5	I, II, III	The TMD must chair and attend a minimum of 50% of the multidisciplinary trauma peer review committee meetings. (CD 5-10)	TYPE II
5	I, II, III	The TMD, in collaboration with the TPM, must have the authority to correct deficiencies in trauma care and exclude from trauma call the trauma team members who do not meet specified criteria (CD 5-11).	TYPE II
5	I, II, III	In addition, the TMD must perform an annual assessment of the trauma panel providers in the form of Ongoing Professional Practice Evaluation (OPPE) and Focused Professional Practice Evaluation (FPPE) when indicated by findings of the PIPS process (CD 5-11).	TYPE II
5	I, II, III	The TMD must have the responsibility and authority to ensure compliance with the above requirements and cannot direct more than one trauma center (CD 5-12).	TYPE II
5	I, II, III, IV	The criteria for a graded activation must be clearly defined by the trauma center, with the highest level of activation including the six required criteria listed in Table 2 (CD 5–13).	TYPE II
5	I, II	In Level I and II trauma centers, the highest level of activation requires the response of the full trauma team within 15 minutes of arrival of the patient, and the criteria should include physiologic criteria and some or several of the anatomic criteria (CD 5-14)	TYPE II
5	III, IV	In Level III and IV trauma centers the team must be fully assembled within 30 minutes (CD 5-15).	TYPE II
5	I, II, III, IV	Other potential criteria for trauma team activation that have been determined by the trauma program to be included in the various levels of trauma activation must be evaluated on an ongoing basis in the PIPS process (CD 5-16) to determine their positive predictive value in identifying patients who require the resources of the full trauma team.	TYPE II
5	I, II, III	The emergency physician may initially evaluate the limited-tier trauma patient, but the center must have a clearly defined response expectation for the trauma surgical evaluation of those patients requiring admission (CD 5-16).	TYPE II
5	I, II	In a Level I or II trauma center, seriously injured patients must be admitted to, or evaluated by, an identifiable surgical service staffed by credentialed trauma providers (CD 5-17).	TYPE II
5	III	In Level III centers, injured patients may be admitted to individual surgeons, but the structure of the program must allow the trauma director to have oversight authority for the care of these patients. (CD 5-17)	TYPE II
5	I, II, III	Programs that admit more than 10% of injured patients to non-surgical services must review all non-surgical admissions through the trauma PIPS process (CD 5–18).	TYPE II
5	I, II	Sufficient infrastructure and support to ensure adequate provision of care must be provided for this service (CD 5–19).	TYPE I

5	I, II	In teaching facilities, the requirements of the residency review committees must be met (CD 5–20).	TYPE II
5	III	There must be a method to identify the injured patients, monitor the provision of health care services, make periodic rounds, and hold formal and informal discussions with individual practitioners (CD 5–21).	TYPE I
5	I, II, III	In addition to administrative ability, the TPM must show evidence of educational preparation and clinical experience in the care of injured patients (CD 5-22).	TYPE II
5	I, II	In Level I and II trauma centers, the TPM must be full-time and dedicated to the trauma program (CD 5–23).	TYPE II
5	I, II	The TPM must show evidence of educational preparation, with a minimum of 16 hours (internal or external) of trauma-related continuing education per year and clinical experience in the care of injured patients (CD 5-24).	TYPE II
5	I, II, III	The trauma center's PIPS program must have a multidisciplinary trauma peer review committee chaired by the TMD (CD 5-25).	TYPE II
Chapter 6: Clinical Functions: General Surgery			
6	I, II, III	General surgeons caring for trauma patients must meet certain requirements, as described herein (CD–6-1). These requirements may be considered to be in four categories: current board certification, clinical involvement, performance improvement and patient safety, and education.	TYPE II
6	I, II, III	Board certification or eligible for certification by the American Board of Surgery according to current requirements or the alternate pathway is essential for general surgeons who take trauma call in Level I, II, and III trauma centers (CD 6–2).	TYPE II
6	I, II, III	Alternate Criteria (CD 6-3) for non–Board-Certified Surgeons in a Level I, II, or III Trauma Centers.	TYPE II
6	I, II, III	Trauma surgeons must have privileges in general surgery (CD 6–4).	TYPE II
6	I, II	In Level I and II trauma centers, the trauma surgeon on call must be dedicated to a single trauma center while on duty (CD 6–5).	TYPE I
6	I, II	In addition, a published backup call schedule for trauma surgery must be available (CD 6–6).	TYPE II
6	I, II, III, IV	For Level I and II trauma centers, the maximum acceptable response time is 15 minutes; for Level III and Level IV trauma centers, the maximum acceptable response time is 30 minutes. Response time will be tracked from patient arrival rather than from notification or activation. An 80 percent attendance threshold must be met for the highest-level activations (CD 2–8).	TYPE I
6	I, II, III	For Level I, II, and III trauma centers, the attending surgeon is expected to be present in the operating room for all operations. A mechanism for documenting this presence is essential (CD 6–7).	TYPE II

6	I, II, III	In Level I, II, and III trauma centers, there must be a multidisciplinary trauma peer review committee chaired by the trauma medical director (CD 5-25) and representatives from general surgery (CD 6-8), and liaisons from orthopedic surgery (CD 9-16), emergency medicine (CD 7-11), ICU (CD 11-62), and anesthesia (CD 11-13) – and for Level I and II trauma centers, neurosurgery (CD 8-13) and radiology (CD 11-39).	TYPE II
6	I, II, III	Each member of the group of general surgeons must attend at least 50 percent of the multidisciplinary trauma peer review committee meetings (CD 6–8).	TYPE II
6	I, II, III	All general surgeons on the trauma team must have successfully completed the Advanced Trauma Life Support® (ATLS®) course at least once (CD 6–9).	TYPE II
6	I, II	The trauma medical director must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related CME (CD 5–7).	TYPE II
6	I, II	In Level I and II trauma centers, this requirement must be met by the acquisition of 16 hours of CME per year on average or by demonstrating participation in an internal educational process conducted by the trauma program based on the principles of practice-based learning and the performance improvement and patient safety program (CD 6–10).	TYPE II
Chapter 7: Clinical Functions: Emergency Medicine			
7	I, II, III	The emergency departments of Level I, II, and III trauma centers must have a designated emergency physician director supported by an appropriate number of additional physicians to ensure immediate care for injured patients (CD 7–1).	TYPE I
7	I, II	An emergency physician must be present in the department at all times in a Level I and Level II trauma centers (CD 7–2).	TYPE I
7	III	Occasionally, in a Level III trauma center, it is necessary for the physician to leave the emergency department for short periods to address in-house emergencies. Such cases and their frequency must be reviewed by the performance improvement and patient safety (PIPS) program to ensure that this practice does not adversely affect the care of patients in the emergency department (CD 7–3).	TYPE II
7	I, II, III	In institutions in which there are emergency medicine residency training programs, supervision must be provided by an in-house attending emergency physician 24 hours per day (CD 7–4).	TYPE II
7	I, II, III	These roles and responsibilities must be defined, agreed on, and approved by the director of the trauma service (CD 7–5).	TYPE II
7	I, II, III	Board certification or eligibility for certification by the appropriate emergency medicine board according to current requirements or the alternate pathway is essential for physicians staffing the emergency department and caring for trauma patients in Level I, II, and III trauma centers (CD 7–6).	TYPE II
7	I, II, III	Alternate Criteria (CD 6-3) for Non–Board-Certified Emergency Medicine Physicians in Level I, II, and III Trauma Centers	TYPE II
7	I, II, III	Emergency physicians on the call panel must be regularly involved in the care of injured patients (CD 7–7).	TYPE II

