RESOURCES FOR OPTIMAL CARE OF THE INJURED PATIENT: 1999

AMENDMENTS
"Resources for Optimal Care of the Injured Patient" document, 1999

1) The volume performance criteria for Level I verification will consist of:
   A. 1200 admissions per year
   B. OR 240 admissions with ISS > than 15 OR
   C. an average of 35 patients of ISS > 15 for the trauma panel surgeons. Each individual surgeon does not have to have 35 patients with ISS > 15 as long as the average for all trauma panel surgeons is 35 cases.

2) The volume criterion of 1200 patients per year may include burn patients when the trauma service and NOT A SEPARATE BURN SERVICE is responsible for burn care.

3) A surgeon who is board certified/eligible may fulfill the pediatric surgical emergency department attending response criterion even when he/she is a surgical Fellow.

4) External treatment guidelines such as the AANS Guidelines for the Treatment of Head Injuries will be treated as recommendations. Lack of specific compliance to external guidelines or even internal hospital guidelines will not, by itself, be a criterion deficiency. The reviewer, however, may identify poor care within a specialty as a deficiency.

5) There must be a multi-disciplinary peer review committee meeting with an attendance requirement. The makeup of this multi-disciplinary peer review committee is comprised of the Trauma Medical Director, representatives of General Surgery, Orthopedic Surgery, Neurosurgery, Emergency Medicine, Anesthesia, and Trauma Nurse Coordinators/ Trauma Program Managers OR their alternates. There is an attendance requirement of at least 50% by the representatives from General Surgery, Neurosurgery, Orthopedic Surgery, Anesthesia, and Emergency Medicine, or his or her alternate. The goals of this committee are to:
   A) review selective deaths;
   B) review complications;
   C) discuss sentinel events;
   D) review organizational issues on a regular basis and in a systematic fashion.

   The objectives of this multi-disciplinary peer review committee are:
   A) to identify and resolve problems or specific issues that need to be rectified and/or
   B) trigger new policies/protocols and have the representatives from the various departments listed above act as a conduit for information back to their respective departments.

6) Each physician on the General Surgical, Orthopedic, Neurosurgical, and Emergency Medicine trauma panel will have an average of 16 hours of trauma related CME per year. At least 50% of this CME must be extramural; both Category I and Category II CME can be counted.

7) Trauma specialists who work in centers which provide care for only injured children, must have 16 hours of trauma related CME per year.

8) Pediatric specific CME for specialists working in centers providing care for both injured adults and children is no longer mandated.

9) Verification of a Level I trauma center that cares for only injured children requires that there be at least two pediatric trained (residency, fellowship, or practice pattern) general surgeons, orthopedic surgeons, neurosurgeons, and emergency physicians.

10) The presence of a Research committee with Research director and documented minutes is no longer a criterion for verification.

11) Research productivity must include ten peer reviewed publications over a three year period. These publications may come from any aspects of the trauma program. In addition, twelve education/outreach presentations must occur over a three year period.

12) When the surgical coverage for the ICU patient comes from out-of-house, there must be documentation of appropriate response time.

13) A non-boarded specialist who does not meet all of the eight criteria listed in the Alternate Pathway document may be included on the trauma panel if he/she has:
    A) provided exceptional care of trauma patients;
    B) has numerous publications and presentations;
    C) has published excellent research;
    D) and is documented to provide excellent teaching.

14) The trauma medical director, although not board certified, will still qualify to be the trauma medical director if he/she is a Fellow of the ACS.

15) There must be a surgeon in the community and available to take trauma call to have a Level IV site visit.

16) The presence of a cardiopulmonary capability and operating microscope equipment are necessary for Level I verification. This does not have to be age specific.

17) The minimum criteria for the definition of a major resuscitation are as follows:

A. **CONFIRMED** Blood pressure < 90 at any time in adults and age specific hypotension for children;
B. Respiratory compromise/obstruction and/or intubation;
C. Transfer patients from other hospitals receiving blood to maintain vital signs;
D. Emergency physician's discretion;
E. Gunshot wounds to the abdomen, neck, or chest;
F. GCS < 8 with mechanism attributed to trauma.

18) The attending surgeon is expected to be present in the ED upon patient arrival in all patients meeting the **hospital specific guidelines for defining a major resuscitation** when given sufficient advance notification from the field OR within fifteen minutes of trauma team activation when the advance notification is short. Documentation of compliance with this expectation must be 80% or greater to be verified.

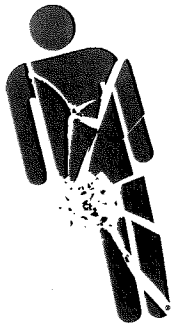
19) In a Level II trauma center, with regard to Anesthesia, requirements may be fulfilled when local conditions assure that the staff Anesthesiologist will be in the hospital at the time of arrival of the trauma patient. During the interim period prior to the arrival of the staff Anesthesiologist, an IN-HOUSE certified registered nurse anesthetist (CRNA) capable of assessing emergent situations in trauma patients, and of initiating and providing any indicated treatment will be available. In some hospitals without a CRNA IN-HOUSE, local conditions may allow Anesthesiologists to be rapidly available on short notice. Under these circumstances, local criteria must be established to allow Anesthesiologists to take call from outside the hospital but WITH THE CLEAR COMMITMENT THAT the Anesthesiologists will be IMMEDIATELY AVAILABLE for airway emergencies and operative management. The availability of the Anesthesiologist and the absence of delays in airway control and/or operative Anesthesia management MUST BE DOCUMENTED in the hospital PI process. The Level I trauma center in-house Anesthesia requirement, as noted on page 43 of the document, "**Resources for Optimal Care of the Injured Patient**" remains the same.

20) Board certification for Anesthesia is desirable but not required.

These and any future amendments will be posted on the ACS website. The ACS website is www.facs.org.

Dated June 28, 2000
Kathy O'Donnell Thielman

TABLE OF CONTENTS



List of Illustrations

List of Tables

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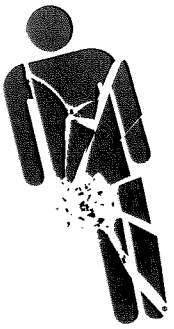

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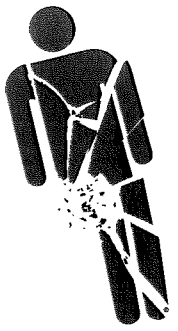

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INTRODUCTION

HISTORY

The American College of Surgeons (ACS) was founded in 1913 on the basic principles of improving the care of the surgical patient 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 care of the injured patient, always believing that trauma is a surgical disease demanding surgical leadership. This resources document was first published in 1976 and established guidelines for care of the injured patient.

The evolution of the name of this document corresponds with the evolution of the philosophy of care set forth by 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 revision 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 would include all the components identified with optimal trauma care, such as prevention, access, 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. While 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 the injured patient to avoid wasting precious medical resources. For, in the era of health care reform, we not only must strive for optimal care, but we must also try to provide this optimal care in a cost-effective manner.

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 and II centers can provide care for the volume of trauma patients in the region, Level III centers may not be necessary. In less densely populated areas and certainly in rural areas, however, Level II and III centers will be essential. It must be emphasized that in any trauma system, the *designating authority* is 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 (see Glossary). 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 a less dense population base, 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. 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. This current revision makes a clearer distinction between Level I and Level II centers.

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. 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 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 the major responsibility of 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), 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 is also expected to provide initial definitive trauma care, regardless of the severity of injury. 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 (for example, patients requiring advanced and extended surgical critical care). Level II trauma centers may be the most prevalent facility in a community, managing the majority of trauma patients.

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. In some areas where a Level I center does not exist, the Level II center should take on the responsibility for education and system leadership.

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 possible transfer to a facility that can provide definitive trauma care. 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. 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 prior to patient transfer in remote areas where no higher level of care is available (see Chapter 13: Rural Trauma). Such a facility may be a clinic rather than a hospital and may or may not have a physician available. Because of geographic isolation, however, the Level IV trauma facility is the de facto primary care provider. 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. As at Level III trauma centers, treatment protocols for resuscitation, transfer protocols, data reporting, and participation in system performance improvement (PI) 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 health care provider, who can provide leadership and sustain the affiliation with other centers.

An inclusive system should leave no facility without direct linkage to a Level I or II trauma center. This association should facilitate expeditious transfer of seriously injured patients who require a higher level of care. Exchange of medical personnel between Level I/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 the rural areas in the form of professional education, consultation, or community outreach. A mechanism should deliver feedback about individual patient care and outcome analysis to the referring hospital.

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 by mid-1998, more than 720 verification and consultation site visits were completed (see Chapter 22). This document has become a guide for the Verification/ Consultation program of the ACS COT. This edition was developed to further aid the process of verification and consultation 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 assessed areas within a hospital.

PRINCIPLES OF CHANGE FOR THIS EDITION

This is the fourth 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 incorporated. The result is a book that attempts to define the resources that are needed at various types of facilities to provide optimal care. The authors were guided by a number of principles that are worth mentioning.

Emphasis on Trauma System Rather than Trauma Center

Care of the injured patient 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. The *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 the injured 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 also avoid excessive and inappropriate resource expenditure in a time of limited medical resources.

Differences in External Environment

It is recognized that we provide care to the injured patient 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. While 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 upon their served patient population needs. Our resource assignment tried to be practical given current medical marketplace demands.

Performance Guidelines

Volume performance guidelines are one method to measure outcomes. These guidelines have been alluded to in previous editions of *Resources for Optimal Care of the Injured Patient*. This revision attempts to use current data to define volume performance guidelines. Naturally, these guidelines will be further refined as this document is adopted and new data are generated. These volume performance guidelines represent a best estimate based upon present information.

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 the injured. As the level of care increases, these individuals must become more involved and be part of the resource commitment for a successful trauma program. The role of the trauma coordinator or trauma program manager is better defined. In a larger trauma program, this individual functions as a co-manager of the program with the trauma medical director.

Involvement of Surgeons and Physicians

Resources can be measured in human and capital equipment parameters. Human resources include medical professionals. Optimal care is assumed to be defined for human resources as having the best and the

brightest medical professionals available to treat our injured patients. This edition establishes a new level of responsibility for the board-eligible or -certified general surgeon and emergency medicine physician. These individuals must be available 24 hours a day in facilities providing the highest level of care and cannot abrogate that responsibility to a resident in training.

Care of the Injured Child

Proper care for injured children is redefined 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 Levels I–IV. It is hoped that this change will facilitate more pediatric hospitals to make a commitment to an inclusive trauma system. It is acknowledged, however, that many adult hospitals will still need to provide quality care to injured children. The additional criteria these hospitals need to provide this care is succinctly defined. It is felt that this approach to providing care to injured children will help us move to a more collaborative systematic approach, using appropriate community resources.

Critical Care Services

As nonoperative care becomes more prevalent, the need for critical care resources is increasing. A dedicated ICU team with surgical direction is now required at Level I institutions. The implications of this change is an attempt to ensure that critically ill patients have immediate physician coverage when needed. This also implies that other surgeons are available to provide immediate care to newly injured patients who are admitted through the emergency department.

GOALS

Other differences from previous editions of *Resources for Optimal Care of the Injured Patient: 1993* are present in this revision, but the ones listed in the preceding pages are believed to be the major ones. Our goal is to better define what resources are truly needed to provide optimal care of the injured patient 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 which we did not achieve was to use an evidence-based scientific method to support recommendations completely. While our intention was sincere, we learned that, often, current data are lacking to definitely establish one recommendation over another. However, whenever possible, we did use existing data combined with expert opinion to establish a consensus opinion. This opinion realistically assesses our resource capability while emphasizing our goal of quality patient care. We have put forth a set of guidelines that will certainly challenge our existing methods of providing trauma care. We believe that the challenging ideals we have set are also positive and constructive. When enacted, these methods will improve our ability to provide excellent care to the injured patient.

CHAPTER 1

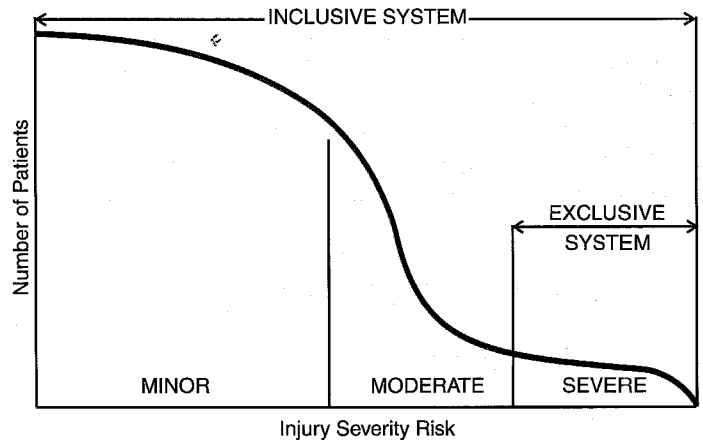
TRAUMA SYSTEMS

Care of the injured patient has been fundamental to the practice of medicine since recorded history. The word *trauma* derives from the Greek meaning "bodily injury." The Greek word *iatros* (healer) was originally found in Homer's Iliad and referred to the "remover of arrows." The first trauma centers were used to care for wounded soldiers in Napoleon's armies. The lessons learned in successive military conflicts have advanced our knowledge of care of the injured patient. The Korean Conflict and the Vietnam War established the importance of minimizing time from injury to *definitive care*. The extension of this concept to the management of civilian trauma led to the evolution from the 1970s onward of today's trauma systems. In this country, the first de facto trauma centers were inner city hospitals which largely provided emergency services to the uninsured. By contrast, in a system, the hospital which provides acute care for the severely injured patient (*trauma center*) is a key component of a system which encompasses *all* phases of care from prehospital through acute care and rehabilitation. The initial trauma systems did not consider the non–trauma center hospitals, even though they cared for a majority of the less severely injured. Rather, these systems were driven by the major or severely injured "trauma" patient who required immediate treatment, optimally, at a trauma center (see Figure 1). These exclusive systems need readjustment and conversion to a system structure that involves all providers and all acute care facilities in a full range of injury severity.

INCLUSIVE TRAUMA SYSTEMS

An inclusive trauma system was first described in the *CDC Position Paper on Trauma Care Systems* and was later refined in *The Model Trauma Care System Plan,* which was developed in response to the 1990 Trauma Care Systems Planning and Development Act (PL 101-590). This plan was written in 1992 under the auspices of the Health Resources Services Administration (HRSA) and clearly outlines the basic system components. It has been the template for many new trauma systems in the U.S. The plan establishes a system that is fully integrated into the emergency medical service (EMS) system and strives to meet the needs of *all* injured patients requiring an acute care facility, regardless of severity of injury, geographic location, or population density. The trauma center remains a key component, but the system recognizes the necessity of other health care facilities. *The* goal *is to match a facility's resources with a patient's needs so that optimal and cost-effective care is achieved.*

FIGURE 1
SCOPE OF A TRAUMA CARE SYSTEM



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The structure of a trauma care system involves a number of components and providers, each of which must be adapted to a specific environment, whether urban or rural. The components and providers are listed in Table 1. An inclusive system has a preplanned response to caring for the injured patient (see Figure 2).

ADMINISTRATION

The system requires administrative leadership, authority, planning and development, legislation, and finances. Together these components form an outer sphere of stability that is vital for the continuation of activities

TABLE 1
STRUCTURE OF A TRAUMA SYSTEM

Administrative Components	Operational and Clinical Components
Leadership	Injury prevention and control
System development	Human resources
Legislation	Work force resources
Finances	Education
	Prehospital care
	Emergency medical services management agency
	Ambulance and nontransporting guidelines
	Communications system
	Emergency/disaster preparedness plan
	Definitive care facilities
	Trauma care facilities
	Interfacility transfer
	Medical rehabilitation
	Information systems
	Evaluation
	Research

irectly related to patient care. The diversity of the opulation as defined by the environment (rural or rban) or by special segments (geriatric, pediatric, and o on) must be addressed by the system.

revention reduces the actual incidence of injury and is ost efficient for the system and for society. Injury revention is achieved through public education, egislation, and environment modification. Public ducation leads to a change in behavior and thus inimizes injury exposure.

ublic education and involvement include the proper ecognition of injury and efficient access to the emer- ency medical system. These components stimulate he necessary political and legislative activity to stablish the legal authority (legislation), lead agency leadership), and system funding (finances).

he development of a system is a major challenge for ny community. The concept of centralizing trauma are creates potential political and economic problems, ince the normal flow of patients may be altered by rauma triage protocols. Systems, by their nature, will irect the care of the most critically injured patients to limited number of "designated trauma centers." This ay become particularly problematic in the era of anaged care. The trauma system will succeed only if ll parties are involved in the initial planning, develop- ent, and implementation.

t is crucial that physicians and, particularly, surgeons re involved in the system planning process. These hysicians should help establish standards for all clinical omponents and participate in planning, verification, erformance improvement, and system evaluation.

With the advent of health care reform and the increasing proportion of reimbursement through managed care entities, trauma systems face a particular challenge. The "Statement on Managed Care and the Trauma System" (see Appendix A), as established by the American College of Surgeons, has been an excellent resource.

INJURED PATIENT MANAGEMENT WITHIN A SYSTEM

Once injury is identified, the trauma system must ensure easy access, central EMS dispatching, and the appropriate medical responses to and at the scene of injury. The system must also assign responsibility and authority for care and triage decisions made prior to trauma center access. Triage guidelines must be accepted by all providers and used to determine which patients require immediate trauma center care. This coordination requires direct communication systems between prehospital providers, physicians who provide medical direction, and trauma facility professionals.

The trauma center, which serves as the definitive specialized care facility, is a key component of the trauma system. The trauma center is different from other hospitals since it guarantees immediate availability of specialized surgeons, anesthesiologists, other physician specialists, nurses, and resuscitation life-support equipment 24 hours a day. Within a region or a state, trauma centers need to be integrated into the system plan to allow for the best and most timely match of the facility's resources with the patient's needs. The system coordinates care among all levels of trauma centers and facilities so that efficient and

prompt interfacility communication and transfer can take place according to *patient need*. Access to rehabilitation services, first in the acute care hospital and subsequently in more specialized facilities, is of paramount importance for the patient's optimal recovery. Equally important is the return of transferred patients to their own communities and physicians when medically appropriate.

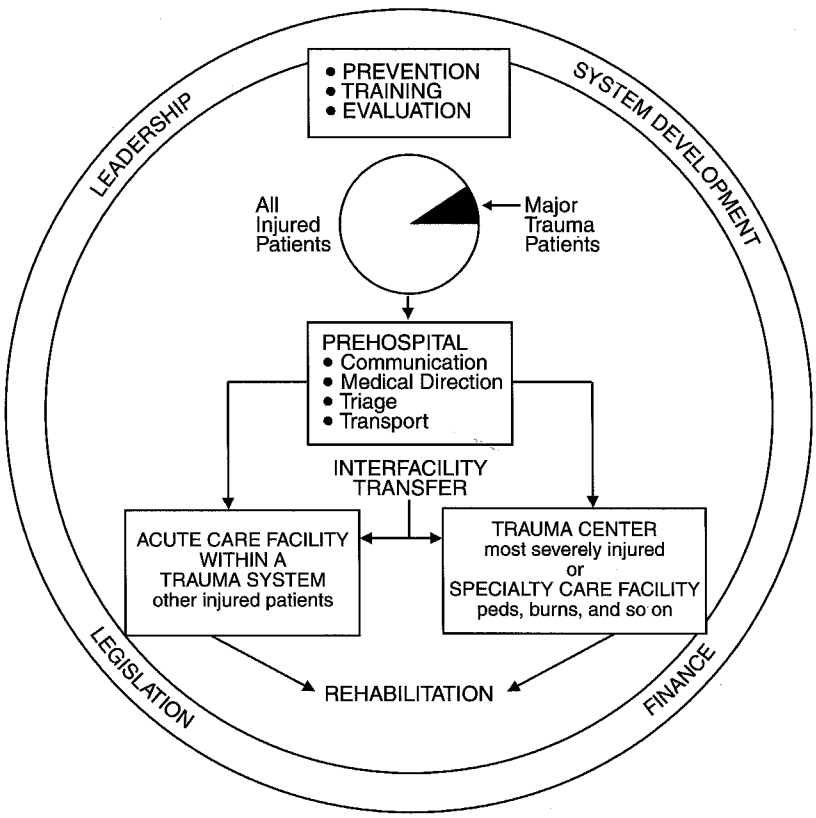
STEPS IN ORGANIZING A TRAUMA SYSTEM

Public support is necessary to enact enabling legislation that establishes the system. This process is begun by establishing the need for improved trauma care (needs assessment study). A complete injured patient database must assist with need and resources assessment and future planning. An analysis to determine the region's or state's available resources must also be performed. This resource assessment must be formulated to identify the current capabilities of the system and the levels, distribution, and current operations of all components—including the prehospital and hospital providers and facilities—including acute care, specialty, and rehabilitative facilities. This detailed assessment enables planners to locate deficiencies and create solutions for the system.