7	I, II, III	A representative from the emergency department must participate in the prehospital PIPS program (CD 7–8).	TYPE II
7	I, II, III	A designated emergency physician liaison must be available to the trauma director for PIPS issues that occur in the emergency department (CD 7–9).	TYPE II
7	I, II, III	Emergency physicians must participate actively in the overall trauma PIPS program and the multidisciplinary trauma peer review committee (CD 7–10).	TYPE II
7	I, II, III	The emergency medicine liaison on the multidisciplinary trauma peer review committee must attend a minimum of 50 percent of the committee meetings (CD 7–11).	TYPE II
7	I, II	In Level I and II trauma centers, the liaison from emergency medicine must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related CME (CD 7–12).	TYPE II
7	I, II	Other emergency physicians who participate on the trauma team also must be knowledgeable and current in the care of injured patients. This requirement may be met by documenting the acquisition of 16 hours of trauma-related CME per year on average or by demonstrating participation in an internal educational process conducted by the trauma program based on the principles of practice-based learning and the PIPS program (CD 7–13).	TYPE II
7	I, II, III	In Level I, II, and III trauma centers, all board-certified emergency physicians or those eligible for certification by an appropriate emergency medicine board according to current requirements must have successfully completed the ATLS course at least once (CD 7–14).	TYPE II
7	I, II, III	Physicians who are certified by boards other than emergency medicine who treat trauma patients in the emergency department are required to have current ATLS status (CD 7–15).	TYPE II
Chapter 8: Clinical Functions: Neurosurgery			
8	I, II	If this surgeon is not the director of the neurosurgery service, a neurologic surgeon liaison must be designated (CD 8–1).	TYPE I
8	I, II	Neurotrauma care must be continuously available for all TBI and spinal cord injury patients and must be present and respond within 30 minutes based on institutional-specific criteria (CD 8–2).	TYPE I
8	I, II	The trauma center must provide a reliable, published neurotrauma call schedule with formally arranged contingency plans in case the capability of the neurosurgeon, hospital, or system to care for neurotrauma patients is overwhelmed (CD 8–3).	TYPE I
8	I, II	The center must have a predefined and thoroughly developed neurotrauma diversion plan that is implemented when the neurosurgeon on call becomes encumbered (CD 8–4). A predefined, thoroughly developed neurotrauma diversion plan must include the following: • Emergency medical services notification of neurosurgery advisory status/ diversion. • A thorough review of each instance by the performance improvement and patient safety (PIPS) program. • Monitoring of the efficacy of the process by the PIPS program.	TYPE II

8	I, II, III	A formal, published contingency plan must be in place for times in which a neurosurgeon is encumbered upon the arrival of a neurotrauma case (CD 8–5). The contingency plan must include the following: • A credentialing process to allow the trauma surgeon to provide initial evaluation and stabilization of the neurotrauma patient. • Transfer agreements with a similar or higher-level verified trauma center. • Direct contact with the accepting facility to arrange for expeditious transfer or ongoing monitoring support. • Monitoring of the efficacy of the process by the PIPS program.	TYPE II
8	I, II, III	If one neurosurgeon covers two centers within the same limited geographic area, there must be a published backup schedule (CD 8-6.)	TYPE II
8	I, II, III	In addition, the performance improvement process must demonstrate that appropriate and timely care is provided (CD 8–6).	TYPE II
8	III	A Level III trauma center must have a plan approved by the trauma medical director that determines which types of neurosurgical injuries may remain and which should be transferred (CD 8–7).	TYPE II
8	III	Transfer agreements must exist with appropriate Level I and Level II trauma centers (CD 8–8).	TYPE II
8	III	In all cases, whether patients are admitted or transferred, the care must be timely, appropriate, and monitored by the PIPS program (CD 8–9).	TYPE I
8	I, II, III	Board certification or eligibility for certification by an appropriate neurosurgical board according to the current requirements or the alternate pathway is essential for neurosurgeons who take trauma call in Level I, II, or III trauma centers (CD 8–10).	TYPE II
8	I, II, III	Alternate Criteria (CD 6-3) for Non–Board-Certified Neurosurgeons in Level I, II, and III Trauma Centers	TYPE II
8	I, II	Qualified neurosurgeons should be regularly involved in the care of patients with head and spinal cord injuries and must be credentialed by the hospital with general neurosurgical privileges (CD 8–11).	TYPE I
8	I, II	The neurosurgery service must participate actively in the overall trauma PIPS program (CD 8–12).	TYPE II
8	I, II	The neurosurgery liaison on the multidisciplinary trauma peer review committee must attend a minimum of 50 percent of the committee's meetings (CD 8–13).	TYPE II
8	III	Level III centers with any emergent neurosurgical cases must also have the participation of neurosurgery on the multidisciplinary trauma peer review committee (CD 8–13).	Type II
8	I, II	The liaison representative from neurosurgery must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related CME (CD 8–14)	TYPE II
8	I, II	This requirement may be documented by the acquisition of 16 hours of trauma CME per year on average or through an internal educational process (IEP)conducted by the trauma program and the neurosurgical liaison based on the principles of practice-based learning and the PIPS program (CD 8–15).	TYPE II

Chapter 9: Clinical Functions: Orthopaedic Surgery			
9	I, II	Because of their skills and training in the management of the acute and rehabilitation phases of musculoskeletal trauma, physical and occupational therapists and rehabilitation specialists are essential at Level I and II trauma centers (CD 9–1).	TYPE II
9	I, II, III	Operating rooms must be promptly available to allow for emergency operations on musculoskeletal injuries, such as open fracture debridement and stabilization, external fixator placement, and compartment decompression (CD 9–2).	TYPE I
9	I, II	In Level I and II trauma centers, a system must be organized so that musculoskeletal trauma cases can be scheduled without undue delay and not at inappropriate hours that might conflict with more urgent surgery or other elective procedures (CD 9–3).	TYPE II
9	I, II, III	Level I, II, and III trauma centers must have an orthopaedic surgeon who is identified as the liaison to the trauma program (CD 9–4).	TYPE I
9	I	In a Level I trauma center the orthopaedic care must be overseen by an individual who has completed a fellowship in orthopaedic traumatology approved by the Orthopaedic Trauma Association (OTA) (CD 9-5).	TYPE I
9	PTC I	In Pediatric Level I trauma centers this requirement may be met by having formal transfer agreements that specify which cases will be transferred for high level orthopaedic oversight and assuring that all such transfers (or potential transfers) are reviewed as part of the performance improvement process (CD 9-5).	TYPE I
9	I, II	Orthopaedic team members must have dedicated call at their institution or have an effective backup call system (CD 9–6).	TYPE II
9	I, II	They must be available in the trauma resuscitation area within 30 minutes after consultation has been requested by the surgical trauma team leader for multiply injured patients (CD 9-7) based on institution-specific criteria.	TYPE II
9	I, II	The performance improvement process must ensure that care is timely and appropriate (CD 9-8).	TYPE II
9	I, II	If the on-call orthopaedic surgeon is unable to respond promptly, a backup consultant on-call surgeon must be available (CD 9-9).	TYPE II
9	I, II	The design of this system is the responsibility of the orthopaedic trauma liaison but must be approved by the trauma program director (CD 9-10).	TYPE II
9	I, II	The trauma center must provide all the necessary resources for modern musculoskeletal trauma care, including instruments, equipment, and personnel, along with readily available operating rooms for musculoskeletal trauma procedures (CD 2–3).	TYPE II
9	III	Level III facilities vary significantly in the staff and resources that they can commit to musculoskeletal trauma care, but they must have an orthopaedic surgeon on call and promptly available 24 hours a day (CD 9-11).	TYPE II

9	III	If the orthopaedic surgeon is not dedicated to a single facility while on call, then a published backup schedule is required (CD 9-12).	TYPE II
9	III	The PIPS process must review the appropriateness of the decision to transfer or retain major orthopaedic trauma cases (CD 9-13).	TYPE II
9	I, II	There must be protocols in Level I and II centers for the following orthopaedic emergencies: 1) the type and severity of pelvic and acetabular fractures that will be treated at the institutions as well as those that will be transferred out for care; 2) the timing and sequence for the treatment of long bone fractures in multiply injured patients; and 3) the wash out time for open fractures. These protocols must be included as part of the PIPS process (CD 9-14).	TYPE II
9	I, II, III	The orthopaedic service must participate actively with the overall trauma PIPS program and the multidisciplinary trauma peer review committee (CD 9–15).	TYPE II
9	I, II, III	The orthopaedic liaison to the trauma PIPS program must attend a minimum of 50 percent of the multidisciplinary trauma peer review committee meetings (CD 9–16).	TYPE II
9	I, II, III	Board certification or eligibility for certification by an appropriate orthopaedic board according to the current requirements, or the alternate pathway is essential for orthopaedic surgeons who take trauma call in Level I, II, and III trauma centers (CD 9–17).	TYPE II
9	I, II, III	Alternate Criteria (CD 6-3) for Non–Board-Certified Orthopaedic Surgeons in a Level I, II, or III Trauma Center	TYPE II
9	I, II	The orthopaedic surgical liaison to the trauma program at Level I and II centers must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related continuing medical education (CME) (CD 9–18).	TYPE II
9	I, II	This requirement may be documented by the acquisition of 16 hours of trauma CME per year on average or through an internal educational process conducted by the trauma program and the orthopaedic liaison based on the principles of practice-based learning and the PIPS program (CD 9–19).	TYPE II
Chapter 10: Pediatric Trauma Care			
10	PTC I, II	Hospitals that pursue verification as pediatric trauma centers must meet the same resource requirements as adult trauma centers, in addition to pediatric resource requirements (CD 2–3) (Table 1)	TYPE II
10	PTC I	A Level I pediatric trauma center must annually admit 200 or more injured children younger than 15 years (CD 10–1)	TYPE I
10	PTC II	A Level II pediatric trauma center must annually admit 100 or more injured children younger than 15 years (CD 10–2).	TYPE I
10	PTC I, II	All Level I and II pediatric trauma centers must have a dedicated pediatric trauma program manager (CD 10–3)	TYPE I
10	PTC I, II	All Level I and II pediatric trauma centers must have a pediatric trauma registrar (CD 10–4).	TYPE II
10	PTC I	In a Level I pediatric trauma center, the pediatric trauma program manager must be a full-time position dedicated to the pediatric trauma service (CD 10–5)	TYPE II

10	PTC I, II	All pediatric trauma centers must have a pediatric trauma performance improvement and patient safety (PIPS) program (CD 10–6).	TYPE I
10	PTC I, II	In addition, all pediatric trauma centers must have the following programs: pediatric rehabilitation, child life and family support programs, pediatric social work, child protective services, pediatric injury prevention, community outreach, and education of health professionals and the general public in the care of pediatric trauma patients (CD 10–7).	TYPE II
10	PTC I, II	Level I and II pediatric trauma centers must have a mechanism in place to assess children for maltreatment (CD 10–8).	TYPE II
10	PTC I	Level I pediatric trauma centers must have identifiable pediatric trauma research (CD 10–9).	TYPE II
10	PTC I	The pediatric Level I center's research requirement is equivalent to that of adult Level I trauma centers (CD 10–10).	TYPE II
10	PTC I	In combined Level I adult and pediatric centers, half of the research requirement must be pediatric research (CD 10–11).	TYPE II
10	PTC I	A Level I pediatric trauma center must have at least two surgeons who are board certified or eligible for certification by the American Board of Surgery according to current requirements in pediatric surgery (CD 10–12).	TYPE I
10	PTC I	On staff, there must be one board-certified surgeon or one surgeon eligible for certification by an appropriate orthopaedic board (see Chapter 9, Clinical Functions: Orthopaedic Surgery) according to the current requirements of that board who also has had pediatric fellowship training (CD 10–13).	TYPE I
10	PTC I	Additionally, there must be on staff at least one board-certified surgeon or one surgeon eligible for certification by an appropriate neurosurgical board (see Chapter 8, Clinical Functions: Neurosurgery) according to current requirements of that board who also has had pediatric fellowship training (CD 10–14).	TYPE I
10	PTC I	There must be one additional board-certified orthopaedic surgeon or surgeon eligible for certification by an appropriate orthopaedic board according to the current requirements of that board (CD 10–15), who is identified with demonstrated interests and skills in pediatric trauma care.	TYPE II
10	PTC I	There must be one additional board-certified neurosurgeon or surgeon eligible for certification by an appropriate neurosurgical board according to the current requirements of that board, who is identified with demonstrated interests and skills in pediatric trauma care (CD 10–16).	TYPE II
10	PTC I	There must be two physicians who are board certified or eligible for certification in pediatric critical care medicine, according to current requirements in pediatric critical care medicine: or in pediatric surgery and surgical critical care by the American Board of Surgery (CD 10–17).	TYPE I
10	PTC I	There must be two physicians who are board certified or eligible for certification by an appropriate emergency medicine board according to current requirements in pediatric emergency medicine (CD 10–18).	TYPE II

10	PTC I, II	The pediatric intensive care unit must be staffed by individuals credentialed by the hospital to provide pediatric trauma care in their respective areas (CD 10–19).	TYPE II
	PTC I, II	The pediatric section of the emergency department must be staffed by individuals credentialed by the hospital to provide pediatric trauma care in their respective areas (CD 10-20).	TYPE II
10	PTC II	In a Level II pediatric trauma center, there must be at least one pediatric surgeon who is board-certified or eligible for certification by the American Board of Surgery according to current requirements in pediatric surgeon (CD 10–21).	TYPE I
10	PTC II	There must be one surgeon who is board-certified or eligible for certification by an appropriate orthopaedic board (CD 10–22) identified with demonstrated interests and skills in pediatric trauma care.	TYPE II
10	PTC II	There must be one surgeon who is board-certified or eligible for certification by an appropriate neurosurgical board (CD 10–23) identified with demonstrated interests and skills in pediatric trauma care.	TYPE I
10	PTC I	In a Level I pediatric trauma center, the pediatric trauma medical director must be board certified or eligible for certification by the American Board of Surgery according to current requirements for pediatric surgery or alternatively, a pediatric surgeon who is a Fellow of the American College of Surgeons with a special interest in pediatric trauma care, and must participate in trauma call (CD 10–24).	TYPE I
10	PTC II	In a Level II pediatric trauma center, the pediatric trauma medical director should be a board-certified pediatric surgeon or a surgeon eligible for certification by the American Board of Surgery according to current requirements for pediatric surgeons. This individual must be a board-certified general surgeon or a general surgeon eligible for certification by the American Board of Surgery according to current requirements qualified to serve on the pediatric trauma team as defined in the following paragraph (CD 10–25).	TYPE I
10	PTC I, II	When the number of pediatric surgeons on staff is too few to sustain the pediatric trauma panel, general surgeons who are board certified or eligible for certification by the American Board of Surgery according to current requirements may serve on the pediatric trauma team. In this circumstance, they must be credentialed by the hospital to provide pediatric trauma care, be members of the adult trauma panel, and be approved by the pediatric trauma medical director (CD 10–26).	TYPE I
10	PTC I	At a minimum, a Level I pediatric trauma center must have continuous rotations in trauma surgery for senior residents (Clinical PGY 3–5) who are part of an Accreditation Council for Graduate Medical Education–accredited program (CD 10–27).	TYPE I
10	PTC I	At a minimum, these rotations should include residency programs in all the following specialties: general surgery, orthopaedic surgery, emergency medicine, and neurosurgery. They may also include support of a pediatric surgical fellowship (CD 10–28).	TYPE I

10	PTC I, II	In Level I and II pediatric trauma centers, other specialists (in anesthesiology, neurosurgery, orthopaedic surgery, emergency medicine, radiology, and rehabilitation) providing care to injured children who are not pediatric-trained providers also should have sufficient training and experience in pediatric trauma care and be knowledgeable about current management of pediatric trauma in their specialty. The program must make specialty-specific pediatric education available for these specialists (CD 10–29).	TYPE II
10	PTC I, II	An organized pediatric trauma service led by a pediatric trauma medical director must be present in Level I and II pediatric trauma centers (CD 10–30).	TYPE I
10	PTC I, II	The pediatric trauma service must maintain oversight of the patient's management while the patient is in the intensive care unit (CD 10–31).	TYPE II
10	PTC I, II	The trauma service should work collaboratively with the pediatric critical care providers, although all significant therapeutic decisions must be approved by the trauma service, and the service must be made aware of all significant clinical changes (CD 10–32).	TYPE II
10	PTC I, II	The surgical director of the pediatric intensive care unit must participate actively in the administration of the unit, as evidenced by the development of pathways and protocols for care of surgical patients in the intensive care unit and in unit-based performance improvement and should be board-certified in surgical critical care (CD 10–33).	TYPE I
10	PTC I, II	Pediatric surgeons or trauma surgeons with pediatric privileges must be included in all aspects of the care of injured children admitted to an intensive care unit (CD 10–34).	TYPE II
10	ATCTIC I, II	Any adult trauma center that annually admits 100 or more injured children younger than 15 years must fulfill the following additional criteria demonstrating its capability to care for the injured child (CD 2-23).	TYPE II
10	ATCTIC I, II	The trauma surgeons must be credentialed for pediatric trauma care by the hospital's credentialing body (CD 2-23).	TYPE II
10	ATCTIC I, II	There must be a pediatric emergency department area, a pediatric intensive care area, appropriate resuscitation equipment, and a pediatric-specific trauma PIPS program (CD 2-24).	TYPE II
10	ATCTIC I, II	For adult trauma centers admitting fewer than 100 injured children younger than 15 years per year, these resources are desirable. These hospitals, however, must review the care of all injured children through their PIPS programs (CD 2-25).	TYPE II
10	PTC I, II	Level I and II pediatric trauma centers must submit data to the National Trauma Data Bank® (NTDB®) (CD 10–35).	TYPE II
10	PTC I, II	There must be a trauma peer review committee chaired by the pediatric trauma medical director with participation by the pediatric /general surgeons and liaisons from pediatric/general surgery, orthopaedic surgery, neurosurgery, emergency medicine, pediatric critical care medicine, anesthesia, and radiology to improve trauma care by reviewing selected deaths, complications, and sentinel events with the objectives of identification of issues and appropriate responses (CD 10–36).	TYPE I