Legal authority for system development should be established once the need for a trauma system has been demonstrated. Legislation will be required to establish a lead agency, with a strong oversight or advisory body composed of health care, medical, and public representatives. This agency will be charged to develop criteria for the system, regulate and direct prehospital care, establish prehospital triage, ensure medical direction, designate the appropriate facilities to render care, establish a trauma registry, and establish performance improvement programs. The establishment of this authority is imperative to avoid subsequent legal challenges to the system.

Criteria for optimal care must be established by the lead authority in conjunction with health and medical professionals. The adoption of criteria for optimal care and systemwide standards are imperative to the success of any trauma system. The most widely recog-

FIGURE 2
AN INCLUSIVE TRAUMA CARE SYSTEM



Adapted with permission from Bureau of Health Services Resources, Division of Trauma and Emergency Medical Services: *Model Trauma Care System Plan*. Health Resources and Services Administration, U.S. Department of Health and Human Services, Rockville, MD, 1992.

nized guidelines are those of the American College of Surgeons Committee on Trauma (*Resources for Optimal Care of the Injured Patient*), which serve as the template for the trauma *center* designation process. In addition, the "Consultations for Trauma Systems," sponsored by the ACS COT and written by a multidisciplinary task force; "Guidelines for Trauma Care Systems," created by the American College of Emergency Physicians; and the "Model Trauma Care System Plan," published by the United States Department of Health and Human Services, Public Health Service, provide a basis for system development. These four sets of guidelines provide contemporary resources for system design and implementation.

Designation of trauma centers must take place through a public process directed by the lead agency. In the inclusive system, consideration must be given to the role of all the acute care facilities in the area which care for injured persons. Representatives from these non–trauma center facilities must be included in the planning process. It is fundamental to the development of a system that the number of *designated trauma centers* be limited to those necessary for the patient population at risk for major injury. One of the most common failings in urban/suburban system development is to designate *too many centers*. This weakens the system, as too many trauma centers dilute the experience necessary to maintain trauma expertise and adequate levels of training and for educational opportunity and research. Most important, duplication of service increases global expenditures.

This designation process eventually requires verification of the hospital and system capabilities. The ACS COT verification program is one method used to help systems verify trauma center performance. The ACS COT system document is also helpful in evaluating system components.

Development of a system requires that all of the principal players be involved at the beginning. There must be agreement about the minimal data set that *all* acute care facilities will contribute. Without the data from the hospitals managing less severely injured (that is, non–trauma centers), the database will be incomplete. Conversely, a complete data set will allow accurate determination of where injured patients receive their care and therefore can establish the true rate of over- and under-triage.

SYSTEM EVALUATION

Trauma systems are complex and dynamic organizational structures, with continually evolving standards of care. It is necessary to have a mechanism for ongoing evaluation. This evaluation process should have two components: self monitoring and external evaluation.

Self monitoring requires a defined performance improvement program based on a trauma registry and a system medical audit process. These quality assessment and improvement activities should complement the performance improvement programs performed by the prehospital agencies and hospitals/facilities. The lead agency, *trauma centers*, prehospital providers, the Medical Examiner (that is, coroner), and non–trauma center acute care facilities must all be involved.

MEDICAL AUDIT PROCESS

The lead agency, trauma centers, prehospital providers, the Medical Examiner (coroner), and non–trauma center acute facilities should all be involved in a Medical Audit Committee (MAC), which meets on a regular (monthly) basis. Utilizing the system trauma registry, trauma service performance improvement processes, and trauma director case summaries, specific cases representing deaths, complications, or quality of care issues are selected for review at MAC. The cases are discussed and judgments made regarding appropriateness of care and potential preventability of death. This process results in performance improvement of patient care in the trauma system.

External evaluation of the system is necessary. The ACS COT document, "Consultations for Trauma Systems," provides an evaluation process that will contribute to the initial development, evolution, and improvement of trauma systems.

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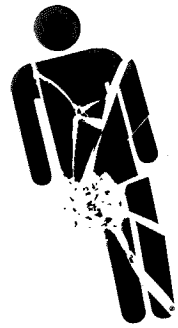
CHAPTER 2

TRAUMA CENTER DESCRIPTIONS AND THEIR ROLES IN A TRAUMA SYSTEM



IDEAL TRAUMA CENTER WITHIN AN IDEAL TRAUMA SYSTEM

An ideal trauma system would include all the components identified with optimal trauma care, such as prevention, access, acute hospital care, rehabilitation, and research activities. Central to an ideal system is a large resource-rich trauma center. The need for resources is primarily based on the concept of being able to provide immediate medical care for unlimited numbers of injured patients at any time. Optimal resources at such a trauma center would include in-house board-certified emergency medicine physicians, general surgeons, anesthesiologists, neurosurgeons, and orthopaedic surgeons. Other board-certified specialists would be available, within a short time frame, to all patients who require their expertise. This center would require a certain volume of injured patients to be admitted each year, and these patients would include the most severely injured patients within the system. Additionally, certain injuries that are infrequently seen would be concentrated in this special center to ensure that these patients could be properly treated and studied, providing the opportunity to improve the care of these patients. These research activities are necessary to enhance our knowledge of the care of the injured. Basic science research in areas such as shock, brain edema, organ failure, and rehabilitation would also be present in the ideal center. This trauma center would have an integrated concurrent performance improvement (PI) program to ensure optimal care and continuous improvement in care. This center would not only be responsible for assessing care delivered within its trauma program, but for helping to organize the assessment of care within the entire trauma system. This ideal trauma center would serve as a total resource for all organizations dealing with the injured patient in the system's catchment area. This description is ideal, but, given the limitations of our health care system, may not be achievable for multiple reasons which include financial and specialty physician availability.

One resource of a trauma center that cannot be limited is the surgical commitment. In fact, without surgical leadership it is highly unlikely the program will be able to meet the requirements outlined in the ACS COT's *Resources for Optimal Care of the Injured Patient*. While this commitment is often difficult to objectively measure, it can be recognized in a number of ways. These include a surgeon who acts as the full-time director of the trauma program, surgeons who take an active role in all aspects of caring for the injured patient, surgical participation in the trauma PI program, and surgeons who take an advocacy role for the injured patient. Surgical leadership promoting the trauma program to the community, hospital, and other colleagues should also be easily recognized. In summary, this commitment is a valuable resource which is integral to a successful trauma program.

The ACS COT desires to encourage trauma center and trauma system development, but recognizes that there are financial considerations to providing the resources necessary for optimal care of the injured. Assuming equitable financial support, a classification system would offer the possibility of distributing funding for the management of injury within the United States. Unfortunately, such a reimbursement system is yet to be achieved. Despite this shortcoming, each community should assess its true needs for trauma care. This assessment should emphasize a system approach. Our classification scheme is intended to help communities assess their true needs for trauma care. This approach implies that there be limitations on the number of verified trauma centers within a given area. The goal in every community is to ensure that resources are used appropriately to achieve the stated goal of optimal care of the injured patient.

Formal categorization of trauma care facilities is essential for the development, implementation, and improvement of medical systems that strive to provide optimal care of the injured patient. Such categorization is assumed to be associated with cost-effective regionalized trauma systems. Optimal patient outcome demands the timely availability of health care profes-

sionals who are dedicated to providing medical care to the injured patient. These health care professionals have distinguished themselves through special training, an ongoing commitment to new knowledge, and sufficient clinical experience to maintain the unique skills necessary to provide optimal care. These concepts are designed to consolidate trauma care within a community. This type of organization is consistent with regionalization of health care, which is based on the premise that quality and cost effectiveness will improve with experience and patient volume.

Survival and other outcome measures after complex surgical procedures correlate directly with the volume of experience for both the institution and the surgeon. Data suggest these same principles apply to the care of the seriously injured. In an analysis of the Chicago, IL, trauma system, seriously injured patients had a 30 percent greater chance of death at a lower-volume trauma center compared with that at a higher-volume center. A study from the Pennsylvania system suggests that each trauma surgeon should manage a minimum number of seriously injured patients annually to achieve expected survival rates. While further data are needed to correlate these volume characteristics with complications, length of hospitalization, and direct and indirect costs of injury, these data support concentrating and limiting community resources to care for injured patients within a defined geographic area.

Proper triage is the hallmark of a good trauma system and is necessary to achieve optimal care of the injured. The goal of every system is to match the needs of injured patients to the capabilities of the trauma facility. This type of patient flow optimizes outcome and facilitates clinical and basic research as we learn to deal with injury as a disease. All systems must be careful to protect academic activities, because the major scientific advances in trauma management over the past 30 years have primarily occurred at academic trauma centers with extensive clinical experience. Clearly, sufficient exposure to the seriously injured patient is required to ask the right investigative questions and develop the right answers. It is acknowledged and supported that for this type of system to work, proper prenotification and transport to an appropriate level hospital within the system is imperative.

Appropriate verification of hospitals regarding their commitment and capability to provide trauma care is an early step in a regional trauma system's development. Due to the inherent differences in population density and geography, as well as in trauma resources, the utilization of trauma centers and the design of each regional trauma system must be somewhat individualized to achieve the objective of optimal patient care. The differences between communities mandate flexibility to develop the most appropriate system to fit the individual region.

Regardless of the size of an area, each trauma system should have an identified lead hospital. Although it is possible that this role be shared among hospitals, identifying one hospital is the ideal. This hospital would be looked upon as the resource leader within a given service area. In a fully mature model, this would ideally correlate with a Level I center. This Level I hospital would be responsive to all other hospitals within the system. In some communities, a Level II might function as a lead hospital. It is possible, although unlikely, that a Level III could serve as a lead hospital in an area of low population density. However, ideally, this situation would be handled by a network of hospitals led by a Level I or II institution and include multiple levels of resources (see Chapter 13: Rural Trauma Care).

TRAUMA CENTER DESCRIPTORS WITHIN A TRAUMA SYSTEM

Level I

The Level I Trauma Center should be a regional resource center and will generally serve large cities or population-dense areas. This institution will usually serve as the lead hospital for a system. In larger population-dense areas, more than one Level I may be needed. This institution is expected to manage large numbers of injured patients with a certain severity level of injury. These centers are expected to admit at least 1,200 trauma patients yearly, and of those, 20 percent will have an Injury Severity Score (ISS) of 15 or greater, **OR** there will be 35 patients per surgeon with an ISS of 15 or greater. The trauma director using the trauma PI program is responsible for determining each general surgeon's ability to participate on the trauma panel. This will be based on annual review of each surgeon's performance in the trauma program. Qualified general surgeons are expected to participate in major therapeutic decisions and be present in the emergency department for major resuscitations and at operative procedures in all seriously injured patients.

The 24-hour in-house availability of the attending surgeon is the most direct method for providing this involvement. A postgraduate year (PGY) 4 or 5 resident may be approved to begin resuscitation while awaiting the arrival of the attending surgeon, but cannot be considered as a replacement for the attending surgeon in the emergency department. This may allow the attending surgeon to take call from outside the hospital. In this case, local criteria and PI must be established to define conditions requiring the attending surgeon's immediate hospital presence. The attending surgeon's participation in the major therapeutic decisions, presence in the emergency department for major resuscitations, and presence at operative procedures are mandatory. Compliance with these criteria and their

appropriateness must be monitored by the hospital's trauma PI program.

The Level I center is also expected to conduct trauma research and be a leader in education, prevention, and outreach activities.

Level II

The Level II Trauma Center provides comprehensive trauma care in two distinct environments which have been recognized in the ongoing verification program sponsored by the ACS COT. The first is in a population-dense area where a Level II supplements the clinical activity and expertise of a Level I institution. In this scenario, the Levels I and II work together to optimize resources expended to care for all injured patients in their area. This implies a cooperative environment between institutions which allows patients to flow between hospitals, depending upon resources and clinical expertise. The trauma director using the trauma PI program is responsible for determining each general surgeon's ability to participate on the trauma panel. This participation will be based on annual review of the surgeon's performance in the trauma program. Qualified general surgeons will be expected to participate in major therapeutic decisions and be present in the Emergency Department for major resuscitations and at operative procedures in all seriously injured patients. Additionally, the attending general surgeon would be responsible for the timely evaluation of every trauma admission.

Local conditions may allow the surgeons to be rapidly available on short notice. Under these circumstances, local criteria must be established that allow the surgeon to take call from outside the hospital, but with the clear requirement on the part of the hospital and the surgical staff that the general surgeon will participate in the early care of the patient. Compliance with this requirement and applicable criteria must be monitored by the hospital's PI program.

The second Level II environment occurs in less population-dense areas. The Level II hospital now serves as the lead trauma facility for a geographic area, as a Level I institution is not likely to be geographically close. Many rural areas will use this model (see Chapter 13: Rural Trauma Care). Volume performance standards will depend on geographic area served, population density, resources available, and the maturity of the system. This lead trauma hospital is expected to have an outreach program which incorporates smaller institutions in their service area (see Chapter 13: Rural Trauma Care). Transfer arrangements with distant Level I or II institutions are dictated by local resources. Surgeon involvement in these institutions would be consistent with the alternatives described in the preceding pages.

Level III

A trauma system will usually determine the need for Level III trauma centers. Definition of the Level III's role will be aided by communication with Level I and II trauma centers. A level III will have continuous general surgical coverage. Level III must have the capability to manage the initial care of the majority of injured patients and have transfer agreements with other trauma hospitals for patients that exceed its resources. A resuscitation team will be organized for the severely injured patient. The general surgeon must be promptly available for all major resuscitations. The Level III trauma center must be involved with prevention and must have an active outreach program for its referring communities. Level III will conduct education programs for nurses, physicians, and allied health care workers involved with trauma.

Level IV

The Level IV hospital is usually located in a rural area and will supplement care within a larger network of hospitals. Level IV facilities will provide initial evaluation and assessment of injured patients. Most patients will require transfer to larger facilities that have more resources that are dedicated to providing optimal care for the injured patient. A Level IV facility will have 24-hour emergency coverage by a physician. The hospital has operative capabilities when the surgeon is available. Specialty coverage may or may not be available. It will have transfer plans to handle most patients. The surgeon will respond promptly for the resuscitations of the injured patient. A resuscitation team will be organized for the severely injured patient. Level IV facilities should be involved in prevention, outreach, and education.

The rural system requires other acute care facilities (see Chapter 13: Rural Trauma Care).

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CHAPTER 3

PREHOSPITAL TRAUMA CARE

INTRODUCTION

The principles of modern prehospital management of the severely injured patient were derived from concepts developed in military conflicts. Not all injuries are immediately obvious. Prehospital personnel should be trained to detect specific injuries and to know the mechanism of forces which could lead to severe injury. The successful management of the patient requires the identification of specific injuries or mechanisms likely to cause severe injury to allow correct triage to an appropriate facility. The process of identifying significant injuries should be defined prospectively by triage protocols. The triage process determines that the patient is transported to the appropriate trauma facility.

On-scene initial assessment and management is provided by the prehospital medical team. Medical direction of prehospital trauma care is by preexisting protocol (indirect medical direction) or by a physician via voice communication (direct medical direction).

The protocols which guide patient care should be established by trauma health care providers, including surgeons, emergency physicians, medical directors for ambulance services, and appropriately trained basic and advanced emergency medical personnel. This team approach helps establish continuity of care between prehospital care and hospital protocols. These protocols should be consistent throughout the system.

Treatment of the severely injured patient in the prehospital arena should consist of assessment, extrication, initiation of resuscitation, and rapid transportation to the closest appropriate facility. The essential components of resuscitation should be limited to the establishment of an airway, provision of ventilation, hemorrhage control, stabilization of fractures, and immobilization of the entire spine. Intravenous access may be established en route to the hospital. If there is a prolonged extrication, it may be feasible to establish an intravenous (IV) line. Scene time should not be extended to start an IV.

The goal of the prehospital component of the system is to minimize injury through safe and rapid transport of the injured patient. The patient should be taken directly to the center most appropriately equipped and staffed to handle the patient's injury as defined by the region's trauma system (see Chapter 1), the designation process, or the ACS COT verification process. These destinations should be clearly identified and understood by prehospital personnel and should be determined by system guidelines, triage protocols, or direct medical direction. Ambulances should bypass those facilities not identified by the region's trauma system as appropriate destinations, even if they are closest to the incident.

OVER-TRIAGE AND UNDER-TRIAGE

The entire trauma system is driven by the tenet that severely injured trauma patients should be triaged to the appropriate trauma facility. Imprecision results in over-triage, as minimally injured patients are transferred to trauma centers, and under-triage, as severely injured patients are taken to non–trauma centers. In general, priority has been given to reduction of under-triage, because under-triage may result in preventable mortality or morbidity from delays in definitive care. Although over-triage carries minimal or no adverse consequences for the patient, it does result in excessive costs and burden for the trauma center. In most systems, an under-triage rate of 5 to 10 percent is considered unavoidable and is associated with an over-triage rate of 30 to 50 percent. An over-triage rate of up to 50 percent may be required to maintain an acceptable level of under-triage in a community. Clearly, the medical community needs to be more concerned about under-triage and the medical consequences that result from inadequate use of a trauma system. Each system's performance improvement program should evaluate the triage criteria to afford the best quality care to severely injured patients without either overtaxing the receiving trauma center with minimally injured patients or inappropriately transporting minimally injured patients long distances.

TABLE 1
FIELD TRIAGE DECISION SCHEME

Measure vital signs and level of consciousness

Step One[1]

- Glasgow Coma Scale ..... <14 or[2]
- Systolic blood pressure ..... <90 or
- Respiratory rate ..... <10 or >29
- Revised Trauma Score (see Table 2) ..... <11

YES → Take to trauma center; alert trauma team.
Steps 1 and 2 triage attempts identify the most seriously injured patients in the field. In a trauma system, these patients would preferentially be transported to the highest level of care within the system.

NO → Assess anatomy of injury

Step Two[3]

- All penetrating injuries to head, neck, torso, and extremities proximal to elbow and knee
- Flail chest
- Combination trauma with burns
- Two or more proximal long-bone fractures
- Pelvic fractures
- Open and depressed skull fracture
- Paralysis
- Amputation proximal to wrist and ankle
- Major burns (see Chapter 14: Guidelines for the Operation of Burn Units)

YES → Take to trauma center; alert trauma team
Steps 1 and 2 triage attempts identify the most seriously injured patients in the field. In a trauma system, these patients would preferentially be transported to the highest level of care within the system.

NO → Evaluate for evidence of mechanism of injury and high-energy impact

Step Three[4]

- Ejection from automobile
- Death in same passenger compartment
- Extrication time >20 minutes
- Falls >20 feet
- Rollover

- High-speed auto crash — Initial speed >40 mph; Major auto deformity >20 inches; Intrusion into passenger compartment >12 inches

- Auto-pedestrian/auto-bicycle injury with significant (>5 mph) impact
- Pedestrian thrown or run over
- Motorcycle crash >20 mph or with separation of rider from bike

YES → Contact medical direction and consider transport to a trauma center
Consider trauma team alert

NO

Step Four[5]

- Age <5 or >55
- Cardiac disease, respiratory disease
- Insulin-dependent diabetes, cirrhosis, or morbid obesity
- Pregnancy
- Immunosuppressed patients
- Patient with bleeding disorder or patient on anticoagulants

YES → Contact medical direction and consider transport to trauma center
Consider trauma team alert

NO → Reevaluate with medical direction

WHEN IN DOUBT TAKE TO A TRAUMA CENTER

CONTINUOUS PERFORMANCE IMPROVEMENT

Improving the final outcome of the injured patient is directly dependent on effectively monitoring, integrating, and evaluating all components of the patient's care. Prehospital personnel must be involved in the review process and be accountable to the medical direction system that is in place at the hospital and the geographic region (see Chapter 16: Performance Improvement).

MEDICAL DIRECTION

High-quality medical direction of prehospital trauma care may be rendered by two methods. Direct medical direction is by voice communication from the emergency medical personnel in the field to a physician. The clinical findings are presented, and orders are received for the initial and continuing care of the patient. Indirect medical direction is by protocol and involves development, revision, and monitoring of all operating protocols and procedures by physicians, including reviewing prehospital reports for compliance with preestablished procedures. Surgeons should provide leadership for the development of trauma protocols and be actively involved in prehospital personnel training as well as the performance improvement process. Surgeons must also be involved in the development of trauma components of the emergency medical service (EMS) system. This is increasingly important, as these protocols and procedures are being incorporated in state regulations. High-quality, consistent, emergency care demands that all prehospital personnel in a geographic region understand the treatment protocols, transportation methods, and destination facilities in that geographic region. The state and regional EMS agencies and authorities should consult with the ACS COT for recommendation of surgeons in the region who are capable of providing leadership.