10	PTC I, II	The aforementioned representatives must attend at least 50% of the trauma peer review meetings, and their attendance must be documented (CD 10–37)	TYPE II
10	PTC I, II	All pediatric and general surgeons on the pediatric trauma panel treating children must attend at least 50% of the trauma peer review meetings (CD 10–38).	TYPE II
10	PTC I, II	In Level I and II pediatric trauma centers, the pediatric trauma medical director and the liaisons from neurosurgery, orthopaedic surgery, emergency medicine, and critical care medicine must each accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external CME, of which at least 12 hours (in 3 years) must be related to clinical pediatric trauma care (CD 10–39)	TYPE II
10	PTC I, II	The other general surgeons, orthopaedic surgeons, neurosurgeons, emergency medicine physicians, and critical medicine care physicians who take trauma call in Level I and II pediatric trauma centers also must be knowledgeable and current in the care of injured patients. This requirement may be met by documenting the acquisition of 16 hours of CME per year on average or by demonstrating participation in an internal educational process conducted by the trauma program based on the principles of practice-based learning and the PIPS program (CD 10–40).	TYPE II
Chapter 11 Collaborative Clinical Services			
11	I, II, III	Anesthesiology services are critical in the management of severely injured patients and must be available within 30 minutes for emergency operations (CD 11–1)	TYPE I
11	I, II, III	Anesthesiology services are critical in the management of severely injured patients and must be available within 30 minutes for managing airway problems (CD 11–2).	TYPE I
11	I, II	The anesthetic care of injured patients in a Level I or II trauma center must be organized and supervised by an anesthesiologist who is highly experienced and committed to the care of injured patients and who serves as the designated liaison to the trauma program (CD 11–3).	TYPE I
11	I, II, III	In Level I, II, and III trauma centers, a qualified and dedicated physician anesthesiologist must be designated as the liaison to the trauma program (CD 11–3),	TYPE I
11	I, II	Anesthesia services in Level I and II trauma centers must be available in-house 24 hours a day (CD 11–4).	TYPE I
11	I, II	When anesthesiology senior residents or CRNAs are used to fulfill availability requirements, the attending anesthesiologist on call must be advised, available within 30 minutes at all times, and present for all operations (CD 11–5).	TYPE I
11	I, II, III	The availability of anesthesia services and delays in airway control or operations must be documented by the hospital performance improvement and patient safety (PIPS) process (CD 11–6).	TYPE II
11	III	In Level III hospitals, in-house anesthesia services are not required, but anesthesiologists or CRNAs must be available within 30 minutes (CD 11–7).	TYPE I

11	III	In Level III trauma centers without in-house anesthesia services, protocols must be in place to ensure the timely arrival at the bedside by the anesthesia provider within 30 minutes of notification and request. (CD 11–8).	TYPE I
11	III	Under these circumstances, the presence of a physician skilled in emergency airway management must be documented (CD 11–9).	TYPE I
11	I, II	All anesthesiologists taking call must have successfully completed an anesthesia residency program (CD 11–10).	TYPE I
11	I, II	Furthermore, in Level I and II trauma centers, anesthesiologists taking call must be currently board certified or eligible for certification by an appropriate anesthesia board according to current requirements in anesthesiology (CD 11–11).	TYPE I
11	I, II	Board certification or eligibility for certification is essential for anesthesiologists who take trauma call in Level I and II trauma centers (CD 11–11).	TYPE I
11	I, II, III	In Level I, II, and III trauma centers participation in the trauma PIPS program by the anesthesia liaison is essential (CD 11–12).	TYPE II
11	I, II, III	The anesthesiology liaison to the trauma program must attend at least 50 percent of the multidisciplinary peer review meetings, with documentation by the trauma PIPS program (see Chapter 16, Performance Improvement and Patient Safety) (CD 11–13).	TYPE II
11	I, II	An operating room must be adequately staffed and available within 15 minutes at Level I and II trauma centers (CD 11–14).	TYPE I
11	I, II	In Level I and II trauma centers, if the first operating room is occupied, an adequately staffed additional room must be available (CD 11–15).	TYPE II
11	I, II	Availability of the operating room personnel and timeliness of starting operations must be continuously evaluated by the trauma PIPS process and measures must be implemented to ensure optimal care (CD 11–16).	TYPE II
11	III	In Level III trauma centers, an operating room must be adequately staffed and available within 30 minutes (CD 11–17).	TYPE I
11	III	If an on-call team is used, the availability of operating room personnel and the timeliness of starting operations must be continuously evaluated by the trauma PIPS process, and measures must be implemented to ensure optimal care (CD 11–18).	TYPE II
11	I, II, III	All trauma centers must have rapid fluid infusers, thermal control equipment for patients and resuscitation fluids, intraoperative radiologic capabilities, equipment for fracture fixation, and equipment for bronchoscopy and gastrointestinal endoscopy (CD 11–19).	TYPE I
11	I, II, III	Level I, II, III trauma centers must have the necessary equipment to perform a craniotomy (CD 11–20). Only Level III trauma centers that do not offer neurosurgery services are not required to have craniotomy equipment.	TYPE I
11	I	Level I trauma centers must have cardiothoracic surgery capabilities available 24 hours per day and should have cardiopulmonary bypass equipment (CD 11–21)	TYPE II

11	I, II	In Level I and Level II trauma centers, if cardiopulmonary bypass equipment is not immediately available, a contingency plan, including immediate transfer to an appropriate center and 100 percent performance improvement review of all patients transferred, must be in place (CD 11–22).	TYPE II
11	I	Level I trauma centers must have an operating microscope available 24 hours per day (CD 11–23).	TYPE II
11	I, II, III	At Level I, II, and III trauma centers, a PACU with qualified nurses must be available 24 hours per day to provide care for the patient if needed during the recovery phase (CD 11–24).	TYPE I
11	I, II, III	If this availability requirement is met with a team on call from outside the hospital, the availability of the PACU nurses and compliance with this requirement must be documented by the PIPS program (CD 11–25).	TYPE II
11	I, II, III	The PACU must have the necessary equipment to monitor and resuscitate patients, consistent with the process of care designated by the institution (CD 11–26).	TYPE I
11	I, II, III	The PIPS program, at a minimum, must address the need for pulse oximetry, end-tidal carbon dioxide detection, arterial pressure monitoring, pulmonary artery catheterization, patient rewarming, and intracranial pressure monitoring (CD 11–27).	TYPE II
11	I, II, III	The trauma center must have policies designed to ensure that trauma patients who may require resuscitation and monitoring are accompanied by appropriately trained providers during transportation to, and while in, the radiology department (CD 11–28).	TYPE II
11	I, II, III, IV	Conventional radiography must be available in all trauma centers 24 hours per day (CD 11–29).	TYPE I
11	I, II, III	Computed tomography (CT) must be available in Levels I, II, and III trauma centers 24 hours per day (CD 11–30)	TYPE I
11	I, II	An in-house radiology technologist and CT technologist are required at Level I and II trauma centers (CD 11–31).	TYPE I
11	I, II, III	In Level I, II, and III trauma centers, qualified radiologists must be available within 30 minutes in person or by teleradiology for the interpretation of radiographs. (CD 11-32)	TYPE I
11	I, II	In Level I and II trauma centers qualified radiologists must be available within 30 minutes to perform complex imaging studies, or interventional procedures (CD 11-33).	TYPE II
11	I, II, III	In Level I, II, and III trauma centers diagnostic information must be communicated in a written or electronic form and in a timely manner (CD 11–34).	TYPE II
11	I, II, III	Critical information deemed to immediately affect patient care must be verbally communicated to the trauma team in a timely manner (CD 11–35).	TYPE II
11	I, II, III	The final report must accurately reflect the chronology and content of communications with the trauma team, including changes between the preliminary and final interpretations (CD 11–36).	TYPE II

11	I, II, III	Changes in interpretation between preliminary and final reports, as well as missed injuries, must be monitored through the PIPS program (CD 11–37).	TYPE II
11	I, II	In Level I and II facilities, a radiologist must be appointed as liaison to the trauma program (CD 11–38).	TYPE II
11	I, II	The radiologist liaison must attend at least 50 percent of peer review meetings and should educate and guide the entire trauma team in the appropriate use of radiologic services (CD 11–39).	TYPE II
11	I, II	In Level I and II trauma centers, participation in the trauma PIPS program process by the radiology liaison is essential (CD 11–40).	TYPE II
11	I, II	At a minimum, radiologists must be involved in protocol development and trend analysis that relate to diagnostic imaging (CD 11–41).	TYPE II
11	I, II	Level I and II facilities must have a mechanism in place to view radiographic imaging from referring hospitals within their catchment area (CD 11–42).	TYPE II
11	I, II	Board certification or eligibility for certification by an appropriate radiology board according to current requirements is essential for radiologists who take trauma call in Level I and II trauma centers (CD 11–43).	TYPE II
11	I, II	Interventional radiologic procedures and sonography must be available 24 hours per day at Level I and II trauma centers (CD 11–44).	TYPE I
11	I, II	Magnetic resonance imaging (MRI) capability must be available 24 hours per day at Level I and II trauma centers (CD 11–45).	TYPE II
11	I, II	The MRI technologist may respond from outside the hospital; however, the PIPS program must document and review arrival within 1 hour of being called. This time should meet current clinical guidelines (CD 11–46).	TYPE II
11	III	In Level III centers, if the CT technologist takes call from outside the hospital, the PIPS program must document the technologist's time of arrival at the hospital (CD 11–47).	TYPE II
11	I	In a Level I trauma center, a surgically directed ICU physician team must be led by a surgeon boarded in surgical critical care, and critically ill trauma patients should be cared for in a designated ICU (CD 11–48).	TYPE I
11	I	A surgeon with current board certification in surgical critical care must be designated as the ICU director (CD 11–49).	TYPE II
11	I	The ICU team may be staffed by critical care physicians from different specialties but must remain surgically directed as noted above (CD 11-49).	TYPE II
11	I	The ICU must be staffed with a dedicated ICU physician team led by the ICU director (CD 11–50).	TYPE II
11	I	Appropriately trained physicians must be available in-house within 15 minutes to provide care for the ICU patients 24 hours per day (CD 11–51).	TYPE I
11	I	If the trauma attending provides coverage, a backup ICU attending must be identified and readily available (CD 11–52).	TYPE II

11	II, III	In Level II and III trauma centers, a surgeon must serve as co-director or director of the ICU and be actively involved in, and responsible for, setting policies and administrative decisions related to trauma ICU patients (CD 11–53).	TYPE II
11	II, III	In a Level II facility, the ICU director or co-director should be currently board certified or eligibility for certification in surgical critical care. In Level II and III facilities, the ICU director or co-director must be a surgeon who is currently board certified or eligible for certification by the current standard requirements (CD 11–54).	TYPE II
11	II	In Level II trauma centers, physician coverage of critically ill trauma patients must be available within 15 minutes 24 hours per day for interventions by a credentialed provider (CD 11–55).	TYPE I
11	III	In Level III trauma centers, physician coverage of the ICU must be available within 30 minutes, with a formal plan in place for emergency coverage (CD 11–56).	TYPE I
11	III	In Level III trauma centers, the PIPS program must review all ICU admissions and transfers of ICU patients to ensure that appropriate patients are being selected to remain at the Level III center vs. being transferred to a higher level of care (CD 11–57).	TYPE II
11	I, II, III	In Level I, II, and III trauma centers, the trauma surgeon must retain responsibility for the patient and coordinate all therapeutic decisions (CD 11–58).	TYPE I
11	I, II, III	Many of the daily care requirements can be collaboratively managed by a dedicated ICU team, but the trauma surgeon must be kept informed and concur with major therapeutic and management decisions made by the ICU team (CD 11–59).	TYPE I
11	I, II, III, IV	For all levels of trauma centers, the PIPS program must document that timely and appropriate ICU care and coverage are being provided (CD 11–60).	TYPE II
11	I, II, III	In all Level I, II, and III trauma centers, the timely response of credentialed providers to the ICU must be continuously monitored as part of the PIPS program (CD-11-60).	TYPE II
11	I, II, III	There must be a designated ICU liaison to the trauma service (CD 11–61).	TYPE II
11	I, II, III	This [ICU] liaison must attend at least 50 percent of the multidisciplinary peer review meetings, with documentation by the trauma PIPS program (CD 11–62).	TYPE II
11	I, II	The ICU liaison to the trauma program at Level I and II centers must accrue an average of 16 hours annually or 48 hours in 3 years of verifiable external trauma-related continuing medical education (CME) (CD 11–63).	TYPE II
11	I, II	This requirement must be documented by the acquisition of 16 hours of trauma CME per year, on average, or through an internal educational process conducted by the trauma program and the ICU liaison based on the principles of practice-based learning and the PIPS program (CD 11–64).	TYPE II
11	I, II, III	At Level I, II, and III trauma centers, qualified critical care nurses must be available 24 hours per day to provide care for patients during the ICU phase (CD 11–65).	TYPE I

11	I, II, III	The patient-to-nurse ratio in the ICU must not exceed two to one (CD 11–66).	TYPE II
11	I, II, III	The ICU must have the necessary equipment to monitor and resuscitate patients (CD 11–67).	TYPE I
11	I, II, III	Intracranial pressure monitoring equipment must be available in Level I and II trauma centers and in Level III trauma centers with neurosurgical coverage that admit neurotrauma patients (CD 11–68).	TYPE I
11	III	Trauma patients must not be admitted or transferred by a primary care physician without the knowledge and consent of the trauma service, and the PIPS program should monitor adherence to this guideline (CD 11–69).	TYPE II
11	I	Level I facilities are prepared to manage the most complex trauma patients and must have available a full spectrum of surgical specialists, including specialists in orthopaedic surgery, neurosurgery, cardiac surgery, thoracic surgery, vascular surgery, hand surgery, microvascular surgery, plastic surgery, obstetric and gynecologic surgery, ophthalmology, otolaryngology, and urology (CD 11–70).	TYPE I
11	II	Level II centers must have the surgical specialists described for Level I trauma centers and should provide cardiac surgery (CD 11–71). [Level I facilities must have specialists in orthopaedic surgery, neurosurgery, thoracic surgery, vascular surgery, hand surgery, microvascular surgery, plastic surgery, obstetric and gynecologic surgery, ophthalmology, otolaryngology, and urology.	TYPE I
11	III	Level III trauma centers must have the availability and commitment of orthopaedic surgeons (CD 11–72).	TYPE I
11	I, II, III	For all patients being transferred for specialty care, such as burn care, microvascular surgery, cardiopulmonary bypass capability, complex ophthalmologic surgery, or high-complexity pelvic fractures, agreements with a similar or higher-qualified verified trauma center should be in place. If this approach is used, a clear plan for expeditious critical care transport, follow-up, and performance monitoring is required (CD 8–5). If complex cases are being transferred out, a contingency plan should be in place and must include the following: • A credentialing process to allow the trauma surgeon to provide initial evaluation and stabilization of the patient. • Transfer agreements with similar or higher-verified trauma centers. • Direct contact with the accepting facility to arrange for expeditious transfer or ongoing monitoring support. • Monitoring of the efficacy of the process by the PIPS programs.	TYPE II
11	I, II	In Level I and II trauma centers, medical specialists on staff must include specialists in cardiology, internal medicine, gastroenterology, infectious disease, pulmonary medicine, and nephrology and their respective support teams (for example, respiratory therapy, a dialysis team, and nutrition support) (CD 11–73).	TYPE II
11	III	In a Level III facility, internal medicine specialists must be available on the medical staff (CD 11–74).	TYPE II
11	I, II	Several support services are required to care for trauma patients. In Level I and II trauma centers, a respiratory therapist must be available in the hospital 24 hours per day (CD 11–75).	TYPE I