EMS PATIENT RECORDS

The prehospital record of the incident should include the type and mechanism of injury, the anatomic and physiologic derangement of the patient, relevant times of the incident, extrication, on-scene care, and the timing of the interventions. Documentation of these events allows personnel in the trauma center to have an understanding of the event and the potential for injuries. Photographs can be useful. The degree of damage to a motor vehicle should be reported, especially if the patient may appear to have minimal injuries. This information prompts hospital personnel to evaluate the patient for occult injuries. Trauma scores, when requested, should be filled in. Accurate EMS patient care records are essential to building trauma registries.

AIR TRANSPORTATION

Air medical transportation has become an important method of rapidly transporting injured patients from the scene or the transferring facility to the trauma

NOTES TO TABLE 1

It is the general intention of these triage guidelines to select severely injured patients for trauma center care. When there is doubt, the patient is best evaluated at the highest level trauma center available.

[1]Step One—Physiologic status thresholds are values of the Glasgow Coma Scale, blood pressure, and respiratory rate from which further deviations from normal are associated with less than 90 percent probability of survival. Used in this manner, prehospital values can be included in the admission trauma score and the quality assessment process.

A variety of physiologic severity scores has been used for prehospital triage and has been found to be accurate. Those scores contained in the triage guidelines are believed to be the simplest to perform and provide an accurate basis for field triage based on physiologic abnormality.

Deterioration of vital signs would necessitate transport to a trauma center.

[2]Shackford SR, Wald SL, Ross SE, et al: The clinical utility of computed tomographic scanning and neurologic examination in the management of patients with minor head injuries. *J Trauma* 1992; 33(3): 385–394.

[3]Step Two—A patient who has normal vital signs at the scene of the accident may still have a serious or lethal injury.

[4]Step Three—It is essential to look for indications that significant forces were applied to the body.

Evidence of damage to the automobile can be a helpful guide to the change in velocity. Intrusion into the passenger compartment **from any direction** should prompt consideration of the potential for major injury.

Each trauma system and its hospitals should use PI programs to determine use of mechanism of injury and comorbid factors as activators for bypass and trauma team activation.

[5]Step Four—Certain other factors that might lower the threshold at which patients should be treated in trauma centers must be considered in field triage, including:

A. Age—Patients over age 55 have an increasing risk of death from even moderately severe injuries. Those younger than age 5 have certain characteristics that may merit treatment in a trauma center with special resources for children.

B. Comorbid Factors—The presence of significant cardiac, respiratory, or metabolic diseases are additional factors that may merit the triage of patients to trauma centers.

Each trauma system and its hospitals should use PI programs to determine use of mechanism of injury and comorbid factors as activators for bypass and trauma team activation.

TABLE 2
REVISED TRAUMA SCORE

			Score	Start of Transport	End of Transport
A. Respiratory rate	10–29/min		4		
	>29/min		3		
	6–9/min		2		
	1–5/min		1		
	0		0		
B. Systolic blood pressure	>89 mm Hg		4		
	76–89 mm Hg		3		
	50–75 mm Hg		2		
	1–49 mm Hg		1		
	No pulse		0		
C. Eye opening	Spontaneous		4		
	To voice		3		
	To pain		2		
	None		1		
D. Verbal response	Oriented		5		
	Confused		4		
	Inappropriate words		3		
	Incomprehensible words		2		
	None		1		
E. Motor	Obeys command		6		
	Localizes pain		5		
	Withdraws (pain)		4		
	Flexion (pain)		3		
	Extension (pain)		2		
	None		1		
F. Glasgow Coma Score (Total C + D + E)					
G. Glasgow Conversion Scale	13–15	=	4		
	9–12	=	3		
	6–8	=	2		
	4–5	=	1		
	<4	=	0		
Trauma score total = A + B + G					

Adapted with permission from Champion HR, Sacco WJ, Copes WS, et al: A revision of the Trauma Score. *J Trauma* 1989; 29(5): 624.

center. Air medicine has allowed advanced life support and critical care to be delivered at the scene of the incident and en route to the trauma center. A structured air medical safety program must 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. Criteria and procedures for requesting air medical transport should be developed prior to the implementation of an air medical program. Air medical dispatch guidelines have been developed by the National Association of EMS Physicians.[1] Both direct and indirect medical direction must be part of air medical care. The medical flight crew should have a structured air medical educational curriculum and an ongoing performance improvement program.

CAUTIONS

Victims who suffer decapitation or bodies exhibiting decomposition or rigor mortis and other conditions defined by the EMS system are dead and need to be transported at the direction of the medical examiner or coroner.

Communicable diseases, such as hepatitis and AIDS, are a significant potential problem for prehospital personnel. Compliance with Occupational Safety and Health Administration (OSHA) standards is mandatory. The receiving facility is responsible for proactively informing prehospital personnel of exposure to suspected infectious diseases.

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CHAPTER 4

INTERHOSPITAL TRANSFER AND AGREEMENTS

Local hospitals are usually capable of providing definitive care to injured patients. A minority of patients will require specialty services exceeding the capabilities of local resources. As an initial step, an inventory of local resources and capabilities should be developed to assist in the identification of patients who may require transfer to a facility that can provide specialty services. This inventory should be done with reference to the available resources in the region and be a part of the development of a regional trauma system/plan. The development of agreements for transfer of patients between institutions should be made well in advance of the acute need to facilitate the timeliness of the transfer process. Once the need for transfer is recognized, the process should not be delayed for laboratory or diagnostic procedures that have no impact on the transfer process or the immediate need for resuscitation. Most experts agree that minimizing the time from injury to appropriate definitive care can have a positive influence on outcome. The development of trauma systems facilitates the transfer process and improves the efficiency of patient movement through the system by designing and implementing transfer plans which deal with issues prior to acute patient need.[1-6]

There are identifiable injuries and combinations of injury and injury mechanisms which result in high mortality, even when these injuries are managed in dedicated trauma centers. Individuals with these critical injuries should be considered for early transfer after initiation of appropriate resuscitation efforts. The criteria which suggest the necessity for early transfer are outlined in Table 1. These criteria are intended to prompt consideration for transfer and are not inclusive or hospital-specific. Physicians in community hospitals should develop specific guidelines for the identification of patients who would benefit from early transfer based on available local resources. Written agreements for transfer of patients between hospitals have their greatest utility in establishing a system in which patients can be expeditiously moved to an institution which has been identified by prior agreement to be capable and willing to provide needed specialty services.

The decision to transfer an injured patient to a specialty care facility in an acute situation should be based solely on the needs of the patient and not on the requirements of the patient's specific provider network (PPO, HMO, AHP, and so on) or the patient's ability to pay. The subsequent decisions regarding transfer to a facility within a managed care network should be made, after stabilization, by the patient, family, and the responsible trauma surgeon (see Appendix A: ACS Statement on Managed Care and the Trauma System).

Federal legislation through the Consolidated Omnibus Budget Reconciliation Act (COBRA) of 1987 (Pub. L. 100-203) imposes civil penalties on individual practitioners and hospitals who fail to provide emergency care in a timely fashion. This "antidumping" law was designed to prevent the transfer of patients based solely on the patient's ability to pay. Additional elements in COBRA legislation relative to the obligations of the referring physician and facility include:

1) identify a facility with available beds and personnel before beginning the transfer
2) do not transfer unstable patients, except for medical necessity
3) provide appropriate transportation with a vehicle augmented with life-support equipment and staff to meet the anticipated contingencies which may arise during transportation (EMTs and paramedics are generally inadequate for the transfer of the critically injured patient)
4) send all records, test results, X rays, and so on, with the patient to the referring facility unless delay would increase the risks of transfer, then send the information as soon as possible
5) issue a physician transfer certificate and consent for transfer to accompany the patient

Receiving hospitals also have obligations under the COBRA statute. Facilities which have entered into Medicare provider agreement who have specialized capabilities or facilities are obligated to accept the

appropriate transfer of an individual requiring such services if the hospital has the capacity to treat them.

Written agreements between hospitals help ensure the consistent and efficient movement of patients between institutions, allow for review of the structure of the transfer process with the goal of performance improvement, and result in mutual educational benefit for both institutions. The value of these agreements is to design a process **prior to its necessity** that allows the injured patient to receive the specialty care needed. This process avoids delays that prolong the time from injury to definitive care. The transferring and receiving hospitals benefit by having predetermined the needs and expectations of both institutions and resolving problematic areas prior to the actual transfer process. The best plans are those that are carefully considered, mutually approved, written, and frequently reviewed.

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 ATLS® Program offers one proven method to accomplish this task (see ATLS® Student Manual, Chapter 1, Initial Assessment and Management). The referring physician should select an appropriate mode of transport for the patient's needs so that the level of care does not deteriorate during transport. Direct physician-to-physician contact is essential.

Another aspect of interhospital transfer that is necessary is proper performance improvement of transport activities. These can be accomplished in a number of ways, depending upon the transport service. Regardless of how the process is accomplished, the receiving hospital should have input, feedback, and adequate communication to the personnel responsible for the transport process to ensure that problems occurring during and associated with transport are addressed in a timely fashion. This communication should also allow recognition for transportation efforts that are consistent with optimal care.

GUIDELINES FOR TRANSFERRING PATIENTS

1. Transferring Physician Responsibilities

a. Identify the patient needing transfer

b. Initiate the transfer process by direct contact with the receiving surgeon

c. Initiate resuscitation measures within the capabilities of the facility

d. Determine the appropriate mode of transportation in consultation with the receiving surgeon or physician

e. Transfer all records, results, and X rays to receiving facility

2. Receiving Physician Responsibilities

a. Ensure resources are available at the receiving facility

b. Provide advice/consultation regarding specifics of the transfer or additional evaluation/resuscitation prior to transport

c. Once transfer of the patient is established, clarify and identify medical control

d. Identify a PI process for transportation, allowing feedback from the receiving physician to the transport team directly or at least to the medical direction of the transport team

3. Management During Transport

a. Qualified personnel and equipment must be available during transport to meet anticipated contingencies

b. Sufficient supplies must accompany the patient during transport, such as IV fluids, blood, and medications as appropriate

c. Vital functions should be frequently monitored

d. Vital functions should be supported; for example, hemodynamics, ventilation, central nervous system, and spinal protection

e. Records should be kept during transport

f. Communication must be kept with on-line medical direction during transport

4. Information to Accompany The Patient

Available patient demographic information and the name of the next of kin should accompany the patient. Information concerning the nature of the injury event, time of occurrence, and prehospital care (run report) constitute important facts which can influence subsequent treatment. A summary of evaluation and care provided at the transferring facility should include the results of diagnostic tests, X rays obtained, the injuries identified, the patient's response to treatment, the amount of fluids and blood infused, and a chronologic record of the patient's vital signs/urinary output. Additional information that is helpful includes the medical history, current medications, medications/immunizations administered, and allergies. The name, address, and phone number of the referring doctor is helpful if additional details are needed. The name of the physician who accepted the patient at the receiving hospital should also be indicated. An example of a transfer form is shown in Table 2. In general, the more information supplied, the better.

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TABLE 1
CRITERIA FOR CONSIDERATION OF TRANSFER

(These guidelines are not intended to be hospital-specific)

CENTRAL NERVOUS SYSTEM

Head injury	—Penetrating injury or open fracture (with or without cerebrospinal fluid leak)
	—Depressed skull fracture
	—Glasgow Coma Scale (GCS) <14 or GCS deterioration
	—Lateralizing signs
Spinal cord injury	—Spinal cord injury or major vertebral injury

CHEST

Major chest wall injury or pulmonary contusion
Wide mediastinum or other signs suggesting great vessel injury
Cardiac injury
Patients who may require prolonged ventilation

PELVIS/ABDOMEN

Unstable pelvic ring disruption
Pelvic fracture with shock or other evidence of continuing hemorrhage
Open pelvic injury
Solid organ injury

MAJOR EXTREMITY INJURIES

Fracture/dislocation with loss of distal pulses
Open long-bone fractures
Extremity ischemia

MULTIPLE-SYSTEM INJURY

Head injury combined with face, chest, abdominal, or pelvic injury
Burns with associated injuries
Multiple long-bone fractures
Injury to more than two body regions

COMORBID FACTORS

Age >55 years
Children ≤5 years of age (see Chapter 10)
Cardiac or respiratory disease
Insulin-dependent diabetes, morbid obesity
Pregnancy
Immunosuppression

SECONDARY DETERIORATION (LATE SEQUELAE)

Mechanical ventilation required
Sepsis
Single or multiple organ system failure (deterioration in central nervous, cardiac, pulmonary, hepatic, renal, or coagulation systems)
Major tissue necrosis

Note: It may be appropriate for the injured patient to undergo operative control of ongoing hemorrhage **prior** to transfer if a qualified surgeon and operating room resources are promptly available at the referring hospital.

TABLE 2
TRANSFER FORM

Date ___/___/___ Time ___.___ am pm

Patient Name _____

Address _____

Age _____

Birth Date _____

SSAN _____

Phone _____

Next of Kin _____

Phone _____

Notified Yes_____ No_____

Injury Mechanism

MVC GSW Stab Alter Fall Other

Date of Injury ___/___/___

Time of Injury ___.___ am pm

Medications _____

_____

_____

_____

_____

Allergies _____

_____

_____

Medications Administered _____

_____

_____

_____

_____

Fluid Administered

Crystalloid (type) _____ (Vol) _____

Colloid (type) _____ (Vol) _____

Blood (type) _____ (Vol) _____

FFP _____ (Vol) _____

Other (type) _____ (Vol) _____

Initial Vital Signs

BP ____/____ P____ RR____ T____.__F/C

RTS_____ GCS_____

Prehospital run report attached

Yes_____ No_____

Injuries Identified _____

_____

_____

_____

_____

_____

_____

_____

Treatment/Procedures _____

_____

_____

_____

_____

_____

_____

_____

_____

Immunizations: _____

_____

_____

Referring M.D.

Address

Phone (_____) _____

Accepting M.D. _____

Time ___.___ am pm

Additional Information:

Attach all pertinent flow sheets, vital signs, notes, diagnostic tests/results, consent forms for transfer, and so on.

CHAPTER 5

HOSPITAL ORGANIZATION AND THE TRAUMA PROGRAM

A decision by a hospital to become a trauma center requires the commitment of both the institutional governing body and the medical staff. The commitment and collaboration of these two bodies will facilitate the allocation of resources and the development of programs designed to improve care of the injured patient. The resources include (1) hospital organization, (2) institutional support, (3) the trauma program, (4) the trauma medical director, (5) the trauma team, (6) the trauma nurse coordinator, and (7) the trauma performance improvement program.

HOSPITAL ORGANIZATION

The administrative structure must support the trauma program. Written commitment by the hospital's governing body and the medical staff is necessary. An identified hospital administrative leader must work closely with the trauma medical director to establish and maintain the components of the trauma program, including appropriate financial support. Administrative support of the trauma program helps solve system issues such as the lack of adequate resources to provide optimal care of injured patients. This administrative representative works closely with the trauma medical director to establish and maintain the components of the trauma program. Participation with the trauma service activities will ensure that the written support of the trauma service by the Medical Executive Committee and hospital administration is backed by decisions which mandate optimal multidisciplinary trauma care.

The administration organizational structure defines institutional support and commitment. Administrative structure must include an administrator, medical director, and trauma program manager. The trauma program's location in the organizational structure of the hospital must be placed so it can interact with at least equal authority with other departments providing patient care. Administrative support includes human resources, educational activities, community outreach activities, and community cooperation to enhance a systematic approach to the care of the injured (see Chapter 17: Education and Outreach). Adequate funding of the trauma program is the direct responsibility of the institution that is supporting the trauma program.

MEDICAL STAFF SUPPORT

The 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 the injured patient.

TRAUMA PROGRAM

The trauma program involves multiple disciplines that transcend normal departmental hierarchies. Since optimal care extends from the scene of an injury until discharge from a rehabilitation center, the trauma program must have appropriate specialty representation. Each discipline provides the appropriate skills as team members working in concert implement treatment based upon a prioritized plan of care. This multidisciplinary trauma program must ensure optimal and timely care. The performance improvement evaluation of this care must extend to all of the involved departments.

TRAUMA MEDICAL DIRECTOR

The trauma medical director is the surgeon who leads the multidisciplinary activities of the trauma program. The director must be a board-certified surgeon (usually general surgery) with special interest in trauma care. The trauma director's responsibility extends far beyond the technical skills of surgery. The trauma director should have the authority to affect all aspects of trauma care, including (1) recommending trauma team privileges; (2) cooperating with the nursing administration to support the nursing needs of the trauma patients; (3) developing treatment protocols; (4) coordinating the performance improvement peer

review process; (5) correcting deficiencies in trauma care or excluding from trauma call those trauma team members who do not meet criteria; and (6) coordinating the budgetary process for the trauma program. The trauma medical director will identify representatives from neurosurgery, orthopaedic surgery, emergency medicine, and other appropriate disciplines who will work with the trauma medical director to identify physicians from their disciplines who are qualified to be members of the trauma program.

THE TRAUMA TEAM

The trauma team consists of physicians, nurses, and allied health personnel. The size of the trauma team may vary with hospital size and with the severity of injury which leads to trauma team activation. A high-level response to a severely injured patient might include (1) the general surgeon, (2) the emergency physician, (3) the surgical and emergency residents, (4) the emergency department nurses, including a scribe nurse, (5) the laboratory technician, (6) the radiology technologist, (7) a critical care nurse, (8) the anesthesiologist or Certified Registered Nurse Anesthetist, (9) an operating room nurse, (10) security officers, and (11) the chaplain and/or social worker. In contrast, the trauma team response to a less severely injured patient might consist of only (1) the emergency physician and (2) the emergency department nurses. In hospitals with limited resources, trauma team members will be drawn from available physician, nursing, and allied health personnel. The team leader should be a general surgeon. In small rural hospitals, when no general surgeon is available, the leader may be a primary care physician, physician assistant, nurse practitioner, or nurse, who coordinates stabilization and transfer to definitive care.

All team members, including the on-call specialists, coordinate their interventions defined by established principles (for example, ATLS® and Appendix D: Resuscitation). The captain or team leader ensures that each phase of care flows in continuity. During the resuscitation phase, the general surgeon, emergency physician, and anesthesiologist work simultaneously. During operative care, multiple surgical specialists may work simultaneously. This close working environment facilitates correct and timely decisions, such as the decision to terminate operative intervention in a hypotensive patient with hypothermia and coagulopathy. Finally, the team leader reviews the many decisions made during efforts to salvage life and limb in order to define areas for possible improvement, working through the trauma performance improvement process.

TRAUMA SERVICE

A trauma service represents a structure of care for the injured patient. The service includes personnel and other resources necessary to ensure appropriate and efficient care delivery. The precise nature of a trauma service may vary based on specific needs of the medical facility, available personnel, and quantity of resources. In a Level I or II trauma center, all injured patients must be admitted to or seen by a designated service with identifiable trauma specialists directing the service and a cadre of residents or other health care personnel assigned solely to that service. The number of individuals required will be determined by the volume of patients requiring care. 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 injured patients. This may require 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.

PROGRAM MANAGER/TRAUMA COORDINATOR

The Trauma Program Manager (TPM or Manager) is fundamental to the development, implementation, and evaluation of the trauma program. In addition to administrative ability, qualified candidates must show evidence of educational preparation, certification, and clinical experience in care of the injured. This individual works in close collaboration with the trauma medical director, and complements the director's abilities and efforts. A constructive, mutually supportive relationship between these two key leaders is essential to the success of the program. The TPM, a full-time Registered Nurse, is responsible for the organization of services and systems necessary for a multidisciplinary approach to care of the injured. He or she will, in particular, assume day-to-day responsibility for process and performance improvement activities as they relate to nursing and ancillary personnel and assist the trauma medical director in carrying out the same functions for the doctors. Ultimate accountability for all activities of the trauma program resides with the director. The role of the TPM in the educational, clinical, research, administrative, and outreach activities of the trauma program will be determined by the needs of the trauma medical director and the institution. (Various responsibilities of TPMs are detailed in Table 1.)

Administrative and budgetary support for the TPM will depend on the size of the program. As a guideline, one

can identify the need for a full-time equivalent in support of the registry for each 500 to 1,000 admissions per year. A comparable level of secretarial and clinical nursing support helps fulfill needs for outreach, concurrent case review, and discharge planning. The registrar, secretary, and trauma nurse clinician(s) should report to the TPM.

TRAUMA COMMITTEES

Trauma Program Performance Committee

Although trauma centers may have multiple committees, a Trauma Program Performance Committee is necessary. The exact format may be hospital specific, but this committee is multidisciplinary and assesses and corrects global trauma program issues. The committee handles process, includes all program-related services, meets regularly, takes attendance, has minutes, and works to correct overall program deficiencies to continue to optimize patient care.

Trauma Multidisciplinary Peer Review Committee

Another committee activity is peer review. This committee handles peer review, which is independent from department-based peer review. Examples of relevant peer review include response times, appropriateness and timeliness of care, and evaluation of care priorities among specialties. This multidisciplinary peer review committee meets frequently (usually monthly), takes attendance, has minutes, and documents how patient care problems will be avoided in the future (loop closure). This committee functions under the aegis of the performance improvement program (see Chapter 16: Performance Improvement).

TABLE 1
THE TRAUMA PROGRAM MANAGER

Qualifications of the Trauma Program Manager (TPM)

The TPM, usually a Registered Nurse, must show evidence of educational preparation, with a minimum of 16 hours of trauma-related continuing education per year, certification, and clinical experience in care of the injured. A selection process defined by the institution's personnel policy must be delineated. Qualifications and activities should include the following:

Clinical Activities

Coordinating trauma care management across the continuum of trauma care, including planning and implementing of clinical protocols/practice management guidelines, monitoring care of in-hospital patients, and serving as a resource for clinical practice.

Education Responsibilities

Providing for interfacility and regional professional staff development, participating in case review, standardizing practice guidelines, and directing community trauma education and prevention programs.

Performance Improvement

Monitoring clinical outcomes and system issues related to quality of care delivery, developing quality filters, audits, and case reviews, identifying trends and sentinel events, and helping to outline remedial actions while maintaining confidentiality.

Administration

Managing, as appropriate, the operational, personnel, and financial aspects of the Trauma Program, serving as a liaison to administration, and representing the Trauma Program on various hospital and community committees to enhance and foster optimal trauma care management.

Supervision of the Trauma Registry

Collecting, coding, scoring, and developing processes for validation of data and designing the registry to facilitate performance improvement activities, trend reports, and research while protecting confidentiality.

Consultant/Liaison

Stabilizing the complex network of many disciplines that work in concert to provide high-quality care, serving as an internal resource for staff in all departments, and acting as an extended liaison for Emergency Medical Services agencies, the community, and the nation.

Research

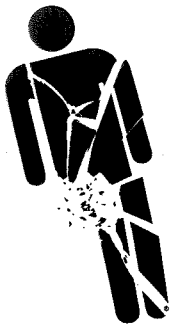
Being involved in research selection, analysis, and distribution of findings, and facilitating protocol design for accurate data collection, feedback, and analysis.

Community/National Involvement in Trauma Care Systems

Participating in the development of trauma care systems at the community, state, provincial, or national levels.

CHAPTER 6

CLINICAL FUNCTIONS: GENERAL SURGERY



The general surgeon is the foundation of a trauma hospital's trauma program. The director of the trauma service is usually a board-certified general surgeon who oversees administrative aspects of the trauma program. The general surgeon is the leader of the trauma team and is responsible for the overall care of the trauma patient, including coordinating care with other specialties and maintaining continuity of care.

TRAUMA TEAM

The team leader must be a general surgeon who is knowledgeable in all aspects of trauma care. This surgeon must provide specific care and coordinate the operation of the team. Finally, the general surgeon must interpret and reconcile the recommendations of team members and consultants to optimize patient care (see Chapter 5: Hospital Organization and the Trauma Program).

PARTICIPATION

The general surgeon serves as the captain of the resuscitating team and is expected to be in the emergency department upon arrival of the seriously injured patient. The general surgeon must coordinate all aspects of treatment, including resuscitation, operation, critical care, recuperation, and rehabilitation or discharge. The care of the patient with multisystem injuries should be under the supervision of the general surgeon. This continuity of care is especially critical in the intensive care unit, where fragmentation should be avoided.

QUALIFICATIONS

General surgeons caring for trauma patients must meet certain requirements. These requirements fall into four categories: board certification, clinical involvement, education, and regional/national commitment. Compliance with these requirements is the responsibility of the trauma director (see Chapter 5).

1. Board Certification

Basic to qualification for trauma care for any surgeon is board certification in a surgical specialty recognized by the American Board of Medical Specialties, the Advisory Board for Osteopathic Specialties, the Royal College of Physicians and Surgeons of Canada, or other appropriate foreign board. It is acknowledged that many boards require a practice period and that complete certification may take three to five years after a residency approved by the Accreditation Council for Graduate Medical Education (ACGME, the American Board of Osteopathic Specialties, or the American Osteopathic Board). If an individual has not been certified five years after successful completion of an ACGME or Canadian residency, that individual is ordinarily unacceptable for inclusion on the trauma team. Such an individual may be included when recognition by major professional organizations has been received in his or her specialty (for example, American College of Surgeons).

The board certification requirement applies to the general surgeon, orthopaedic surgeon, and neurosurgeon. These requirements also are essential for the emergency medicine physicians in Level I and II centers and desirable for those in Levels III and IV. These requirements are desirable for anesthesiologists.

In rare circumstances, a non–board-certified surgeon may be included in the trauma service. This situation may arise when the number of surgeons is limited in a community that desires to establish a verified trauma program. To assist these programs in providing optimal care to the injured patient with existing surgical resources, the following alternative to board certification is offered. This option cannot be used for the trauma director of a trauma program.

Alternate Criteria

The non–board-certified surgeon must have completed an approved surgical residency program. The surgeon must be licensed to practice medicine and approved for

surgical privileges by the hospital's credentialing committee. The surgeon must meet all criteria established by the trauma director to serve on the trauma team. The surgeon must have experience in caring for trauma patients which must be tracked by the performance improvement (PI) program. The Trauma Director must attest to this surgeon's experience and quality of patient care as a part of the recurring granting of trauma team privileges consistent with the hospital's policy. This individual is expected to meet all other qualifications for members of the trauma team.

2. Clinical Involvement

Qualified surgeons must be regularly involved in the care of injured patients. In a hospital committed to trauma care, surgeons with special expertise in trauma should be identified. Participation in the organization of trauma protocols, trauma teams, trauma call rosters, and trauma rounds are clear indicators of commitment to excellence in trauma patient care. The general surgeon participating as a non–board-certified member of the trauma team must have at least 12 months' experience tracked by the PI program.

Specific volume parameters for individual surgeons are not currently available. Each trauma surgeon should see an adequate number of patients to maintain the performance improvement standards of the program.

3. Education

The background of trauma surgeons should reflect an interest in and a commitment to trauma care. Formal trauma fellowships, training in surgery on an active trauma service, or combat experience as a surgeon constitute prime examples of such interest.

Active participation as an instructor for the American College of Surgeons ATLS® Course clearly demonstrates educational involvement in trauma. Successful completion of the ACS ATLS Course is the essential standard for all general surgeons on the trauma team. All members of the trauma team should be involved in at least 16 hours of trauma-related continuing medical education annually. Over a three-year period, one-half of these hours should be obtained outside the surgeon's own institution.

4. Regional/National Commitment

These requirements are essential for the trauma director in Levels I and II, desirable for the trauma director in Levels III and IV, and desirable for the trauma service. Participation in regional and national trauma organizations is essential for the trauma director in Level I or II trauma centers and desirable in Level III and IV facilities. The major trauma organizations in the United States and Canada presently include (1) the Committee on Trauma of the American College of Surgeons and its state/provincial committees, (2) the American Association for the Surgery of Trauma, (3) the Canadian Trauma Association, (4) the American Burn Association, and (5) trauma organizations of various surgical specialties, such as the Orthopaedic Trauma Association, the Joint Section on Neurotrauma and Critical Care of the American Association of Neurological Surgeons, and the Congress of Neurological Surgeons. The criteria governing membership in these organizations are such that active membership ordinarily signifies a position of leadership among trauma surgeons. Participation in regional groups, such as state and regional trauma committees, and membership in regional organizations, such as the Western Trauma Association or the Eastern Association for the Surgery of Trauma, identify significant involvement in and commitment to trauma-related matters.

CHAPTER 7

CLINICAL FUNCTIONS: EMERGENCY MEDICINE

Emergency medicine and emergency physicians are essential components of the trauma system and team. The trauma surgeon and the emergency physician must have a good working relationship with clearly defined areas of mutual responsibility. These responsibilities and capabilities will vary from hospital to hospital. Both the emergency physician and the 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 the injured patient is determined by many factors, some of which are commitment, experience, continuing education, ongoing credentialing, and board certification. Continuous performance improvement (PI) is an important component in maintaining this proficiency. The emergency department will conduct its own PI program. A designated emergency physician must be available to the trauma director for PI issues that occur in the emergency department. As part of the trauma program PI program, a designated emergency medicine physician must be responsible for all audits, critiques, and mortality reviews of patients who are seen in the emergency department. Similarly, the emergency medicine physicians should be included when trauma patients are reviewed by the surgical staff.

LEVELS OF CARE

The emergency departments of Level I and II centers should have a designated emergency physician director supported by an appropriate number of additional physicians to ensure immediate care for the injured patient. These physicians should be board certified and physically present in the department at all times. In those institutions where there are emergency medicine residency training programs, supervision must be provided by an in-house attending emergency physician 24 hours per day.

The initial assessment and evaluation of the severely injured patient are the responsibility of the general surgeon. The emergency physician works closely with the trauma surgeon. Performance of various diagnostic and resuscitative procedures may be shared, especially in training institutions. These responsibilities must be agreed upon and approved by the director of the trauma service. When the surgeon is not immediately available, the emergency physician assumes control until the surgeon arrives.

In some rural hospitals, emergency department coverage will vary according to the resources of the community. Ideally, a physician should be designated as the emergency department director. In smaller communities with small numbers of injured patients, physicians providing care to injured patients are recommended to have current ATLS® training. It is also suggested that these smaller hospitals establish links with larger institutions that can help support a system of trauma care in their community.

CREDENTIALING

Each hospital must have a credentialing process for the trauma program. The director of emergency medicine, along with the trauma director and as part of the PI program, will establish trauma-specific credentials that exceed those that are required for general hospital privileges. Each hospital must develop its own set of credentials. Examples of credentialing items would include skills proficiency, training requirements, conference attendance, education requirements, ATLS verification, and specialty board certification.

Continuing Education

Emergency physicians who are members of the trauma team will be expected to acquire at least 16 hours of trauma-related continuing education each year. Trauma CME credit can be obtained at regional or national meetings concerning trauma-related issues and from in-house conferences, such as grand rounds and multidisciplinary conferences. Over a three-year period, at least one-half (24 hours) should be obtained outside the physician's own institution.

ATLS®

Successful completion and current verification of ATLS status is an optimal standard for emergency medicine physicians who participate in the initial assessment and resuscitation of injured patients. All physicians providing emergency trauma care are expected to have successfully completed an ATLS Student Course (see Chapter 17). Current ATLS verification is required for all physicians who work in the emergency department and are boarded in a specialty other than emergency medicine.

QUALIFICATIONS

Physicians providing emergency medical coverage must meet certain requirements. These requirements fall into four categories: board certification, clinical involvement, education, and regional/national commitment. Compliance with these requirements is the responsibility of the trauma director and the emergency medicine director.

1. Board Certification

Basic to qualification for trauma care for any physician is board certification in a specialty recognized by the American Board of Medical Specialties, the Advisory Board for Osteopathic Specialties, the Royal College of Physicians and Surgeons of Canada, or other appropriate foreign board. It is acknowledged that many boards require a practice period and that complete certification may take three to five years after a residency approved by the Accreditation Council for Graduate Medical Education (ACGME), the American Board of Osteopathic Specialties, or the American Osteopathic Board. If an individual has not been certified five years after successful completion of an ACGME or Canadian residency, that individual is ordinarily unacceptable for inclusion on the trauma team. Such an individual may be included when recognition by major professional organizations has been received in his or her specialty (for example, American College of Emergency Physicians).

In rare circumstances, a non-boarded physician may be included to provide care to the injured patient. This situation may arise when the number of physicians is limited in a community that desires to establish a verified trauma program. To assist these programs in providing optimal care to the injured patient with existing surgical resources, the following alternative to board certification is offered.

Alternate Criteria

The non–board-certified physician must have completed an approved residency program. The physician must be licensed to practice medicine and approved for emergency medicine privileges by the hospital's credentialing committee. The physician must meet all criteria established by the trauma director and emergency medicine director. The physician must have experience in caring for trauma patients which must be tracked by the PI program. The trauma director emergency medicine director must attest to this physician's experience and quality of patient care as a part of the recurring granting of trauma team privileges consistent with the hospital's policy. This individual is expected to meet all other qualifications for members of the trauma team.

2. Clinical Involvement

Qualified physicians must be regularly involved in the care of injured patients. Participation in the organization of trauma protocols, trauma teams, trauma call rosters, and trauma rounds are clear indicators of commitment to excellence in trauma patient care. The physician participating as a non–board-certified member of the trauma team must have at least 12 months experience tracked by the PI program.

3. Education

The background of emergency medicine physicians should reflect an interest in and a commitment to trauma care. Formal trauma fellowships, training in trauma, or combat experience constitute prime examples of such interest.

4. Regional/National Commitment

National membership in the American College of Emergency Physicians and the Society for Academic Emergency Medicine is evidence of commitment. Participation in regional groups, such as state and regional trauma and emergency medicine committees, and membership in regional trauma organizations identify significant involvement in and commitment to trauma-related matters.

CHAPTER 8

CLINICAL FUNCTIONS: NEUROSURGERY

INTRODUCTION

Head injury continues to account for a disproportionate share of morbidity and mortality in the injured patient. Head injury leads to 500,000 hospitalizations per year, resulting in more than 175,000 significant disabilities and deaths.[1] The incidence of penetrating head injury (that is, gunshot wounds) is ever increasing and has become very common in some trauma centers. While the incidence of spinal cord injury is low and appears to be decreasing, the sequelae of these injuries remain devastating. The past two decades have witnessed a significant decline in overall head injury mortality, from the mid-30 percent range in the 1970s to less than 20 percent in the 1990s.[2,3] This improvement has paralleled an understanding of the secondary injury process. 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, but evolves over the ensuing hours and days. This secondary injury may be ameliorated or prevented by careful attention to the details of patient management, including avoidance of hypoxia and hypotension, rapid removal of mass lesions, and treatment of elevated intracranial pressure. These interventions should begin as soon as possible after injury. Similarly, neurosurgical intervention after acute spinal cord injury—utilizing techniques of spinal stabilization and realignment, the administration of methylprednisolone within eight hours of injury, and rapid surgical intervention for decompression when indicated—have, in combination, resulted in significant improvements in neurologic recovery after spinal cord injury.

Neurotrauma management should occur within an organized trauma system. Thus, in order to optimize outcome, the neurosurgeon should be actively involved in the management of these challenging patients with head and spinal cord injury. Neurosurgeons taking neurotrauma call should recognize and support the clinical care parameters established in the *Guidelines for the Management of Severe Head Injury* (see Appendix B).

ORGANIZATION

The active participation of neurosurgeons is crucial in the successful planning and implementation of a trauma system and individual trauma centers. The realities of neurosurgical availability must be taken into careful consideration early on in this process. Not every facility that desires trauma center verification will have sufficient manpower or resources to care for patients with neurotrauma. Neurosurgeons, either independently or through organized state societies, must realistically appraise their manpower resources and commitment so as to offer appropriate advice and input on how many trauma centers can be adequately supported by the neurosurgeons in a given community or within a specific trauma system. Neurosurgeons also must be active in setting triage criteria for head and spinal cord injury.

AVAILABILITY OF NEUROSURGEONS

Neurotrauma care should be organized and, ideally, run by a neurosurgeon who is highly experienced and devoted to the neurosurgical care of the injured patient. If this surgeon is not the director of the neurosurgery service, a neurological surgeon liaison with the same qualifications for the care of the injured should be designated. A neurosurgeon must be promptly and continuously available to provide neurotrauma care for severe head and spinal cord injury, as well as less severe head and spinal injuries, when necessary. An organized trauma system necessitates a reliable on-call schedule, with a formally arranged contingency plan in the event the capability of the neurosurgeon, hospital, or system to care for neurotrauma is overwhelmed.

A number of models may be acceptable in designing a back-up call schedule so long as performance improvement confirms optimal delivery of neurotrauma care and outcome. In trauma centers with accredited neurosurgical residency training programs, the chief neurosurgery resident may serve as the backup. In centers

without residency programs, but with sufficient numbers of neurosurgeons to provide adequate emergency call, it is necessary to have a defined back-up call schedule. In communities where neurosurgical manpower is limited, or a limited number of neurosurgeons are obligated to cover more than one hospital at a time, neurotrauma should be triaged to a single center with available neurosurgical coverage. Such a model requires considerable trauma center cooperation and coordination within the trauma system.

Within any trauma center, when 25 emergency neurosurgical trauma procedures (excluding intracranial pressure monitors) are done within 24 hours of admission per year, a published back-up call list is necessary. When fewer than 25 emergency neurosurgical trauma procedures are done, then a published back-up call list is not necessary, because the likelihood that the neurosurgeon will be unable to answer a neurosurgical consult promptly is extremely low. For example, the probability is that there would be only one patient per year who would have to wait beyond 30 minutes because the neurosurgeon is involved with emergency procedures.[4] Consequently, an identified back-up neurosurgeon is not cost effective and not mandated. Regardless, the hospital should have a predefined neurotrauma diversion plan for anytime a physician is unavailable. In trauma centers where a single neurosurgeon provides simultaneous coverage of two or more hospitals, an identified back-up neurosurgeon must be on call, or a previously defined, coordinated neurotrauma diversion plan must exist.

The contingency bypass system must be thoroughly developed, prearranged, and known to all members of the trauma team so that the care of the injured patient is not compromised by the lack of availability of a neurosurgeon.

The emergency department response for neurosurgical patient care may be met by an in-house attending neurosurgeon, a neurosurgery resident, or trauma surgeon who has been credentialed in the initial management of neurotrauma, as determined by the director of neurotrauma. When neurosurgical consultation is requested, an attending neurosurgeon must be promptly available to that hospital's trauma service in Level I and II trauma centers.

Level III and IV trauma centers will generally have limited or no neurosurgical coverage. Where there is no neurosurgical coverage, the trauma director will determine if any type or severity of neurologic injury will remain at the facility. If the facility does treat neurotrauma, then a performance improvement program must convincingly demonstrate appropriate care. In any case, clear transfer agreements must exist with appropriate Level I and II centers. On rare occasions due to unavoidable delay in transfer of the patient, the limited neurosurgical procedure of burr holes might be lifesaving; however, this procedure should be undertaken by a non-neurosurgeon only after appropriate training by neurosurgeons.

SPECIFIC QUALIFICATIONS FOR NEUROSURGEONS

1. Board Certification

Basic to qualification for trauma care for any surgeon is board certification in a surgical specialty recognized by the American Board of Medical Specialties, a Canadian board, or other equivalent foreign board. Examples for neurosurgeons include the American Board of Neurosurgery and the Royal College of Physicians and Surgeons of Canada. It is acknowledged that many boards require a practice period and that complete certification may take a number of years after a residency approved by the Accreditation Council for Graduate Medical Education (ACGME). If a neurosurgeon has not been certified within a reasonable time frame after successful completion of an ACGME or Canadian residency, that individual is ordinarily unacceptable for inclusion on the trauma team. Such an individual may be included when recognition by major professional organizations has been received in his or her specialty (for example, American College of Surgeons).

In rare circumstances, a non–board-certified neurosurgeon may be included in the trauma service. This situation may arise when the number of neurosurgeons is limited in a community that desires to establish a verified trauma program. To assist these programs in providing optimal care to the injured patient with existing surgical resources, the following alternative to board certification is offered. This option cannot be used for the trauma director of a trauma program.

Alternate Criteria

The non–board-certified surgeon must have completed an approved surgical residency program. The surgeon must be licensed to practice medicine and approved for surgical privileges by the hospital's credentialing committee. The surgeon must meet all criteria established by the trauma director to serve on the trauma team. The surgeon must have experience in caring for trauma patients which must be tracked by the performance improvement program. The Trauma Director and neurosurgical trauma liaison must attest to this surgeon's experience and quality of patient care as a part of the recurring granting of trauma team privileges consistent with the hospital's policy. This individual is expected to meet all other qualifications for members of the trauma team.