11	III	In Level III centers, there must be a respiratory therapist on call 24 hours per day (CD 11–76).	TYPE I
11	I, II	Acute hemodialysis must be available in Level I and II trauma centers (CD 11–77).	TYPE II
11	III	Level III trauma centers that do not have dialysis capabilities must have a transfer agreement in place (CD 11–78).	TYPE II
11	I, II	Nutrition support services must be available in Level I and II centers (CD 11–79).	TYPE II
11	I, II, III, IV	In trauma centers of all levels, laboratory services must be available 24 hours per day for the standard analyses of blood, urine, and other body fluids, including microsampling when appropriate (CD 11–80).	TYPE I
11	I, II, III, IV	The blood bank must be capable of blood typing and cross-matching (CD 11–81).	TYPE I
11	I, II	For Level I and II centers, the blood bank must have an adequate in-house supply of red blood cells, fresh frozen plasma, platelets, cryoprecipitate, and appropriate coagulation factors to meet the needs of injured patients (CD 11–82).	TYPE I
11	III	In Level III centers, the blood bank must have an adequate supply of packed red blood cells and fresh frozen plasma available within 15 minutes (CD 11–83).	TYPE I
11	I, II, III, IV	Trauma centers of all levels must have a massive transfusion protocol developed collaboratively between the trauma service and the blood bank (CD 11–84).	TYPE I
11	I, II, III	Coagulation studies, blood gas analysis, and microbiology studies must be available 24 hours per day (CD 11–85).	TYPE I
11	I, II, III, IV	Advanced practitioners who participate in the initial evaluation of trauma patients must demonstrate current verification as an Advanced Trauma Life Support® provider (CD 11–86).	TYPE II
11	I, II, III, IV	The trauma program must also demonstrate appropriate orientation, credentialing processes, and skill maintenance for advanced practitioners, as witnessed by an annual review by the trauma medical director (CD 11–87).	TYPE II
Chapter 12: Rehabilitation			
12	I, II	In Level I and II trauma centers, rehabilitation services must be available within the hospital's physical facilities or as a freestanding rehabilitation hospital, in which case the hospital must have transfer agreements (CD 12–1).	TYPE II
12	I, II	Rehabilitation consultation services, occupational therapy, speech therapy, physical therapy, and social services are often needed in the critical care phase and must be available in Level I and II trauma centers (CD 12–2).	TYPE II
12	I, II, III	Physical therapy (CD 12–3) must be provided in Level I, II, and III trauma centers.	TYPE I
12	I, II, III	Social services (CD 12–4) must be provided in Level I, II, and III trauma centers.	TYPE II
12	I, II	Occupational therapy (CD 12–5) must be provided in Level I and II centers.	TYPE II

12	I, II	Speech therapy (CD 12–6) must be provided in Level I and II centers.	TYPE II
12	I, II	In Level I and II trauma centers, these services [physical therapy, social services, occupational therapy and speech therapy] must be available during the acute phase of care, including intensive care (CD 12–7).	TYPE II
Chapter 13: Rural Trauma Care			
13	I, II, III, IV	Direct contact of the physician or midlevel provider with a physician at the receiving hospital is essential (CD 4–1).	TYPE II
13	III, IV	Transfer guidelines and agreements between facilities are crucial and must be developed after evaluating the capabilities of rural hospitals and medical transport agencies (CD 2–13).	TYPE II
13	I, II, III, IV	All transfers must be evaluated as part of the receiving trauma center's performance improvement and patient safety (PIPS) process (CD 4–3), and feedback should be provided to the transferring center.	TYPE II
13	I, II	Level I and II centers must be able to read images from referring centers (CD 11–41)	TYPE II
13	I, II, III, IV	The foundation for evaluation of a trauma system is the establishment and maintenance of a trauma registry (CD 15–1).	TYPE II
13	I, II, III, IV	Issues that must be reviewed will revolve predominately around (1) system and process issues such as documentation and communication; (2) clinical care, including identification and treatment of immediate life- threatening injuries (ATLS®); and (3) transfer decisions (CD 16-10).	TYPE II
13	I, II, III, IV	The best possible care for patients must be achieved with a cooperative and inclusive program that clearly defines the role of each facility within the system (CD 1–1).	TYPE II
Chapter 14: Guidelines for the Operation of Burn Centers			
14	I, II, III, IV	Trauma centers that refer burn patients to a designated burn center must have in place written transfer agreements with the referral burn center (CD 14–1)	TYPE II
Chapter 15: Trauma Registry			
15	I, II, III, IV	Trauma registry data must be collected and analyzed by every trauma center (CD 15–1).	TYPE II
15	I, II, III	Finally, these data must be collected in compliance with the National Trauma Data Standard (NTDS) and submitted to the National Trauma Data Bank® (NTDB®) every year in a timely fashion so that they can be aggregated and analyzed at the national level (CD 15–2).	TYPE II
15	I, II, III, IV	The trauma registry is essential to the performance improvement and patient safety (PIPS) program and must be used to support the PIPS process (CD 15–3).	TYPE II
15	I, II, III, IV	Furthermore, these findings must be used to identify injury prevention priorities that are appropriate for local implementation (CD 15–4).	TYPE II
15	I, II, III	All trauma centers must use a risk adjusted benchmarking system to measure performance and outcomes (CD 15-5).	TYPE II
15	I, II, III, IV	Trauma registries should be concurrent. At a minimum, 80 percent of cases must be entered within 60 days of discharge (CD 15–6)	TYPE II

15	I, II, III	[Registrar] They must attend or have previously attended two courses within 12 months of being hired: (1) the American Trauma Society's Trauma Registrar Course or equivalent provided by a state trauma program; and (2) the Association of the Advancement of Automotive Medicine's Injury Scaling Course (CD 15–7).	TYPE II
15	I, II, III, IV	The trauma program must ensure that appropriate measures are in place to meet the confidentiality requirements of the data (CD 15–8).	TYPE II
15	I, II, III	One full-time equivalent employee dedicated to the registry must be available to process the data capturing the NTDS data set for each 500–750 admitted patients annually (CD 15–9).	TYPE II
15	I, II, III, IV	Strategies for monitoring data validity are essential (CD 15–10).	TYPE II
Chapter 16: Performance Improvement and Patient Safety			
16	I, II, III	Trauma centers must have a PIPS program that includes a comprehensive written plan outlining the configuration and identifying both adequate personnel to implement that plan and an operational data management system (CD 16–1).	TYPE II
16	I, II, III, IV	The PIPS program must be supported by a reliable method of data collection that consistently obtains the information necessary to identify opportunities for improvement (CD 15–1).	TYPE II
16	I, II, III, IV	The processes of event identification and levels of review must result in the development of corrective action plans, and methods of monitoring, reevaluation, and benchmarking must be present (CD 2–17).	TYPE II
16	I, II, III	Problem resolution, outcome improvements, and assurance of safety ("loop closure") must be readily identifiable through methods of monitoring, reevaluation, benchmarking, and documentation (CD 16–2).	TYPE II
16	I, II, III, IV	Peer review must occur at regular intervals to ensure that the volume of cases is reviewed in a timely fashion (CD 2–18).	TYPE II
16	I, II, III	The trauma PIPS program must integrate with the hospital quality and patient safety effort and have a clearly defined reporting structure and method for provision of feedback (CD 16–3).	TYPE II
16	I, II, III, IV	Because the trauma PIPS program crosses many specialty lines, it must be empowered to address events that involve multiple disciplines and be endorsed by the hospital governing body as part of its commitment to optimal care of injured patients (CD 5–1).	TYPE I
16	I, II, III, IV	There must be adequate administrative support to ensure evaluation of all aspects of trauma care (CD 5–1).	TYPE I
16	I, II, III, IV	The trauma medical director and trauma program manager must have the authority and be empowered by the hospital governing body to lead the program (CD 5–1).	TYPE I
16	I, II, III	The trauma medical director must have sufficient authority to set the qualifications for the trauma service members, including individuals in specialties that are routinely involved with the care of the trauma patient (CD 5–11).	TYPE II