2. Clinical Involvement

Qualified neurosurgeons must be regularly involved in the care of head- and spinal cord-injured patients. 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, and trauma rounds are clear indicators of commitment to excellence in trauma patient care. The non–board-certified neurosurgeon on the trauma team must have at least 12 months' experience tracked by the performance improvement program before verification can be considered.

3. Education

The background of neurosurgeons should reflect an interest in and a commitment to trauma care. Formal trauma fellowships, residency training on an active trauma service, or combat experience as a surgeon constitute prime examples of such interest. Active participation as an instructor for the American College of Surgeons ATLS® Course clearly demonstrates educational involvement in trauma. At a minimum, neurosurgeons on the trauma team should be encouraged to successfully complete an ATLS Student Course. Neurosurgical members of the trauma team at Level I and II centers must be involved in at least 16 hours of trauma-related continuing medical education annually. Over a three-year period, one-half of these hours should be obtained outside the surgeon's own institution.

4. Regional/National Commitment

The major trauma organizations in the United States and Canada include (1) the Committee on Trauma of the American College of Surgeons and its state/provincial committees, (2) the American Association for the Surgery of Trauma, (3) the Canadian Trauma Association, (4) the American Burn Association, and (5) trauma organizations of various surgical specialties, such as the Orthopaedic Trauma Association, the Joint Section on Neurotrauma and Critical Care of the American Association of Neurological Surgeons, and the Congress of Neurological Surgeons. The criteria governing membership in these organizations are such that active membership ordinarily signifies a position of leadership among surgeons involved in the care of injured. Participation in regional groups, such as state and regional trauma committees, and membership in regional organizations, such as the Western Trauma Association or the Eastern Association for the Surgery of Trauma, identify significant involvement in and commitment to trauma-related matters.

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CHAPTER 9

CLINICAL FUNCTIONS: ORTHOPAEDIC SURGERY

More than half of all hospitalized trauma patients will 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 under the age of 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 this age group, generating $1.2 billion in hospital costs.[1] The majority of these patients are male blue collar workers who are motivated to perform well at their jobs.[2]

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) 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 has the potential to decrease inflammatory mediator production, catecholamine release, analgesic requirements, morbidity rate, and hospital costs.[3] However, patients must be categorized as to their physiologic insult and anatomic injuries and their response to resuscitation in order to plan the appropriate fracture management. For example, a patient with an unstable pelvic fracture with significant bleeding and potential intraabdominal hemorrhage requires rapid consultation among many specialty services. The team must decide the priority of laparotomy, angiography, spinal, and/or pelvic 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 injury. Physical, mental, and vocational rehabilitation will maximize both functional and psychologic outcome.

MUSCULOSKELETAL TRAUMA PATIENT TYPES

Patients with musculoskeletal injury can be classified into three distinct types that will affect resource utilization.

The first type is a patient with an isolated closed musculoskeletal injury unassociated with any other fracture or injury potential. The acute injury assessment is appropriately performed by an emergency department physician with timely referral to an orthopaedic surgical specialist. Surgical intervention is determined on an elective basis. Trauma team involvement is optional.

The second type comprises individuals who have multiple fractures of major long bones and joints or significant injury potential. Because of the potential for missed life-threatening injuries, **they do require assessment by the trauma team.** After resuscitation and the exclusion of other potential injuries, there should be no contraindication to proceeding with early aggressive fracture stabilization.

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

ORTHOPAEDIC SURGICAL TEAM MEMBER(S)

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 of all axial and appendicular musculoskeletal injuries so that the overall goals of patient care are not forgotten.

Minimal qualifications for the orthopaedic surgeon who participates as a member of the trauma team and is on call at a Level I or II trauma center are described at the end of this chapter. These requirements are similar to those established for the emergency medicine physician, general surgeon, and neurosurgeon.

ALLIED TEAM MEMBERS

Optimal musculoskeletal management requires that the orthopaedic surgeon be helped 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 X-ray technologists and operating room staff are important to the smooth running of an efficient musculoskeletal trauma system. Physical and occupational therapists and rehabilitation specialists trained in the management of acute musculoskeletal trauma problems and the rehabilitation phase are essential at Level I and II trauma centers. Social workers and discharge planners facilitate the transition of care from the acute care setting to home or the definitive recovery environment.

FACILITIES

Modern operative musculoskeletal injury care depends upon the coordination of two synergistic resources: (1) a well-trained staff and (2) a well-equipped hospital and operating room. Operating rooms must be continuously available to allow for emergency operations on musculoskeletal injuries. However, the majority of fracture care can be done on a semiurgent or elective basis. Provision for elective and semielective surgical treatment of musculoskeletal injuries that do not require acute care in the off-hours is necessary.

A functional orthopaedic surgical 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 delay and not at inappropriate hours that might conflict with more emergent surgery or other elective procedures. This is necessary to avoid inappropriate delays in patient care. Unique solutions to this scheduling problem must be sought in each trauma center. These solutions need to be monitored to determine effective usage of time.

MUSCULOSKELETAL TRAUMA CARE IN TRAUMA CENTERS

All Levels

The orthopaedic surgeon assigned to provide scheduled coverage for trauma patients must qualify for membership on the trauma service. The surgeon must participate in service-related activities, especially those related to performance improvement and to the development of institutional protocols for systematic evaluation and management of common injuries. A minimum on-call experience should maintain the skills of the orthopaedic surgeon in both evaluation and management.

Level I

The care of musculoskeletal trauma at a Level I trauma center should be organized, and, ideally, run by a director who is highly experienced and devoted to the orthopaedic care of the injured patient. If this surgeon is not the director of the orthopaedic service, a liaison orthopaedic surgeon with the same qualifications for the care of the injured should be designated. The need for more specialty-trained surgeons will depend on the volume and priorities of the service. Plastic surgery, hand surgery, and spinal injury teams are required at a Level I trauma center. Orthopaedic team members will have dedicated call at their institution. They must be promptly available in the trauma resuscitation area when consulted by the attending surgical trauma team leader for multiply-injured patients. A PGY 4,5 level orthopaedic resident or orthopaedic fellow may act as a temporary consultant as long as this is acceptable to the attending surgical trauma team leader. If the on-call orthopaedic surgeon is unable to respond promptly, a back-up call should be available. The design of this system will be the responsibility of the orthopaedic trauma liaison, but must be approved by the trauma program director. Compliance with these requirements will be monitored by the hospital's trauma performance improvement (PI) program.

Level II

Within a Level II trauma center there must be a musculoskeletal component of the trauma program designated for the management of complex skeletal injuries, multiple fracture patients, and multiply-injured patients with fractures. The designation of which patients will

be the responsibility of the orthopaedic service will be at the discretion of the director of the trauma program and its orthopaedic representative. These centers must provide all of the necessary resources, including instruments, equipment, and personnel for modern musculoskeletal trauma care, with readily available operating rooms for musculoskeletal trauma procedures. The services of the related specialists such as plastic surgeons and a spinal injury service should be available, and, if not available, transfer agreements with a Level I trauma center must be established.

Ideally, the individual is on-call at only one institution and must be promptly available. If the orthopaedic surgeon is unable to comply with this requirement, a back-up call system must be in place.

Level III

Level III facilities will vary significantly in the staff and resources that they can commit to musculoskeletal trauma care. A Level III facility with a orthopaedic surgeon can provide basic immediate musculoskeletal care. Management of major long bone fractures and articular fractures 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 agreements with higher-level institutions.

PERFORMANCE IMPROVEMENT

The orthopaedic service must participate actively with the overall trauma PI program as directed by the trauma program. As well, the musculoskeletal trauma program must review their own cases and develop ongoing filters to assess their care. Prospective reviews of identifiable problems must be developed at all levels of care. Reports must be submitted to the trauma program's PI director for review (see Chapter 16: Performance Improvement).

REHABILITATION

The rehabilitation goal is to return an injured individual to society with the maximum function consistent with his or her injuries. This is 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 the individual needs and should be supervised by the surgeon who is 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 that 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.

SPECIFIC QUALIFICATIONS FOR ORTHOPAEDIC SURGEONS

1. Board Certification

Basic to qualification for trauma care for any surgeon is board certification in a surgical specialty recognized by the American Board of Medical Specialties, a Canadian board, or other equivalent foreign board. Examples for orthopaedic specialists include American Board of Orthopaedic Surgery, American Board of Osteopathy, or the Royal College of Physicians and Surgeons of Canada. It is acknowledged that many boards require a practice period and that complete certification may take three to five years after a residency approved by the Accreditation Council for Graduate Medical Education (ACGME). If an individual has not been certified five years after successful completion of an ACGME or Canadian residency, that individual is ordinarily unacceptable for inclusion on the trauma team. Such an individual may be included when recognition by major professional organizations has been received in his or her specialty (for example, American College of Surgeons).

In rare circumstances, a non–board-certified orthopaedic surgeon may be included in the trauma service. This situation may arise when the number of orthopaedic surgeons is limited in a community that desires to establish a verified trauma program. To assist these programs in providing optimal care to the injured patient with existing surgical resources, the following alternative to board certification is offered. This option cannot be used for the trauma director of a trauma program.

Alternate Criteria

The non–board-certified surgeon must have completed an approved surgical residency program. The surgeon must be licensed to practice medicine and approved for surgical privileges by the hospital's credentialing committee. The surgeon must meet all criteria established by the trauma director to serve on the trauma team. The surgeon must have experience in caring for trauma patients which must be tracked by the quality improvement program. The Trauma Director and the orthopaedic trauma liaison must attest to this surgeon's experience and quality of patient care as a part of the recurring granting of trauma team privileges consistent with the hospital's policy. This individual is

expected to meet all other qualifications for members of the trauma team.

2. Clinical Involvement

Qualified orthopaedic surgeons must be regularly involved in the care of injured patients. In a hospital committed to trauma care, orthopaedic surgeons with special expertise in trauma should be identified. Participation in the organization of trauma protocols, trauma teams, trauma call rosters, and trauma rounds are clear indicators of commitment to excellence in trauma patient care. The non–board-certified orthopaedic surgeon on the trauma team must have at least 12 months' experience tracked by the PI program before verification can be considered.

3. Education

The background of orthopaedic surgeons should reflect an interest in and a commitment to trauma care. Formal trauma fellowships, training in surgery on an active trauma service, or combat experience as a surgeon constitute prime examples of such interest. Active participation as an instructor for the American College of Surgeons ATLS® Course clearly demonstrates educational involvement in trauma. At a minimum, orthopaedic surgeons on the trauma team should be encouraged to successfully complete an ATLS Student Course. Orthopaedic surgical members of the trauma team at Level I and II centers must be involved in at least 16 hours of trauma-related CME annually. Over a three-year period, one-half of these hours should be obtained outside the surgeon's own institution.

4. Regional/National Commitment

The major trauma organizations in the United States and Canada include (1) the Committee on Trauma of the American College of Surgeons and its state/provincial committees, (2) the American Association for the Surgery of Trauma, (3) the Canadian Trauma Association, (4) the American Burn Association, and (5) trauma organizations of various surgical specialties, such as the Orthopaedic Trauma Association, and the Section on Neurotrauma and Critical Care of the American Association of Neurological Surgeons, and the Congress of Neurological Surgeons. The criteria governing membership in these organizations are such that active membership ordinarily signifies a position of leadership among surgeons involved in the care of injured. Participation in regional groups, such as state and regional trauma committees, and membership in regional organizations, such as the Western Trauma Association or the Eastern Association for the Surgery of Trauma, identify significant involvement in and commitment to trauma-related matters.

(This chapter has been approved by the Orthopaedic Trauma Association.)

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CHAPTER 10

PEDIATRIC TRAUMA CARE

INTRODUCTION

More children die from injury than from all other causes combined. For the injured who survive, severe disability may be a lifelong problem, as functional impairment may stretch into decades of institutional or custodial care. The societal impact of intentional and unintentional injury is staggering; however, the effect of pediatric injury in terms of lost human potential, cost to society, and impact on families is especially overwhelming.

Effective care of the injured child requires an inclusive approach which recognizes injury as a major pediatric health problem, identifies effective strategies for prevention, improves systems of emergency care for children, and provides the most appropriate care available. Injured children require special resources which should be available at any trauma center that is dedicated to the care of the injured child. Trauma systems must consider the unique needs of injured children.

EPIDEMIOLOGIC CONSIDERATIONS

Regardless of age, injured children are still most commonly killed or disabled by central nervous system injury. Age-related patterns of injury are identifiable. The pediatric population can be divided into three distinct groups. The differences between age groups serve to highlight the unique nature of injuries seen in the pediatric population.

Infants, toddlers, and preschoolers (birth to 5 years) are at greatest risk from falls and sustain the highest proportion of isolated closed-head injuries.

Children between 6 and 12 years of age are most commonly victims of vehicular trauma as pedestrians, bicyclists, or unrestrained passengers.

Adolescents engage in many risk-taking activities. These patients require care plans which combine the psychologic requirements of a child with the physical needs of an adult.

HOSPITAL RESOURCES

The hospital resources for trauma centers are described in Chapter 2. The injured pediatric patient has special needs that may be optimally provided in the environment of a children's hospital with a demonstrated commitment to trauma care. Yet, because of the limited number and geographic distribution of children's hospitals, all injured pediatric patients cannot be cared for in these institutions, therefore, other institutions must be available to provide this resource to the community and system of trauma care.

Adult Hospital

While the capability and mission of these hospitals may vary, the following components must be present in any verified trauma center that cares for injured children (see Table 1). There must be a surgeon who is interested, knowledgeable, and willing to provide appropriate care to the injured pediatric patient. This must be confirmed through the trauma program's performance improvement activities. Six hours of continuing medical education in pediatric trauma per year by each surgeon credentialed to care for injured children are necessary. The institution must have a designated, identifiable emergency department area specifically equipped for children, with appropriately trained staff. Special equipment necessary for resuscitation, operation, and postoperative care of infants and children must be immediately available to every hospital unit providing care. The laboratory must be capable of using microsampling techniques. There must be a dedicated area to care for children. Pediatric intensive care units with appropriately trained surgical and pediatric specialists must be available for the critically injured child, or arrangements must be made for transfer of these individuals to an institution with this resource. The performance improvement program must evaluate, assess, and benchmark specific parameters for the pediatric patient. Additionally, any trauma center that does not admit children must still be capable of initiating resuscitation of the injured child and must have the

capability to stabilize or transport the most severely injured children.

Children's Hospital

Children's hospitals may take a leadership role in the care of the injured child. Children's hospitals that are trauma centers must interact effectively with all hospitals providing care for severely and minimally injured children. These institutions must establish working relationships with other hospitals that provide pediatric care. A children's hospital can be either a free-standing institution or a separate administrative unit within a larger hospital organization. The main characteristic required is dedicated resources to provide for the needs of a pediatric patient population.

Children's hospitals that pursue verification as trauma centers must meet the resource requirements outlined in Chapter 2, except for the volume criteria for admissions and severity of injury. A pediatric trauma center should have a sufficient volume of institutional experience with severe pediatric injuries to maintain the clinical skills of trauma team members. Physicians providing care will primarily be providing care to a pediatric patient population. A dedicated group of individuals for the injured child must be readily available similar to an institution that provides care to an adult population. Level I centers will usually be located in large metropolitan areas and will have the lead role in the care of the injured child within their trauma system. When a Level I center is not present, a level II center would be expected to play a lead role in system development. When a children's hospital is not present, this role must be fulfilled by other trauma centers. In these cases, the minimal requirements, previously noted, to provide care to the injured child must be present.

PARTICIPATION

Regardless of type of hospital or designation, surgeons well trained in the care of critically injured children are required for optimal care. The relative scarcity of pediatric surgeons committed to trauma care frequently requires surgeons who care for injured adults to also care for children. Trauma centers must provide the appropriate training, personnel, and equipment necessary to care for the injured child. Care of critically injured children is not the exclusive domain of any single specialist. A multispecialty team, led by a surgeon skilled in care of the injured child, will provide optimal results. In addition to the surgeon, other pediatric and medical specialists may be needed.

A board-certified surgeon must be identified as the trauma medical director in any verified trauma center (Chapters 5 and 6). Assuming this leadership role implies a demonstrated commitment to maintaining the appropriate skills necessary to ensure the optimal care of the injured child. In a children's hospital, this individual must be board-certified in Pediatric Surgery.

PERFORMANCE IMPROVEMENT

Regardless of type of hospital or designation, system performance for pediatric patients must be measured by analysis of at least mortality, morbidity, and functional status (Chapter 16). Pediatric process and outcome measures that encompass prehospital, hospital, and posthospital care must be concurrently tracked and periodically reviewed (Table 2). This review may include comparison and benchmarking of local trauma center data with national pediatric trauma data from large registries, such as the National Pediatric Trauma Registry and National Trauma Data Bank™. Child safety and injury prevention programs (Chapter 18),

TABLE 1
ADDITIONAL REQUIREMENTS FOR ALL ADULT TRAUMA CENTERS CARING FOR INJURED CHILDREN

Requirements	Level I	Level II	Level III	Level IV
Trauma surgeons credentialed for pediatric trauma care	E	E	D	—
6 hours of pediatric CME per year per surgeon	E	E	D	—
Pediatric emergency department area	E	E	D	—
Pediatric resuscitation equipment in all patient care areas	E	E	E	E
Microsampling	E	E	E	—
Pediatric-specific performance improvement program	E	E	E	E
Pediatric intensive care unit	E*	E†	—	—

E=Essential; D=desirable.

*The PICU must be available onsite.
†This criteria may be satisfied by a transfer agreement.

TABLE 2
EXAMPLES OF PEDIATRIC PROCESS AND OUTCOME MEASURES

	Definition	Purpose
Resuscitation volumes	Infusion of more than 50 mL/kg in first two hours in 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 five minutes to accomplish, especially if intraosseous infusion is not employed.	This is an objective measure of preparation and facility in accomplishment of a critical, size-related component of pediatric resuscitation.
Missed intubation	More than one attempt to place endotracheal tube appropriately.	Efficiency of airway care is the defining variable in outcome for the severely injured child. Who, when, what, and how many attempts were required for successful control of the airway are objective measures of system performance.
Hypo/Hypercapnia	Over- or underventilation, especially in the first 12 hours after injury.	This is a reflection of efficacy and precision of care in the critical first 12 hours after initial stabilization.
Extubation within 24 hours of rapid sequence intubation (excluding operative procedures)	This is self-evident.	This is the objective monitor of appropriateness of use of what is an intrinsically dangerous process. Patients who can be extubated within 24 hours may not have required chemical paralysis and intubation in the first place.
Nosocomial pneumonia	"Pneumonia," as defined in Chapter 16.	This is a major cause of avoidable morbidity and cost. It is especially important in children without evidence of pulmonary injury or aspiration.
Missed Injury	Any lesion related to initial traumatic event diagnosed 24 hours after admission.	This is an objective measure of the specificity and accuracy of initial assessment.

which are usually coordinated with community or governmental activities, can enhance the performance improvement effort.

REGIONAL CARE OF THE INJURED CHILD: PATIENT TRIAGE AND TRANSFER

The triage criteria discussed in Chapter 4 are designed to identify those patients at greatest risk for death or disability who should be considered for expeditious transfer to Level I or II trauma centers. The Pediatric Trauma Score or Revised Trauma Score are additional adjuncts to clinical assessment of the injured child. Repeated evaluations of an injured child identify patients who warrant expeditious transfer and/or operation. Referral to these centers must be protocol driven and continuously monitored by the performance improvement process. Access to such care must be expeditious and must reflect *only* medical need.

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CHAPTER 11

COLLABORATIVE CLINICAL SERVICES

Injured patients may need care by specialists in addition to the general surgeon, emergency physician, orthopaedic surgeon, or neurosurgeon. A trauma center's effectiveness is enhanced by the commitment of these additional personnel. These specialists must be promptly available and qualified in their areas of expertise.

ANESTHESIOLOGY

Anesthesiology services are critical in the management of the severely injured patient and must be promptly available for emergency operations and for airway problems. While anesthesia services may be primarily based in the operating room, the responsibilities of anesthesiology may extend beyond the operating room. Examples include establishing airway control, assisting with resuscitation, providing pre- and postoperative cardiorespiratory support, and assisting with pain control.

Levels I and II

The care of the injured patient who requires anesthesia in a Level I trauma center should be organized and, ideally, run by an anesthesiologist who is highly experienced and devoted to the care of the injured. If this anesthesiologist is not the director of the anesthesia service, an anesthesiologist liaison with the same qualifications for the care of the injured should be designated. The anesthesia services in Level I and II trauma centers must be available in-house 24 hours a day. Anesthesia requirements may be fulfilled by anesthesiology chief residents or Certified Registered Nurse Anesthetists (CRNAs) who are capable of assessing emergent situations in trauma patients and of providing any indicated treatment, including initiation of surgical anesthesia. When anesthesiology chief residents or CRNAs are used to fulfill availability requirements, the staff anesthesiologist on call will be advised, promptly available at all times, and present for all operations. The availability of the anesthesia services and the absence of delays in airway control or operative anesthesia must be documented by the hospital performance improvement process.

Level III

In Level III hospitals without in-house anesthesia services, anesthesiologists or CRNAs must be promptly available. Under these circumstances, local criteria must be established to allow the anesthesiologist to take call from outside the hospital, but with clear commitment that an anesthesiologist will be immediately available for airway and operative management. These circumstances require a documented presence of physicians skilled in emergency airway management. In Level III facilities, anesthesia coverage may also be provided by a CRNA under physician supervision. The availability of the anesthesia services and the absence of delays in airway control or operative anesthesia must be documented by the hospital performance improvement process.

Qualifications

In Level I and II centers, all anesthesiologists taking call must have successfully completed an anesthesia residency program approved by the Accreditation Council for Graduate Medical Education, the American Board of Osteopathic Specialties, or the American Osteopathic Board and should have board certification in anesthesia. Furthermore, in Level I facilities, at least one anesthesiologist should put forth a specific effort and a commitment to education in trauma-related anesthesia and educate other anesthesiologists and the entire trauma team. In all trauma centers, participation in the trauma performance improvement (PI) program process by anesthesia is essential.

RADIOLOGY

Radiology services are critical in the management of the severely injured patient. Staff radiologists must be promptly available, when requested, for the interpretation of radiographs, performance of complex imaging

studies, or interventional procedures. The staff radiologist must ensure that the preliminary interpretation of studies is reviewed and that a final interpretation is promptly reported to the trauma team. Changes in interpretation must be monitored through the PI program.

The trauma and radiology PI program should address and monitor issues common to the use of radiology services in trauma centers. Each trauma program needs collaboration with the radiology representative, and the most appropriate process and outcome measures for this ongoing PI monitoring should be determined. These can include, but are not limited to, the frequency and type of missed, incorrect, or delayed diagnoses; the recommendation of nonessential diagnostic radiology tests; the complications related to interventional procedures; and delays in acquisition of critical imaging procedures on severely injured patients. The PI process must ensure that trauma patients are accompanied by appropriately trained providers and that appropriate resuscitation and monitoring are provided during transportation to and while in the radiology department.

CRITICAL CARE

The trauma service assumes and maintains responsibility for the care of the multiply-injured patient. The surgeon in charge must remain in that role even if the patient requires admission to an Intensive Care Unit (ICU). In most cases, the responsible physician will be a general surgeon.

ICU Organization

In a Level I center, a surgically directed ICU physician team is essential. This team will provide in-house physician coverage for all ICU trauma patients at all times. This service can be staffed by appropriately trained physicians from different specialties, but must be led by a qualified surgeon as determined by critical care credentials consistent with the medical staff privileging process of the institution.

In a Level II center, a surgeon must at least have an administrative role in the ICU structure. An ICU team is not essential; however, arrangements for 24-hour coverage of all trauma patients are necessary for emergencies and routine care.

Surgical Director

All levels of trauma centers—Levels I, II, and III—must have a surgical director for the ICU who is responsible for setting policies and administration related to trauma ICU patients. In a Level I facility, the surgical director must have obtained critical care training during residency or fellowship and must have expertise in the perioperative and postinjury care of the injured patient. This expertise would be best demonstrated by a certificate of added qualification in surgical critical care from the American Board of Surgery and may also be fulfilled by documentation of active participation during the preceding 12 months in trauma patients' ICU care and ICU administration and critical care-related continuing medical education. In a Level II facility, requirements may be fulfilled by documentation of active participation during the preceding 12 months in ICU administration and trauma PI activities, by direct involvement in the ICU trauma PI activities, and by direct involvement in the ICU care of trauma patients. In a Level III facility, the surgical director must be a surgeon who is credentialed to care for ICU patients and who participates in the trauma PI process.

Physician Responsibility

The trauma service that assumes initial responsibility for the care of an injured patient should maintain that responsibility as long as the patient remains critically ill. The surgeon in charge must remain in that role even if the patient requires admission to an ICU. In a Level I trauma center, the trauma service must remain in charge of the patient and coordinate all therapeutic decisions. All orders should be written by the responsible trauma surgeon or designee. The trauma surgeon should maintain control over all aspects of patient care, including respiratory care and management of mechanical ventilation; placement and use of pulmonary catheters; and management of fluids, electrolytes, antimicrobials, and enteral and parenteral nutrition.

The trauma surgeon in Level II trauma centers must also remain in control of the surgical aspects of patient care, although it is appropriate to seek consultation from an intensivist for complicated or long-term management of the patient and to secure in-house coverage.

In addition to overall responsibility for patient care by the patient's own surgeon, the patients in Level I facilities must have in-house physician coverage for intensive care at all times. This coverage may be provided by the patient's primary service or by a physician who is credentialed in critical care by the hospital and surgical director of the ICU. This 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 will be met while the primary surgeon is being contacted. Furthermore, provision of this coverage must not leave the

emergency department without appropriate physician coverage.

PRIMARY CARE PHYSICIAN/PEDIATRICIANS

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

When a committed general surgeon has assumed responsibility for the trauma program in a Level III hospital, he or she should be aware of the family physician with an interest in trauma as a potentially valuable resource. Depending on the local circumstances, a family physician may serve as a member of the trauma team or the trauma committee or as a surgical assistant for emergencies or may simply provide continuity of care and a liaison with the family. No trauma patient should be admitted or transferred by the primary care physician without the knowledge and consent of the trauma service.

OTHER SURGICAL SPECIALISTS

Many surgical specialists may be needed to properly serve the trauma patient. Level I facilities will be prepared to manage the most complex trauma patients and must have available a full spectrum of specialists (see Chapter 23). Level II centers may not have the local resources to have cardiac surgery, hand surgery, and microvascular surgery, but Level II centers should be expected to have specialists as described in Chapter 23. Surgical specialists who treat trauma patients should be board-certified in their specialty.

MEDICAL CONSULTANTS

The complexity of the management of many seriously injured patients may require support from medical specialists. However, surgeons should not relinquish the overall responsibility for patient care. In a Level I trauma center, medical specialists should include cardiology, infectious disease, nutrition support, pulmonary medicine and nephrology, and their respective support teams (for example, respiratory therapy and dialysis team). In a Level II facility, specialists from internal medicine and pulmonary medicine must be available. In a Level III facility, internal medicine specialists must be available.

CHAPTER 12 REHABILITATION

The advent of specialized trauma centers in conjunction with emergency medical systems has increased the survival of trauma patients.[1] Patients who formerly would have died are now surviving to return to society. Rehabilitation of these patients requires a cooperative approach among many disciplines.[2]

The rehabilitation of the injured patient should begin during the first hospital day. The acute care of the patient 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 is also less costly. When rehabilitation results in independent patient function, there is a 90% cost saving when compared with costs for custodial care and repeated hospitalizations.[1]

REHABILITATION TEAM

Rehabilitation requires input from an organized multidisciplinary team. One measure of the trauma program is functional outcome of patients undergoing rehabilitation. Assessments should be made in self-care activities, such as eating, grooming, bathing, upper body dressing, lower body dressing, and toileting. Sphincter control should be assessed for the ability to manage bladder and bowel functions. Transfers should be assessed for bed, chair, and wheelchair; toilet; and tub or shower. For locomotion, patients should be evaluated for their ability to walk or use a wheelchair and for the ability to use stairs. In the area of communication, patients can be assessed for their abilities in both comprehension and expression. It is helpful in the social/cognitive realm to assess for social interaction, problem-solving, and memory. When rating patient function, it is useful to employ a scale for rating patients in each of the forementioned areas. Specifically, patients may be rated as independent, modified independent (use of a device), supervision required, minimal assistance (subject does 75% or more of task), moderate assistance (subject does 50% or more), maximal assistance (subject does 25% or more), or total assistance (subject does less than 25%). Additional measures of outcome may include return to preinjury vocational effort and discharge disposition.

Leadership of the rehabilitation team is most often assumed by a physician with a special interest and training in physical medicine and rehabilitation. However, this does not proscribe physicians in the disciplines of general surgery, neurosurgery, or orthopaedics from a leadership role, providing they have the level of skill, training, and dedication to perform such 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, as far as possible, the potential for rehabilitation benefit. Rehabilitation requires a major commitment by the patient and program to be successful. It is appropriate to make plans early to determine the needs for specific components of therapy. Rehabilitation of all functional deficits is not always simultaneous. As an example, the orthopaedic rehabilitation may necessarily precede the neurologic rehabilitation. Neurologic injuries should not preclude the therapy of other body systems. Physical therapy is provided at the bedside well in advance of return of significant neurologic function in order to minimize the complications of prolonged immobilization. The use of such devices as continuous passive motion machines may be helpful in some orthopaedic injuries, but for general range of motion, physical therapy is much more practical.

ADDITIONAL NEEDS

Nutritional evaluation and therapy is an adjunct to a good rehabilitation program. Minimizing weight loss assists patients to recover from injuries.

A pain service is a valuable part of the rehabilitation team. Patients with such posttraumatic sequelae as reflex sympathetic dystrophy, phantom pain, and

chronic limb spasticity following spinal cord injury will all benefit.

The disciplines of psychology and psychiatry are important to the rehabilitation team. The patient's emotional and psychologic status is vitally important as a determinant of the potential for rehabilitation.

The importance of family support of the injured patient undergoing rehabilitation is essential. Provisions should be made to allow the family to participate in the rehabilitation process. This is particularly important since many of the techniques used during the acute rehabilitation will be continued when the patient returns home.

SPECIFIC REHABILITATION PROGRAMS

Neurologic rehabilitation will require the input and management by physiatrists (physical medicine), neurosurgeons, neurologists, orthopaedic surgeons, speech therapists, psychologists, or psychiatrists. Vocational counseling may assist patients to return to the work force in a functional capacity. Therapeutic recreation assists in the patient's community reintegration, such as access to transportation and shopping.

Musculoskeletal injuries are among the most common forms of trauma and are the predominant cause of work disability.[1] Orthopaedic rehabilitation requires at least the presence of the following services: occupational therapy, physical therapy, and prosthetics and orthotics.

Specific facilities and organizations must be tailored to the pediatric population. A concerted effort must be made to allow the patient to continue school work, even though confined to hospital or home. The concept of teachers for homebound patients is a very valuable adjunct.

HOSPITAL FACILITY

The rehabilitation services can be available within the hospital's physical facilities or as a free-standing rehabilitation hospital where patients receive rehabilitation services according to existing contractual arrangements.

The rehabilitation unit should also be concerned with the prevention of injuries and participate in the prevention programs of the trauma center. The team should contribute to those efforts on behalf of the trauma unit to minimize the incidence of motor vehicle crashes, interpersonal violence, and trauma occurring in the work place.

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CHAPTER 13

RURAL TRAUMA CARE

Rural trauma occurs in areas where geography, population density, weather, distance, or availability of professional or institutional resources combine to isolate the trauma victim in an environment where access to definitive care is limited.

Trauma remains a major problem for the rural population. The most common mechanism of injury in the rural area is blunt force. Although only 25% of all motor vehicle crashes occur in rural areas,[1] these account for two-thirds of all motor vehicle crash deaths.[2,3] The three occupations with the highest mortality and disability rates (farming, lumbering, and mining) are commonly located in rural areas.[3,4] Individuals in the back country, through either work or recreation, often sustain severe injuries and may require complex and prolonged search and rescue efforts before they receive any care. For any given injury severity, the chances of dying in the rural environment are greater than in the urban setting. A longer time to definitive care results in greater death and disability. A larger proportion of deaths occur at the scene in the rural than in the urban setting.[5]

The basic principles of trauma care are the same in rural and urban areas. The problems encountered in the rural area that are different from those in the urban environment include delays in discovery, long transport times, and limited resources. All result in a delay in definitive care. Potential solutions must be based on the available resources.

The Committee on Trauma has developed criteria for rural trauma facilities. This categorization provides for the inclusion of all rural facilities in the system. Every facility, regardless of size or available resources, must participate in the care of the injured patient, because in rural areas, the patient will be taken to the nearest hospital or rural clinic first. A rural facility cannot refuse to accept such patients.

PREHOSPITAL

Rural problems begin in the prehospital setting. A marked delay may occur between injury and discovery of the victim, because the injury is frequently unwitnessed and often occurs in a remote area. The lack of a 911 system or any well-known emergency number in many areas adds further delay. Rural Emergency Medical Services (EMS) communications are often inadequate due to antiquated equipment, overcrowded frequencies, and radio dead spots. Limited financial resources often result in equipment shortages. Personnel shortages are also common. Most rural EMS personnel are volunteers with basic life support (BLS) skills. Educational and training opportunities are limited. Medical direction is often sporadic and inconsistent. Prehospital personnel do not see these patients frequently enough to be proficient in their care. EMS response is further hindered by long distances, inclement weather, and inaccessible locations, resulting in prolonged response and transport times. All of these factors may result in patients presenting for initial care with a level of physiologic deterioration disproportionate to the apparent severity of injury.

Innovative educational programs and technology, as well as basic education programs such as Prehospital Trauma Life Support (PHTLS) and Basic Trauma Life Support (BTLS), are needed for the prehospital providers to help them develop and maintain their skills to better meet the needs of the rural trauma patient. Training EMTs in more advanced skills, such as insertion of intravenous lines and endotracheal intubation, would enable them to provide a higher level of care to the severely injured patient, especially in the more remote areas. Upgrading and maintenance of skills has been assisted in some states with mobile EMS trauma training units.

Inconsistent medical direction of prehospital care may also hamper effective trauma care in the rural setting. Online medical direction is usually not feasible. Treatment and triage protocols, either regional or statewide, should be utilized to standardize the care of the rural EMT and to effect rendezvous with Advanced Life Support (ALS) or critical care transport teams facilitating early transfer to a trauma center. Regional protocols smoothly integrates prehospital care into the rural trauma system. A regional or state medical director could facilitate this need.

HOSPITAL PERSONNEL

In the small rural hospital, the initial patient evaluation is often performed by the emergency department nurse. Consequently, early assessment and resuscitation priorities present a challenge to the rural emergency nurse who frequently has had no special training in trauma. The physician providing the emergency care is typically not a surgeon, but rather, a primary care physician who infrequently encounters the severely injured patient. Acquiring and maintaining adequate training and skills in trauma assessment and resuscitation presents a challenge to this busy physician. Similarly, the rural general surgeon, although well trained, may have difficulty maintaining an adequate skill level because of infrequent exposure to the severely injured patient.

Physician extenders, such as nurse practitioners and physician assistants, often provide the initial assessment and resuscitation of the trauma patient in remote areas and must rely on telephone consultation. These persons encounter many of the same problems as the physician in the acquisition and maintenance of adequate training and skills.

Education can have a major impact on the quality of care the trauma patient receives. Small facilities depend on the region's trauma center for educational programs. The trauma center has an obligation to provide a variety of educational programs for physicians, physician extenders, nurses, prehospital providers, and other ancillary providers. Verification in the Advanced Trauma Life Support® (ATLS®) Course should be strongly encouraged for the primary care physicians and surgeons. Nurses, nurse practitioners, physician assistants, and other health care professionals should also be strongly encouraged to participate in the ATLS Course as auditors. This course provides these individuals with an organized approach to the care of the severely injured patient and should be readily available. Trauma courses designed to meet the needs of the nurses should be available. The surgeon needs ongoing continuing medical education in trauma to maintain competence. Opportunities should exist for physicians of all disciplines to spend time on the trauma services at the major trauma centers. Mechanisms must exist to facilitate 24-hour phone consultation with specialists at the trauma centers. Telemedicine, regional conferences, and computerized learning programs can be utilized to help meet the needs of rural personnel.

HOSPITAL RESOURCES

The organization of the emergency department can have a significant impact on the patient's outcome. The basic equipment needed for resuscitation and stabilization of the trauma patient should be immediately available in the emergency department. Those involved in patient care should be familiar with the use and the location of the equipment. Support personnel, particularly radiological and laboratory technicians, should be readily available.

Since rural facilities have limited resources, establishing a trauma team committed to rapid response for the resuscitation of the trauma patient is the most efficient method for utilizing the available resources and for improving the outcome. Every emergency department, regardless of its size, should establish a trauma team which can assemble on very short notice. The resources of the facility will determine the composition, actions, and goals of the trauma team. Protocols should be established outlining the indications for activation of the trauma alert, the care to be provided, and the roles of the team members. The activation protocol should be devised in cooperation with the prehospital providers. All members of the team should understand their roles. Mechanisms should be in place to allow for notification of the physician and other team members prior to the patient's arrival in the emergency department. Ideally, a general surgeon will be the leader of the team. However, depending on the local resources, a physician, nurse practitioner, or physician's assistant may function in this capacity. In facilities infrequently encountering these patients, trauma activation drills may be needed to ensure proper functioning of the team. The protocols and overall performance of the team must be reviewed regularly to ensure its effectiveness.

Specialty services are rarely available. The primary care physician and the surgeon, if available, must have the knowledge and skills for the initial assessment and management of specific injuries. The rural facility must develop a plan of care for these severely injured patients. The benefits of comprehensive care in a referral hospital need to be balanced against the inherent risks of potential physiologic deterioration during transport.

INTERHOSPITAL TRANSFER

Limited rural resources necessitate more frequent use of secondary transport than occurs in an urban setting. Primary transport to a trauma center is not a viable option in many rural areas, and the closest medical facility must be used. Each institution must recognize its capabilities, as well as its limitations. All rural facilities should have transfer agreements or plans for injured patients whose needs exceed their capabilities. Transport protocols must address the personnel, equipment, and vehicle to be used. Provisions need to be made for alternative methods of transport if the usual transport modality is unavailable (see Chapter 4: Interhospital Transfer and Agreements).

Occasionally, some patients are too unstable for immediate transport to a facility for definitive care, and surgical control of hemorrhage or management of other life-threatening problems prior to transfer may be necessary.

Consideration for transfer should be given for the following injuries:

- intraabdominal hemorrhage
- severe closed head injury
- severe pelvic fracture
- spinal cord injury
- major amputation
- severe burns
- severe maxillofacial injury
- severe chest injury

PERFORMANCE IMPROVEMENT

Since severely injured patients challenge rural hospitals to maximize the use of their limited resources, a well-conceived performance improvement (PI) program is important. Physicians, nurses, and other health care personnel take call from home; personnel shortages limit back-up call arrangements; emergency rooms or departments, operating rooms, laboratory, and X-ray departments are not fully staffed around the clock; many physicians do not have board certification; expensive equipment may be lacking; and specialty services are not immediately available. Institutions caring for trauma patients need to conduct meaningful, concurrent self examination of the services they provide. Facilities with limited resources, but with the desire and commitment to provide excellent care to the injured patient, can employ a PI program to evaluate practitioner performance and patient outcomes. This mechanism can enable the small facility to strive to meet the standards of the highest level of care that is reasonable based on its size and resources (see Chapter 16: Performance Improvement).

RURAL TRAUMA SYSTEM

The Committee on Trauma recommends the development of **inclusive** trauma systems which integrate all facilities in the region to care for all of the injured patients. The goal to utilize available resources efficiently to provide optimal care to the injured patient encourages local treatment when appropriate, but emphasizes using regional resources when the needs of the patient exceed the local capabilities. Conversely, the transfer of patients back to their community hospitals when specialty care is no longer essential will relieve travel and lodging burdens on families, take advantage of small town support systems (churches, service clubs, and neighborhood networks), and decrease the resource utilization at the tertiary center without compromising the care the patient receives.

All trauma patients admitted to any facility or dying as a result of an injury should be entered into a trauma registry. This allows development of a database to identify regional problems and provide opportunities for improvements in patient care. Ideally, this would be a statewide registry. If one does not exist, the trauma centers should assist the smaller facilities with the data collection.

Regional trauma advisory committees should be organized to address system issues, such as quality of care, patient outcomes, education needs, prehospital problems, and prevention. The committees would provide a forum for problem-solving, airing of grievances, and improving communications between all of the facilities and trauma personnel. In the absence of a statewide system, the trauma center for the area should organize these committees.