16	I, II, III	Moreover, the trauma medical director must have authority to recommend changes for the trauma panel based on performance review (CD 5–11).	TYPE II
16	I, II, III	The peer review committee must be chaired by the TMD (CD 5-25)	TYPE II
16	I, II, III	In Level I, II, and III trauma centers, representation from general surgery (CD 6-8), and liaisons to the trauma program from emergency medicine (CD 7–11), orthopaedics (CD 9–16), and anesthesiology (CD 11–13), critical care (CD 11-62)—and for Level I and II centers, neurosurgery (CD 8–13), and radiology (CD 11–39)—must be identified and participate actively in the trauma PIPS program with at least 50 percent attendance at multidisciplinary trauma peer review committee.	TYPE II
16	III	Level III centers with any emergent neurosurgical cases must also have the participation of neurosurgery on the multidisciplinary trauma peer review committee (CD 8–13).	Type II
16	I, II	In Level I and II trauma centers, the trauma medical director (CD 5–7), trauma program manager (5–24), and liaisons to the trauma program in emergency medicine (CD 7–12), orthopaedics (CD 9–18), critical care (CD 11–63), and neurosurgery (CD 8–14) must obtain 16 hours annually or 48 hours in 3 years of verifiable, external, trauma-related education (continuing medical education [CME] or CE, as appropriate to the discipline).	Type II
16	I, II, III, IV	The trauma center must demonstrate that all trauma patients can be identified for review (CD 15–1).	TYPE II
16	I, II, III	In Level I, II, and III trauma centers, the trauma registry must submit the required data elements to the NTDB (CD 15–2).	TYPE II
16	I, II, III, IV	The trauma PIPS program must be supported by a registry and a reliable method of concurrent data collection that consistently obtains information necessary to identify opportunities for improvement (CD 15–3).	TYPE II
16	I, II, III	All trauma centers must use a risk adjusted benchmarking system to measure performance and outcomes (CD 15-5).	TYPE II
16	I, II, III	To achieve this goal, a trauma program must use clinical practice guidelines, protocols, and algorithms derived from evidenced-based validated resources (CD 16–4).	TYPE II
16	I, II, III, IV	All process and outcome measures must be documented within the trauma PIPS program's written plan and reviewed and updated at least annually (CD 16–5).	TYPE II
16	I, II, III	Mortality Review (CD 16–6). All trauma-related mortalities must be systematically reviewed and those mortalities with opportunities for improvement identified for peer review. 1. Total trauma-related mortality rates. Outcome measures for total, pediatric (younger than 15 years), and geriatric (older than 64 years) trauma encounters should be categorized as follows: a. DOA (pronounced dead on arrival with no additional resuscitation efforts initiated in the emergency department). b. DIED (died in the emergency department despite resuscitation efforts). c. In-hospital (including operating room). 2. Mortality rates by Injury Severity Scale (ISS) subgroups using Table 1.	TYPE II

16	I, II, III, IV	Trauma surgeon response to the emergency department (CD 2–9). See previous detail.	TYPE II
16	I, II, III, IV	Trauma team activation (TTA) criteria (CD 5–13). See previous detail.	TYPE II
16	I, II, III, IV	All Trauma Team Activations must be categorized by the level of response and quantified by number and percentage, as shown in Table 2 (CD 5–14, CD 5–15).	TYPE II
16	I, II, III	Trauma surgeon response time to other levels of TTA, and for back-up call response, should be determined and monitored. Variances should be documented and reviewed for reason for delay, opportunities for improvement, and corrective actions (CD 5–16)	TYPE II
16	I, II, III	Response parameters for consultants addressing time-critical injuries (for example, epidural hematoma, open fractures, and hemodynamically unstable pelvic fractures) must be determined and monitored (CD 5–16).	TYPE II
16	I, II, III	Rates of undertriage and overtriage must be monitored and reviewed quarterly (CD 16–7).	TYPE II
16	I, II, III	Trauma patient admissions (NTDS definition) to a nonsurgical service is higher than 10 percent (CD 5–18).	TYPE II
16	I, II	Pediatric (14 years or younger) trauma care. 1. Trauma centers admitting at least 100 pediatric trauma patients annually require a pediatric-specific trauma PIPS program (CD 10–6). 2. Trauma centers admitting less than 100 pediatric trauma patients annually must review each case for timeliness and appropriateness of care (CD 10–6).	TYPE I
16	I, II, III, IV	Acute transfers out (CD 9–14). All trauma patients who are diverted (CD 3–4) or transferred (CD 4–3) during the acute phase of hospitalization to another trauma center, acute care hospital, or specialty hospital (for example, burn center, reimplantation center, or pediatric trauma center) or patients requiring cardiopulmonary bypass or when specialty personnel are unavailable must be subjected to individual case review to determine the rationale for transfer, appropriateness of care, and opportunities for improvement. Follow-up from the center to which the patient was transferred should be obtained as part of the case review.	TYPE II
16	III	Emergency physicians covering in-house emergencies at Level III trauma centers (CD 7–3). See previous detail.	TYPE II
16	I, II, III	Trauma center diversion-bypass hours must be routinely monitored, documented, and reported, including the reason for initiating the diversion policy (CD 3–6), and must not exceed 5 percent.	TYPE II
16	III	Appropriate neurosurgical care at Level III trauma centers (CD 8–9).	TYPE II
16	I, II, III	Availability of the anesthesia service (CD 11–4, CD 11-7, CD 11–16, CD 11-18). • In-house anesthesia service (emergency department, intensive care unit, floor, and postanesthesia care unit) must be available for the care of trauma patients • Operating room delays involving trauma patients because of lack of anesthesia support services must be identified and reviewed to determine the reason for delay, adverse outcomes, and opportunities for improvement.	TYPE II

16	I, II, III	Delay in operating room availability (CD 11–16, CD 11–18) must be routinely monitored. Any case that is associated with a significant delay or adverse outcome must be reviewed for reasons for delay and opportunities for improvement.	TYPE II
16	I, II, III	Response times of operating room and postanesthesia care unit personnel when responding from outside the trauma center (CD 11–16, CD 11–18, CD 11–25) must be routinely monitored.	TYPE II
16	I, II, III	Rate of change in interpretation of radiologic studies (CD 11–32, CD 11–37) should be categorized by RADPEER or similar criteria (describe process/scoring metric used).	TYPE I
16	I, II, III	Response times of computed tomography technologist(30 minutes)/magnetic resonance imaging (60 minutes) technologist/interventional radiology team (30 minutes) when responding from outside the trauma center (CD 11–29, CD 11–30, CD 11–31, CD 11–32, CD 11–33, CD 11–34, CD 11–35, CD 11–36, CD 11-37, and CD 11–46.)	TYPE I
16	I, II, III, IV	Transfers to a higher level of care within the institution (CD 16–8).	TYPE II
16	I, II, III	Solid organ donation rate (CD 16–9).	TYPE II
16	I, II, III, IV	Trauma registry (CD 15–6). See previous detail.	TYPE II
16	I, II, III	Multidisciplinary trauma peer review committee attendance. (Level I, II and III, CD 5-10, CD 6-8, CD 7-11, CD 9-16, CD 11-13, CD 11-62 –and for Level I and II CD 8-13 and CD 11-39)	TYPE II
16	I	Trauma Center Volume (CD 2–4). See previous detail.	TYPE I
16	I, II, III, IV	Sufficient mechanisms must be available to identify events for review by the trauma PIPS program (CD 16–10).	TYPE II
16	I, II, III, IV	Once an event is identified, the trauma PIPS program must be able to verify and validate that event (CD 16–11).	TYPE II
16	I, II, III	There must be a process to address trauma program operational events (CD 16–12).	TYPE II
16	I, II, III	Documentation (minutes) reflects the review of operational events and, when appropriate, the analysis and proposed corrective actions (CD 16–13).	TYPE II
16	I, II, III	Mortality data, adverse events and problem trends, and selected cases involving multiple specialties must undergo multidisciplinary trauma peer review (CD 16–14)	TYPE II
16	I, II, III	This effort may be accomplished in a variety of formats but must involve the participation and leadership of the trauma medical director (CD 5–10); the group of general surgeons on the call panel; and the liaisons from emergency medicine, orthopaedics, neurosurgery, anesthesia, critical care, and radiology ((Level I, II and III, CD 6-8, CD 7-11, CD 9-16, CD 11-13, CD 11-62 - Level I and II centers, CD 8-13 CD 11-39).	TYPE II

16	I, II, III	Each member of the committee must attend at least 50 percent of all multidisciplinary trauma peer review committee meetings (CD 16–15).	TYPE II
16	I, II, III	When these general surgeons cannot attend the multidisciplinary trauma peer review meeting, the trauma medical director must ensure that they receive and acknowledge the receipt of critical information generated at the multidisciplinary peer review meeting to close the loop (CD 16–16).	TYPE II
16	I, II, III	The multidisciplinary trauma peer review committee must systematically review mortalities, significant complications, and process variances associated with unanticipated outcomes and determine opportunities for improvement (CD 16–17).	TYPE II
16	I, II, III	When an opportunity for improvement is identified, appropriate corrective actions to mitigate or prevent similar future adverse events must be developed, implemented, and clearly documented by the trauma PIPS program (CD 16–18).	TYPE II
16	I, II, III	An effective performance improvement program demonstrates through clear documentation that identified opportunities for improvement lead to specific interventions that result in an alteration in conditions such that similar adverse events are less likely to occur (CD 16–19).	TYPE II
Chapter 17: Outreach and Education			
17	I, II, III, IV	All verified trauma centers, however, must engage in public and professional education (CD 17–1).	TYPE II
17	I, II	Level I and II centers also must provide some means of referral and access to trauma center resources (CD 17–2).	TYPE II
17	I	At a minimum, a Level I trauma center must have continuous rotations in trauma surgery for senior residents (Clinical PGY 4–5) that are part of an Accreditation Council for Graduate Medical Education–accredited program (CD 17–3). For pediatric Level I centers, the continuous rotation for surgical residents is extended to include clinical PGY 3 (CD 10-27).	TYPE I
17	I, II, III	In Level I, II, and III trauma centers, the hospital must provide a mechanism to offer trauma-related education to nurses involved in trauma care (CD 17–4).	TYPE II
17	I, II, III, IV	The successful completion of the ATLS® course, at least once, is required in all levels of trauma centers for all general surgeons (CD 6-9), emergency medicine physicians (CD 7-14) and midlevel providers (CD 11-86) on the trauma team.	TYPE II
17	I, II	The trauma director (CD 5-7) and the liaison representatives from neurosurgery (CD 8-14), orthopaedic surgery (CD 9-18), emergency medicine (CD 7-12), and critical care (CD 11-63) must accrue an average of 16 hours annually, or 48 hours in 3 years, of external trauma-related CME.	TYPE II
17	I, II	Other members of the general surgery (CD 6-11), neurosurgery (CD 8-15), orthopaedic surgery (CD 9-19), emergency medicine (CD 7-13), and critical care (CD 11-64) specialties who take trauma call also must be knowledgeable and current in the care of injured patients.	TYPE II

Chapter 18: Prevention			
18	I, II, III, IV	Trauma centers must have an organized and effective approach to injury prevention and must prioritize those efforts based on local trauma registry and epidemiologic data (CD 18–1).	TYPE II
18	I, II, III, IV	Each trauma center must have someone in a leadership position that has injury prevention as part of his or her job description (CD 18-2)	TYPE II
18	I	In Level I centers, this individual must be a prevention coordinator (separate from the trauma program manager) with a job description and salary support (CD 18–2).	TYPE II
18	I, II, III, IV	Universal screening for alcohol use must be performed for all injured patients and must be documented (CD 18–3)	TYPE II
18	I, II	At Level I and II trauma centers, all patients who have screened positive must receive an intervention by appropriately trained staff, and this intervention must be documented (CD 18–4).	TYPE II
18	I, II	Level I and II trauma centers must implement at least two programs that address one of the major causes of injury in the community (CD 18–5).	TYPE II
18	I, II	A trauma center's prevention program must include and track partnerships with other community organizations (CD 18–6).	TYPE II
Chapter 19: Trauma Research and Scholarship			
19	I	For a Level I trauma center, at a minimum, a program must have 20 peer-reviewed articles published in journals included in Index Medicus or PubMed in a 3-year period (CD 19–1).	TYPE II
19	I	These publications must result from work related to the trauma center or the trauma system in which the trauma center participates (CD 19-2)	TYPE II
19	I	Of the 20 articles, at least one must be authored or co-authored by members of the general surgery trauma team (CD 19–3).	TYPE II
19	I	Additionally, at least one article each from three of the following disciplines is required: basic sciences, neurosurgery, emergency medicine, orthopaedics, radiology, anesthesia, vascular surgery, plastics/maxillofacial surgery, critical care, cardiothoracic surgery, rehabilitation, and nursing (CD 19–4).	TYPE II
19	PTC I	The pediatric Level I center's research requirement is equivalent to that of adult Level I trauma centers (CD 10–10).	TYPE II
19	PTC I	In combined Level I adult and [Level I] pediatric centers, half of the research requirement must be pediatric research (CD 10–11).	TYPE II

19	I	In the alternate method, a Level I program must have the following (CD 19–7) a. A program must have 10 peer-reviewed articles published in journals included in Index Medicus or PubMed in a 3-year period. These articles must result from work related to the trauma center or the trauma system in which the trauma center participates. Of the 10 articles, at least one must be authored or co-authored by members of the general surgery trauma team, and at least one article each from three of the following disciplines is required: basic sciences as related to injury, neurosurgery, emergency medicine, orthopaedics, radiology, anesthesia, vascular surgery, plastics/maxillofacial surgery, critical care, cardiothoracic surgery, rehabilitation, and nursing. Trauma-related articles authored by members of other disciplines or work done in collaboration with other trauma centers and participation in multicenter investigations may be included in the remainder. b. Of the following seven trauma-related scholarly activities, four must be demonstrated: • Evidence of leadership in major trauma organizations, which includes membership in trauma committees of any of the regional or national trauma organizations. • Demonstrated peer-reviewed funding for trauma research from a recognized government or private agency or organization. • Evidence of dissemination of knowledge that includes review articles, book chapters, technical documents, Web-based publications, videos, editorial comments, training manuals, and trauma-related educational materials or multicenter protocol development. • Display of scholarly application of knowledge as evidenced by case reports or reports of clinical series in journals included in MEDLINE. • Participation as a visiting professor or invited lecturer at national or regional trauma conferences. • Support of resident participation in mentoring scholarly activity, including laboratory experiences; clinical trials; resident trauma paper competitions at the state, regional, or national level; and other resident trauma presentations. • Mentorship of fellows, as evidenced by the development or maintenance of a recognized trauma, critical care, or acute care surgery fellowship.	TYPE II
19	I	The administration of a Level I trauma center must demonstrate support for the research program by, for example, providing basic laboratory space, sophisticated research equipment, advanced information systems, biostatiscal support, salary support for basic and translational scientists, or seed grants for less experienced faculty (CD 19–8).	TYPE II
Chapter 20: Disaster Planning and Management			
20	I, II, III, IV	Trauma centers must meet the disaster-related requirements of the Joint Commission (CD 20–1).	TYPE II
20	I, II, III	A surgeon from the trauma panel must be a member of the hospital's disaster committee (CD 20–2).	TYPE II
20	I, II, III, IV	Hospital drills that test the individual hospital's disaster plan must be conducted at least twice a year, including actual plan activations that can substitute for drills (CD 20–3)	TYPE II
20	I, II, III, IV	All trauma centers must have a hospital disaster plan described in the hospital's policy and procedure manual or equivalent (CD 20–4).	TYPE II

Chapter 21: Solid Organ Procurement Activities			
21	I, II, III	The trauma center must have an established relationship with a recognized OPO (CD 21–1).	TYPE II
21	I, II, III	A written policy must be in place for triggering notification of the regional OPO (CD 21–2).	TYPE II
21	I, II, III	The trauma center must review its sold organ donation rate annually (CD 16.9).	TYPE II
21	I, II, III, IV	It is essential that each trauma center have written protocols defining the clinical criteria and confirmatory tests for the diagnosis of brain death (CD 21–3).	TYPE II
Chapter 22: Verification, Review, & Consultation Program			
Chapter 23: Criteria quick Reference Guide			
All reference documents will be available at: *https://www.facs.org/quality-programs/trauma/vrc/resources*			

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