The larger trauma centers must accept their responsibility to the facilities with limited resources. This assistance extends beyond offering a more comprehensive capability to care for the severely injured patients. Educational opportunities must be provided for physicians and other health care personnel. Larger trauma centers must be willing to assist these facilities with their data collection and analysis. Specialists in the regional trauma center must be able to provide immediate telephone consultation when requested by the personnel in the smaller facilities.

The rural trauma system must enlist community support. The general public must recognize that most injuries are due to predictable events and are not **accidents.** Engaging the community in prevention

activities is one way to inform about trauma and to encourage recognition of injury as a major health care problem. Local chapters of national organizations dedicated to injury prevention can be very beneficial and facilitate the lay public's active participation in injury prevention.

CHARACTERISTICS OF RURAL FACILITIES

In some rural areas, there are Level I trauma centers, but this is more the exception than the rule. In most rural states, a Level II trauma center will be the lead institution, responsible for providing the highest level of care for a large region and often for the entire state. It will usually not be associated with a medical school or have a surgical residency program. While it may have an association with a Level I trauma center, the Level II trauma center will be responsible for assisting other facilities with their educational programs, data collection, prevention activities, and other outreach activities. This Level II trauma center will have the capability to provide care to most patients, but may transfer patients with special problems.

In some areas, due to geographic isolation, a Level III trauma center will serve as the lead institution providing support, outreach, and guidance to the Level IV facilities and to the trauma receiving facilities in its region. The Level III center will provide definitive care to the majority of patients in its area and will have transfer arrangements with a Level I or II trauma center for patients that exceed its capability. The Level III center will not be competing with Level I or II facilities. The Level III center will have 24-hour emergency coverage, usually by emergency physicians. It will provide continuous general surgical coverage. The facility will commonly have many of the surgical specialties, but usually will not have continuous or any neurosurgical coverage. It will assist the Level IV center and trauma receiving facilities in its referral area with data collection, education, PI, and other outreach activities.

The Level IV trauma hospital is a small rural facility which will provide initial assessment and resuscitation of the injured patients in its geographic area, since there is no higher level of care available. Most patients will require transfer to a higher level of care which could be a Level III, II, or I facility. This facility will have emergency coverage by physicians who will usually not be trained in emergency medicine, but who are primary care physicians. These physicians will usually not be present in the hospital at all times, but will frequently be responding from outside the facility. It is here that the emergency department nurse may be the first person to see the trauma patient. There will be at least one and sometimes two general surgeons on staff, but there will not be continuous general surgical coverage. Other specialists, such as orthopaedists and obstetrics/gynecologists, may be on staff. Anesthesia will frequently be provided by a Certified Registered Nurse Anesthetist (CRNA). The facility may not have a fully staffed and equipped critical care unit. It may be necessary on occasion for the general surgeon to provide operative control of hemorrhage prior to the transfer for definitive care. Few patients with serious injuries will receive definitive care in this facility.

The trauma receiving facility is a small facility in a sparsely populated area. It was established to meet the basic health care needs of the people in its area, since there are no other medical care facilities in the region. The trauma receiving facility will be either a clinic or a small hospital which is often associated with a long-term nursing care facility. The description of this type of facility is included here because it commonly does occur in the rural setting. It is not to be considered another level of trauma center, for purposes of this document, nor is it verified, as such, by the College. Basic laboratory and X-ray services are usually available, but the trauma receiving facility will have no surgical capabilities. It will frequently be staffed by a Physician's Assistant or a Nurse Practitioner who may only have telephone contact with a physician. Due to its location in a geographically isolated area, the injured patient must be taken to the trauma receiving facility for initial assessment and resuscitation prior to transfer to a trauma center. The care of the injured patient will be enhanced in the trauma receiving facility if it has trauma-trained personnel, adequate equipment, a trauma team plan, and a close relationship with its regional trauma center. This will facilitate prompt and appropriate resuscitation, stabilization, and transfer of the patient to provide the best chance for survival.

It is essential in a Rural Trauma System for each facility to have a clearly defined role based on its resources and the distance between the facilities. These factors will determine where the patient receives both initial and definitive care. Every effort should be made to ensure that when the patient is transferred, it will be to the most appropriate facility the first time.

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CHAPTER 14

GUIDELINES FOR THE OPERATION OF BURN UNITS

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 those patients who require hospitalization, about 20,000 are admitted directly or by referral to hospitals with special capabilities in the treatment of burn injuries. These service capabilities, along with the setting in which they are provided, are termed burn units. These guidelines 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 unit.

Many trauma centers do not have a burn unit within the same hospital. If this is the case, the trauma center should be able to communicate with the burn unit and assess, stabilize, and arrange safe transport for the seriously burned patient. Assessment follows ATLS® guidelines. The burn unit should be telephoned and the patient and transfer discussed with the senior burn surgeon on call. In the absence of other injuries, burn patients are usually easily stabilized and can withstand long-distance transport with resuscitation continuing en route.

The trauma center which will need to refer burn patients should have in place a written transfer agreement with a referral burn unit. The agreement should identify which patients will be referred, what specific stabilization will be expected, who will arrange transportation, and what needs the patient will have during transfer.

It is the responsibility of both the referring hospital and the burn unit director to keep this transfer agreement current. If there are collaborative arrangements for the transfer of patients from another unit of the hospital, such as a trauma unit, a surgical intensive care unit, and so on, protocols should be written for such transfer and acceptance.

BURN UNIT REFERRAL CRITERIA

A burn unit may treat adults or children or both.

Burn injuries that should be referred to a burn unit include the following:

1. Partial thickness burns greater than 10% total body surface area (TBSA)
2. Burns that involve the face, hands, feet, genitalia, perineum, or major joints
3. Third-degree burns in any age group
4. Electrical burns, including lightning injury
5. Chemical burns
6. Inhalation injury
7. Burn injury in patients with preexisting medical disorders that could complicate management, prolong recovery, or affect mortality
8. Any patients with burns and concomitant trauma (such as fractures) in which the burn injury poses the greatest risk of morbidity or mortality. In such cases, if the trauma poses the greater immediate risk, the patient may be initially stabilized in a trauma center before being transferred to a burn unit. Physician judgment will be necessary in such situations and should be in concert with the regional medical control plan and triage protocols.
9. Burned children in hospitals without qualified personnel or equipment for the care of children
10. Burn injury in patients who will require special social, emotional, or long-term rehabilitative intervention

I. BURN CARE SYSTEM

A burn care system is a coordinated component of an emergency medical service (EMS) system that encompasses one or more burn units and features communi-

cation links to and triage-transfer protocols between health care facilities, EMS prehospital personnel, and transportation services.

- The burn unit shall have both a medical and an administrative commitment to the care of the patient with burns.
- The burn unit shall have written guidelines for the triage, treatment, and transfer of burned patients from other facilities.
- The burn unit hospital shall maintain current accreditation by the Joint Commission of Accreditation of Healthcare Organizations (JCAHO).

Prehospital Care

- The burn unit shall maintain access to an EMS system for the transport of patients with burns from referral sources within the service area.
- The burn unit shall provide input into the performance improvement of prehospital care of burn patients.
- The burn unit shall have a written multiple casualty plan for the triage and treatment of those patients burned in a multiple casualty incident occurring within its service area.
- The multiple casualty plan shall be reviewed and updated as needed and on an annual basis by EMS representatives and the burn unit director (see Chapter 20).
- The burn unit shall provide education on the current concepts in emergency and inpatient burn care treatment to prehospital and hospital care providers within its service area.

II. ORGANIZATIONAL STRUCTURE

Documentation of Policies and Procedures

- The burn unit shall maintain an organizational chart relating personnel within the burn unit and the hospital.
- The burn unit shall maintain an appropriate policy and procedure manual that is reviewed annually by the burn unit director and the nurse manager.

The policy and procedures manual shall contain policies addressing:

1. Administration of the burn unit
2. Staffing of the burn unit
3. Criteria for admission to the burn unit by the burn services
4. Usage of the burn unit beds by other medical or surgical services
5. Criteria for discharge and follow-up care
6. Availability of beds and the transfer of burn patients to other medical or surgical units within the hospital
7. Care of patients with burns in areas of the burn unit hospital other than the burn unit

TABLE 1
MINIMAL DATA SET FOR THE BURN REGISTRY

Hospital Identifier	ICD-9 code
Patient identifier	Number of operations
Patient gender	Length of hospitalization
Ethnic origin	Disposition
Zip code	Cause of death
Country	Total hospital charges
Age	Method of payment
Date of injury	DRG code
Description of event	Circumstances of injury
Etiology code (E-code)	Complications by code
Body areas injured	PI indicators by code
Total burn size	Discharge date
Total deep burn	Total ICU days
Inhalation injury	Hospital transfer

Burn Program

The burn unit hospital shall formally establish and maintain an organized Burn Program that is responsible for coordinating the care of the burned patient.

Consistency of Protocol and Reporting

- The burn unit shall participate in a registry (such as the ABA TRACS registry) or maintain a minimal data set (see Table 1) that is capable of providing annual statistical reports in a computer-exported format accessible to the National Trauma Data Bank.
- This database shall include all patients who are admitted to the burn unit hospital for acute burn care treatment.

Admission and Census Levels for the Burn Unit Hospital

- The burn unit shall admit an average of 100 or more patients annually, with acute burn injuries averaged over three years.
- The burn unit shall maintain an average daily census of three or more patients with acute burn injuries.

III. MEDICAL PERSONNEL

Administrative Responsibility

- The burn unit director shall be granted the necessary authority to direct and coordinate all services for patients admitted to the burn service.
- It is the director's responsibility to ensure that medical care conforms to the burn unit protocols.
- Privileges for physicians participating in the burn service shall be determined by the medical staff credentialing process and approved by the burn unit director. Qualifications for surgeons who are responsible for the care of the burned patient must conform to criteria documenting appropriate training, patient care experience, continuing medical education, and commitment to teaching and research in the care of the burned patient.

TABLE 2—QUALIFICATIONS FOR BURN UNIT STAFF SURGEONS

	Category/description	Medical director	Staff surgeons
I.	Board certification in general or plastic surgery Special qualification in surgical critical care	Required Desirable	Required[1] Desirable
II.	Training Completion of a one-year fellowship in burn treatment or two or more years of burn care experience during the previous five years	Required	Required
III.	Clinical activity Participation in the care of 50 or more acutely burned patients annually	Required	Required
IV.	Continuing medical education Annual participation in 16 hours or more of burn-related education	Required[2]	Required[2]
V.	Research participation Demonstrated commitment to clinical or basic science burn care research or the organization of burn care systems	Desirable	Desirable
VI.	Community education and burn prevention Participation in development of revision of community or EMS burn treatment protocols or representation of state/local EMS committee At least one of the following: • Annual participation in one or more prehospital training/certification courses in burn care or • Annual development or presentation of acute burn care courses or lectures or • Participation in a burn prevention program	Desirable	Desirable

[1]Can be met by special exemption (see Chapter 6).
[2]Can be met by attendance of the annual meetings of the AAST, ABA, or any ABA-endorsed meetings (for example NABS, ISBI, regional ABA meetings).

- The burn units must be actively engaged in promoting Advanced Burn Life Support (ABLS) and prehospital ABLS courses in their region. It is desirable for the director to be an ABLS instructor, and the unit should have one or more employees who are ABLS instructors.

Qualifications and Activities of the Burn Unit Director (See Table 2)

- The burn unit director shall be a licensed surgeon with board certification by American Board of Surgery or American Board of Plastic Surgery; certification of special qualifications in surgical critical care is desirable.
- The burn unit director shall have completed a one-year fellowship in burn treatment or shall have experience in the care of patients with acute burn injuries for two or more years during the previous five years.
- It would be desirable for the burn unit director to have current certification as an ABLS instructor.
- The director should participate in the care of 50 or more acutely burned patients annually.
- The burn unit director shall participate in continuing medical education in burn treatment and shall demonstrate ongoing involvement in burn-related research and community education in burn care and/or prevention.

Responsibilities of the Burn Unit Director

The responsibilities of the burn unit director shall include, but not be limited to, the following:

1. Creation of policies and procedures within the burn unit which specify the care of burned patients
2. Creation of policies and protocols for use throughout the burn care system for initial care, triage, and transport of burn patients
3. Cooperation with regional EMS authorities in regard to all aspects of burn treatment
4. Communications on a regular basis with physicians and other authorities regarding patients who have been referred
5. Direction of the burn unit administrative functions
6. Direction and active participation in the burn unit performance improvement program
7. Liaison with adjacent and regional burn units
8. Development and participation in both internal and external continuing medical education programs in the care and prevention of burn injuries

Qualifications and Activities of Attending Staff Surgeons (See Table 2)

- The director may appoint qualified attending staff surgeons to participate in the care of patients on the burn service.
- Attending staff surgeons shall be board certified or qualified as established in Chapter 6. Certification of special qualifications in critical care is desirable.
- Attending staff surgeons shall have demonstrated expertise in burn treatment as evidenced by completion of a one-year fellowship in burn treatment or by two or more years of experience in the management of patients with acute burn injuries.
- The attending staff surgeons shall participate in continuing medical education in burn treatment, research in burn care, and community education in burn treatment and/or prevention.

Burn Service Coverage

- There shall be at least one full-time equivalent attending staff surgeon involved in the management of burn patients for each 300 annual acute inpatient admissions.
- The burn service shall maintain an on-call schedule for residents and attending staff surgeons who are assigned to the burn service. The residents and/or staff surgeons shall be available promptly on a 24-hour basis.
- The burn service shall maintain an on-call schedule for residents and attending staff surgeons who are assigned to the burn service.

The following specialists shall be available for consultation:

General surgery
Cardiothoracic surgery
Neurologic surgery
Obstetrics/gynecology
Ophthalmology
Anesthesiology
Pediatrics
Psychiatry
Cardiology
Gastroenterology
Hematology
Orthopaedic surgery
Otorhinolaryngology
Plastic surgery
Urology
Pulmonary
Radiology
Nephrology
Neurology
Pathology
Infectious disease

IV. NURSING PERSONNEL

Nurse Manager

There shall be one registered nurse with a baccalaureate or higher degree who is administratively responsible for the burn unit; this requirement may be met by a registered nurse who has two or more years of experience as a charge nurse on a burn unit.

The nurse manager or charge nurse shall have at least:

1. Two years or more of experience in acute burn care
2. Six months or more managerial experience

There shall be an organizational chart relating the nurse manager to the burn service and other members of the burn team.

Nursing Staff

- There shall be a patient care system in effect that is used to determine nurse staffing for each patient in the burn unit. This system shall be employed to determine daily staffing needs.
- There shall be a burn unit orientation program that documents nursing competencies specific to care and treatment of burn patients, including critical care, wound care, and rehabilitation.

V. REHABILITATION PERSONNEL

General

- There shall be a rehabilitation program designed for the burned patient that identifies specific goals.

Rehabilitation Personnel

- Physical and occupational therapists in the burn unit shall be appropriately licensed in their specific disciplines.
- Staffing shall be based upon both inpatient and outpatient activity with at least one full-time equivalent burn therapist for the burn unit.
- If a therapist is not permanently assigned to the burn unit for both inpatients and outpatients, one shall be assigned for a period of no less than one year.
- Burn therapists shall receive regular supervision from individuals with at least one year of experience in the treatment of burn patients.
- There shall be a competency-based burn therapy orientation program for all new therapists assigned to the burn unit.
- Burn unit therapists shall be provided with a minimum of two burn-related continuing education opportunities annually.

VI. OTHER PERSONNEL

Physician Extenders

- Appropriately credentialed physician extenders may be utilized as members of the burn team. These individuals may include, but are not limited to, physician assistants, surgical assistants, or nurse practitioners.

Social Work

- Social service consultation shall be available to the burn service.
- If a social worker is not permanently assigned to the burn unit for both inpatients and outpatients, one shall be assigned on a rotational basis for a duration of at least one year.

Nutritional Services

- A dietitian shall be available on a daily basis for consultation.

Pharmacy

- A pharmacist who has at least six months of experience in critical care and the pharmacokinetics of patients with acute burn injuries shall be available on a 24-hour basis.

Respiratory Care Services

- Respiratory therapists shall be available for the assessment and management of patients on the burn service on a 24-hour basis.

Clinical Psychiatry or Psychology

- A psychiatrist or clinical psychologist should be available for consultation by the burn service on a 24-hour basis.

VII. PERFORMANCE IMPROVEMENT PROGRAM

Policies and Procedures

- The burn program shall have a performance improvement program that is multidisciplinary.
- The burn unit director shall be responsible for the performance improvement program.
- The burn unit multidisciplinary committee, which oversees the performance improvement program, shall meet at least quarterly. Sufficient documentation shall be maintained to verify problems, identify opportunities for improvement, take corrective actions, and resolve problems.
- Morbidity and mortality conferences shall be held at least monthly with physicians other than the immediate burn care team to ensure objective review of the presentations. Attendees at this conference must include specialist staff members other than those practicing in the burn unit.
- All significant burn complications and all deaths must be discussed. There must be open, candid discussion with high points documented and assessment of the death or complication classified as "caused by disease," "potentially preventable," "possibly preventable" (or the equivalent thereof). Actions recommended must also be documented, and there must be documentation of loop closure. Records of this conference must be kept.

Weekly Patient Care Conferences

- Patient care conferences shall be held at least weekly to review and evaluate the status of each patient admitted to the burn unit. Each clinical discipline shall be represented in order to appropriately contribute to the treatment plan for each patient.
- Patient care conferences shall be documented in the progress notes of each patient and/or in minutes of the conferences.

Audit

- The burn service shall conduct audits at least annually that should include, but should not be limited to, the severity of burn, mortality, incidence of complications, and length of hospitalization.

VIII. OTHER PROGRAMS

Educational Program

- The burn unit shall have an educational program for the medical staff.
- If residents rotate on the burn service, the burn service director or his or her designee shall be responsible for an orientation program for new residents.

Infection Control Program

- The burn unit shall have effective means of isolation that are consistent with principles of universal precautions and barrier techniques to decrease the risk of cross-infection and cross-contamination.
- The burn unit hospital shall provide ongoing review and analysis of nosocomial infection data and risk factors that relate to infection prevention and control for burn patients. These data shall be available to the burn team in order to assess infection risk factors that relate to infection prevention and control for burn patients.

IX. CONTINUITY OF CARE PROGRAM

The burn unit must provide the following services:

1. Recreational therapy for children cared for in the unit
2. Education in rehabilitation (see Chapter 12)
3. Support for family members or other significant persons
4. Coordinated discharge planning
5. Follow-up after hospital discharge
6. Access to community resources
7. Evaluation of the patient's physical, psychological, developmental, and vocational status
8. Planning for future rehabilitative and reconstructive needs

X. BURN PREVENTION PROGRAM

The burn unit shall participate regularly in public burn awareness programs.

XI. RESEARCH PROGRAM

- The burn unit should participate in basic, clinical, or health sciences research.

XII. CONFIGURATION AND EQUIPMENT

Configuration

- The burn unit hospital shall maintain a specialized nursing unit dedicated to acute burn care.
- The burn unit shall be used predominantly for patients with burn injuries or those suffering from skin disorders, major wounds, or other problems requiring treatment similar to that of burn patients.
- The burn unit shall have at least four beds that are ICU-capable.

Equipment

The following equipment shall be available in the burn unit:

1. Weight measurement devices
2. Temperature control devices for the patient, for intravenous fluids, and blood products
3. ICU monitors
4. Cardiac emergency carts with age-appropriate equipment

XIII. OTHER SERVICES

- Renal dialysis, radiologic services, including computed tomographic scanning, and clinical laboratory services available 24 hours per day

XIV. OPERATING SUITES

- The burn unit hospital shall have an operating room available to the burn service on a 24-hour basis.

XV. EMERGENCY SERVICE

- The emergency department shall have written protocols mutually developed with the burn service for the care of acutely burned patients.

XVI. ALLOGRAFT USAGE

- The burn unit hospital shall maintain a written policy stating that allograft tissues are to be obtained only from those tissue banks that adhere to the standards of the American Association of Tissue Banks (AATB) if applicable. This policy shall also indicate compliance with U.S. Food and Drug Administration (FDA) regulations published on December 14, 1993, in the Federal Register (Vol. 58, No. 238, pp. 65514–65521) and any subsequent regulations that shall supersede these.
- The burn unit hospital shall maintain policies for the handling and storage of human skin allograft, if applicable. These policies shall address the documentation of receipt and storage maintenance records (JCAHO: SP.5.1.8). Documentation records shall be maintained indefinitely.
- The burn unit hospital shall maintain written documentation of all allograft transplants that includes the following:

  Name of the tissue bank providing the tissue

  Donor identification number

  Recipient identification number

  Documentation of storage conditions

  Date of allograft transplantation and site of application

  Name of the surgeon utilizing the allograft

  Disposition of all allograft tissues received from the tissue bank
- A file shall be kept containing reports of any adverse reactions related to allograft skin transplantation.
- The burn unit hospital shall maintain a policy and documentation of the notification of the recipients and the tissue bank in the event of an adverse event arising from the use of allograft.
- The burn unit hospital shall name an individual to verify and oversee all functions relating to the handling and storage of human allograft skin.
- The burn unit hospital shall maintain a policy for the proper disposal of all unused or expired human allograft skin in order to minimize any hazards to the hospital staff or the environment.

This chapter was approved by the American Burn Association.

TABLE 3
DEFINITIONS OF TERMS

ABLS
Advanced Burn Life Support course of the American Burn Association.

attending staff surgeon
Surgical member of the burn team appointed by the burn unit director, with credentials and privileges appropriate to the burn service.

burn care system
A component of a coordinated emergency medical services (EMS) system that encompasses one or more burn units. Communication linkages and triage transfer protocols coordinate health care facilities, EMS prehospital personnel, and patient transportation.

burn unit director
Surgeon designated by the institution and medical staff to coordinate the activities of the burn unit.

burn unit hospital
An institution with a commitment to meet the criteria specified in this document.

burn service
A clinical service established by the medical staff that has responsibility for burned patients.

burn program
A group of health care professionals and resources organized to provide care to the burned patient in a coordinated system of care.

burn therapist
A physical or occupational therapist who has a commitment to the burn patient and is responsible for delivering rehabilitation service on the burn unit.

burn unit
A specific area within the hospital that has committed the resources necessary to meet the criteria for a burn unit. This area contains beds and other equipment related to care of the patient with burn injury.

promptly available
The physical presence of health professionals in a stated location in a short period of time, which is defined by the Burn Unit Director and continuously monitored by the PI program.

nurse manager
A registered nurse who has a commitment to the burn unit and is administratively responsible for the nursing service of the burn unit.

CHAPTER 15

TRAUMA REGISTRY

Ideally, data collection on trauma patients would be population-based, with participation of all hospitals in a geographic area submitting a minimal data set. Given current resources, this is unlikely in most geographic areas, and registries have focused on trauma hospitals.

Optimal care of the trauma patient involves decision-making based on a detailed understanding of the causes, treatments, and outcomes of injury. Management of the potential variability in this complex process requires accurate data. Therefore, a trauma registry is an essential component of any trauma program. The registry provides for the collection, storage, and reporting of information about trauma patients, including the facts related to the patient's injury event, severity, care, and outcome.

Obtaining, coding, and sorting this information for analysis and reporting individual and aggregate results are the expressed purposes of the trauma registry. This information management system should function to drive an efficient and effective performance improvement program for the care of the injured patient.

PURPOSE OF A TRAUMA REGISTRY

The data in the trauma registry can be used in a variety of ways. These ways define its purpose at a given hospital.

Performance Improvement

Hospitals committed to serving patients with injuries are anxious to provide the best care possible. The trauma registry facilitates objective review of the care provided and identification of variations in the process or outcome of care. The registry assists in the summation and review of trends in performance and outcome. Both the individual institution and a regional trauma system can monitor a variety of parameters and track variability and improvements. Examples would include prehospital response times; presence and timeliness of care; lengths of stay in the emergency department, ICU, or hospital; incidence of nosocomial pneumonia or other complications; comparison of expected and observed deaths; and cost. These variables can, in turn, be measured for progress against past performance to achieve regional or national goals or standards. Thus, the trauma registry is a tool to drive the performance improvement process for hospitals, emergency medical services, and regional trauma systems and allows comparisons to benchmarks across systems of care.

Public Health

The data contained in a trauma registry can provide information regarding the incidence, care, cost, and outcome of injuries in a specific geopolitical region or state. This is important information for Departments of Health. Several states already require submission of data to a state trauma registry. Registry data may also be used to inform public officials about trauma as a public health problem, thus serving as a basis for legislation and regulatory efforts to benefit prevention programs.

Outcomes Research

Information in individual trauma registries should be incorporated into larger databases for outcomes research, as trauma is a major cause of death and disability in our society. This will facilitate reliable evaluation of innovative technology and strategies of care for injured patients. Outcomes research is largely undeveloped at present. The American College of Surgeons (ACS) has established the National Trauma Data Bank™ (NTDB™) for this purpose. In addition, the American Burn Association and the ACS have developed a national burn registry. A national Pediatric Trauma Registry has been in place for several years.

Resource Utilization

The Trauma Registry may also serve to document the resources required by the trauma program and justify institutional and financial support. This purpose will become increasingly important as purchasers of health

care scrutinize individual practitioners, hospitals, and systems which provide trauma care.

ESTABLISHING 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 in the past, this is no longer necessary. Several trauma registry software packages that will operate on most personal computer platforms are now commercially available. Before selecting registry software, however, several difficult issues should be considered.

Purpose

Those charged with developing the registry and the appropriate institutional officials must be in agreement about the purpose of the trauma registry. This will assist in planning the structure of the registry, the data elements to be included, the mechanisms for collecting the data, and the support necessary to accomplish the goal. When evaluating software, both the trauma registry package and the vendor must be able to support the institution's goals and purpose of the registry. In addition, any registry must be adaptable to suit local needs.

Definitions

Data acquisition and entry into the trauma registry entails cost. Ideally, data would be collected on all patients. Although all patients consume resources, an individual hospital may elect to exclude some patients with less severe or isolated injuries (for example, hip fractures) or specific injuries from the trauma registry. Thus, at any given hospital, a definition of a "trauma patient" must be established. This definition will be influenced by the purpose of the registry in the specific hospital, the nature and size of the trauma population, and any applicable state or local regulations.

For example, the criteria for entry into the NTDB include all patients with at least one injury ICD-9 diagnosis code between 800.00 and 959.9, including 940–949 (burns), excluding 905–909 (late effects of injuries), 910–924 (blisters, contusions, abrasions, and insect bites), 930–939 (foreign bodies), **AND** who were admitted **OR** who died after receiving any evaluation or treatment or were dead on arrival **OR** who transferred into or out of the hospital. The ACS Committee on Trauma (COT) would encourage all registries to use a similar definition. Some states or hospitals, however, have adopted less inclusive criteria by specifying a minimum length of stay (24–48 hours or more) or by excluding single injuries with an Abbreviated Injury Score of 2 or less.

Each institution must also decide what data elements it wishes to collect and review. Since each required piece of information must be located, documented, and entered into the registry, this decision will represent a balance between thoroughness and practicality. These data elements should follow established definitions and be chosen to support the data reporting requirements of the region or state. The data elements included in the trauma registry of the American College of Surgeons, NATIONAL TRACS Version 3.0, are listed in Table 1. This and other registry programs also allow individual hospitals to add data elements that reflect local interest or research questions.

Data Collection

In the planning stages for a registry, it is useful to consider the mechanisms for data collection and entry. Some trauma registry software supports the use of portable computers for data entry directly from the chart and other documents. These data can then be downloaded to the main registry. Alternatively, a paper data form may be designed to record patient information for subsequent batch data entry. 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 trauma registrar is critical to the success of a registry. Registrars come from various backgrounds, and training in uniformity of data collection is essential. Technical support, both locally and from the software distributor, should be available to assist with this training. In addition, a trauma registrar course is available through the American Trauma Society Registrars Group. Typically, one full-time equivalent (FTE) employee dedicated to the registry will be required to process approximately 500 to 1,000 patients annually.

Data Validation

The information provided by a trauma registry is only as valid as the data entered. Strategies for monitoring data validity are essential. Data points with known potential for inaccuracy should be avoided. A scheme for internal validation helps to detect errors in data entry or coding. Many of the trauma registry software packages include mechanisms to ensure consistency. For example, a partial pressure of oxygen (Po_2) of 93 would be allowed, whereas a Po_2 of 7.43 would not. In addition, a plan for ensuring that the data entered are

accurate and reflect the observations made on the patient should be established. One workable approach involves a systematic review of 5 to 10 percent of all patients to compare the data entered with the observations in the medical record.

Patient Confidentiality

Both patient and hospital confidentiality must be maintained. A variety of people and agencies may have a legitimate need for access to the data, but this must not outweigh the necessity of maintaining patient confidentiality. Procedures to do this must be firmly integrated in the administration of the registry, so that identifying information is available only to those who have need to know.

Report Writing

The trauma registry can only be valuable if the data it contains can be transformed into information for some worthwhile purpose. Thus, the data must be able to be accessed and analyzed easily. Most trauma registry software provides for the generation of several standard reports which summarize different ways to address specific questions or areas of concern. Most standard reports are oriented to anticipate the needs of a trauma program quality improvement program, and provide the needed information. This capability should either be built into the software itself or achieved by exporting the data to a separate spreadsheet or statistical program. For the purposes of regional quality improvement, it should be possible to import and export data between different software packages.

National Trauma Data Bank (NTDB™)

The registry responsibilities of the COT occur in two distinct committees. The Subcommittee on the Trauma Registry is responsible for the development of the hospital-based software product NATIONAL TRACS® The Ad Hoc Committee on the NTDB™ is responsible for the National Trauma Data Bank™.

The NTDB is designed to improve the quality of patient care by incorporating trauma data into a central repository and by encouraging the development of better injury scoring and outcome measures by providing comparisons on a national basis. The NTDB is expected to become a rich source of data for injury research and to improve methods of evaluating treatment. The program is designed to be inclusive for all registries, but will not be population-based until there is universal reporting.

The NTDB contains a uniform data set (Table 1) that has been limited to those data points selected to produce meaningful and useful reports. Each of these points has been evaluated for the possibility of collection from multiple sites using different registry products.

This effort has resulted from collaboration among the ACS COT, other trauma registry programs, governmental agencies (Health Resources and Services Administration, National Highway Traffic Safety Administration, and Center for Disease Control and Prevention), the American Trauma Society, and other interested parties.

TABLE 1
COMPARISON OF DATA POINTS BETWEEN NATIONAL TRACS® VERSION 3.0, (ACS SOFTWARE) AND NTDB™

	TRACS	NTDB
DEMOGRAPHICS		
ID # of Hospital	X	X
Registry #	X	X
Patient Identifier	X	
Patient Social Security Number	X	
Patient's First Name	X	
Patient's Middle Name	X	
Patient's Last Name	X	
Patient's Gender	X	X
Patient's Race	X	X
Birth Date	X	X
Patient's Age (Manual)	X	
Patient's Age (Auto Calculated)	X	X
Patient's Home Address	X	
Patient's Home City	X	
Patient's State of Residence	X	
Patient's Home Zip Code	X	
Patient's Home County	X	
Occupation	X	
INJURY		
Date on Which Injury Occurred	X	X
Time at Which Injury Occurred	X	
City in Which Injury Occurred	X	
State in Which Injury Occurred	X	X
Zip Code of Injury Location	X	
County in Which Injury Occurred	X	X
Blunt, Penetrating	X	X
Site at Which Injury Occurred (eg, home)	X	X
E-Code # and Description	X	X
Police Report Number	X	
Position of Patient in Vehicle	X	
Safety Equipment	X	X
Comment(s)	X	
PREHOSPITAL		
Name of EMS Provider	X	
Ambulance Run Number	X	

PREHOSPITAL (cont)	TRACS	NTDB
Scene EMS Report	X	
Condition of Patient	X	
Dispatch Date of EMS	X	
Dispatch Time of EMS	X	
Scene Arrival Time	X	
Scene Departure Time	X	
Scene Time of EMS (Auto Calculated)	X	
Hospital arrival time	X	
Transport Time	X	
Pulse Rate	X	
Respiratory Rate	X	
Systolic Blood Pressure	X	
GCS Eye Score	X	
GCS Verbal Response	X	
GCS Motor Response	X	X
Total Glasgow Coma Score (Auto Calculated)	X	X
Assessment Qualifier (Auto Calculated GCS)	X	
Revised Trauma Score (Auto Calculated)	X	
Total Glasgow Coma Score (Manual)	X	
Assessment Qualifier (Manual GCS)	X	
Revised Trauma Score (Manual)	X	
CPR	X	X
Airway	X	X
Mast	X	X
Fluids	X	X
Needle Thoracostomy	X	
Thoracentesis/Tube Thoracostomy	X	
Drugs(s) Given	X	

REFERRING HOSPITAL		
Hospital Transfer	X	X
Arrival Date	X	
Arrival Time	X	
Discharge Date	X	
Discharge Time	X	
Referring Hospital Name	X	
Referring Physician Name	X	
Pulse Rate	X	
Respiratory Rate	X	
Systolic Blood Pressure	X	
GCS Eye Score	X	
GCS Verbal Response	X	
GCS Motor Response	X	
Total Glasgow Coma Score (Auto Calculated)	X	
Assessment Qualifier (Auto Calculated GCS)	X	
Revised Trauma Score (Auto Calculated)	X	
Total Glasgow Coma Score (Manual)	X	
Assessment Qualifier (Manual GCS)	X	
Revised Trauma Score (Manual)	X	
Head CT	X	
Abdominal CT	X	
Abdominal Ultrasound	X	
Chest CT	X	
Peritoneal Lavage	X	
Aortogram	X	
Arteriogram/Angiogram	X	
Airway	X	
CPR	X	
OR	X	
ICU	X	
Drug(s) Given	X	

ED ADMISSION		
Direct Admission	X	
Arrival/Admit Date	X	X
Arrival Time	X	X
Arrived From	X	

ED ADMISSION (cont)	TRACS	NTDB
Discharge Date	X	
Discharge Time	X	
Length of Stay (Hrs.) (Auto Calculated)	X	
Mode of Transport	X	
Chief Complaint	X	
Arrival Condition	X	
Trauma Team Level 1 - Activation (Y/N)	X	
Trauma Team Level 1 - Activation Time	X	
Time Elapsed (Mins.) Between Level 1 Activation and Patient ED Arrival (Auto Calculated)	X	X
Trauma Team Level 2 - Activation (Y/N)	X	
Trauma Team Level 2 - Activation Time	X	
Time Elapsed (Mins.) Between Level 2 Activation and Patient ED Arrival (Auto Calculated) X	X	
Trauma Team Level 3 - Activation (Y/N)	X	
Trauma Team Level 3 - Activation Time	X	
Time Elapsed (Mins.) Between Level 3 Activation and Patient ED Arrival (Auto Calculated) X	X	
Trauma Surgeon Code	X	
Trauma Surgeon Time Called	X	
Trauma Surgeon Time Arrived	X	
Trauma Surgeon Response Time (Auto Calculated)	X	
Trauma Surgeon Arrival Timely (Y/N)	X	X
Surgical Chief Resident Code	X	
Surgical Chief Resident Time Called	X	
Surgical Chief Resident Time Arrived	X	
Surgical Chief Resident Response Time (Auto Calculated)	X	
Surgical Chief Resident Arrival Timely(Y/N)	X	
Neurosurgeon Code	X	
Neurosurgeon Time Called	X	
Neurosurgeon Time Arrived	X	
Neurosurgeon Response Time (Auto Calculated)	X	
Neurosurgeon Arrival Timely (Y/N)	X	
Orthopedic surgeon Code	X	
Orthopedic surgeon Time Called	X	
Orthopedic surgeon Time Arrived	X	
Orthopedic surgeon Response Time (Auto Calculated)	X	
Orthopedic surgeon Arrival Timely (Y/N)	X	
Emergency Medicine Physician Code	X	
Emergency Medicine Physician Time Called	X	
Emergency Medicine Physician Time Arrived	X	
Emergency Medicine Physician Response Time (Auto Calculated)	X	
Emergency Medicine Physician Arrival Timely (Y/N)	X	
Anesthesiologist Code	X	
Anesthesiologist Time Called	X	
Anesthesiologist Time Arrived	X	
Anesthesiologist Response Time (Auto Calculated)	X	
Anesthesiologist Arrival Timely (Y/N)	X	

ED ASSESSMENT I		
Temperature	X	X
Systolic Blood Pressure	X	X
Pulse Rate	X	
Respiratory Rate	X	X
Respiratory Rate Qualifier	X	
GCS Eye Score	X	
GCS Verbal Response	X	
GCS Motor Response	X	X

ED ASSESSMENT I (cont)	TRACS	NTDB
Total Glasgow Coma Score (Auto Calculated)	X	
Assessment Qualifier (Auto Calculated GCS)	X	
Revised Trauma Score (Auto Calculated)	X	
Weighted Revised Trauma Score (Auto Calculated)	X	
Total Glasgow Coma Score (Manual)	X	X
Assessment Qualifier (Manual GCS)	X	
Revised Trauma Score (Manual)	X	X
Weighted Revised Trauma Score (Manual)	X	
Airway	X	X
CPR	X	
Units of Blood	X	
ETOH Level	X	X
Hematocrit	X	
Base Deficit	X	X
Toxicology/Drug Screen	X	X

ED ASSESSMENT II		
Head CT Results	X	X
Head CT Date	X	
Head CT Time	X	
Abdominal CT Results	X	X
Abdominal CT Date	X	
Abdominal CT Time	X	
Abdominal Ultrasound Results	X	
Abdominal Ultrasound Date	X	
Abdominal Ultrasound Time	X	
Chest CT Results	X	
Chest CT Date	X	
Chest CT Time	X	
Peritoneal Lavage Results	X	
Peritoneal Lavage Date	X	
Peritoneal Lavage Time	X	
Aortogram Results	X	
Aortogram Date	X	
Aortogram Time	X	
Arterio/Angiogram Results	X	
Arterio/Angiogram Date	X	
Arterio/Angiogram Time	X	
Admitting Service	X	X
ED Disposition	X	X
OR Disposition	X	
Admitting Physician	X	
Attending Physician	X	
Consult Service	X	
Consult Date	X	
Consult Time	X	
Comment(s)	X	

HOSPITAL DIAGNOSIS		
Diagnosis #	X	
ICD-9 Diagnosis Code	X	X
ICD-9 Diagnosis Description	X	X
Injury Severity Coding Methodology	X	
AIS 90 Code	X	X
AIS 90 Description	X	
AIS 90 Score	X	
Operation/Procedure Performed	X	
AIS 90 Head/Neck Region (Auto Calculated)	X	
AIS 90 Chest Region (Auto Calculated)	X	
AIS 90 Extremities Region (Auto Calculated)	X	
AIS 90 Face Region (Auto Calculated)	X	
AIS 90 Abdomen Region (Auto Calculated)	X	
AIS 90 External Region (Auto Calculated)	X	
Injury Severity Score (Auto Calculated)	X	X
Probability of Survival (Auto Calculated)	X	X
AIS 90 Head/Neck Region (Manual)	X	

HOSPITAL DIAGNOSIS (cont)	TRACS	NTDB
AIS 90 Chest Region (Manual)	X	
AIS 90 Extremities Region (Manual)	X	
AIS 90 Face Region (Manual)	X	
AIS 90 Abdomen Region (Manual)	X	
AIS 90 External Region (Manual)	X	
Injury Severity Score (Manual)	X	

PRE-EXISTING COMORBIDITY		
Comorbidity Code	X	
Comorbidity Description	X	
Further Explanation of a Pre-Existing Comorbidity Factor	X	X

PROCEDURES		
OR Visit #	X	
OR Procedure #	X	
ICD-9 Procedure Code	X	X
Short ICD-9 Procedure Description	X	X
Full ICD-9 Procedure Description	X	
Date of Operation/Procedure	X	X
Time of Operation/Procedure	X	X
Operation/Procedure Location	X	
Physician Code	X	
Physician Name	X	
OR Book Time	X	

COMPLICATIONS*		
Occurrence Date	X	
TRACS Code	X	
Description	X	
Peer Review Judgment	X	
Peer Review Date	X	
Status	X	
Further Explanation of a Complication	X	
Acute Respiratory Distress Syndrome (ARDS) (3002)	X	X
Aspiration Pneumonia (3003)	X	X
Bacteremia (5507)	X	X
Cardiac Arrest (3502)	X	X
Coagulopathy (5001)(5002)	X	X
Compartment Syndrome (6501)	X	X
Deep Vein Thrombosis (DVT) (Lower Extremity) (7502)	X	X
Disseminated Fungal Infection (5502)	X	X
Dehiscence/+Evisceration (4003)	X	X
Empyema (3005)	X	X
Esophageal Intubation (1002)(2501)	X	X
Hypothermia (8504)	X	X
Intra-abdominal Abscess (5503)	X	X
Jaundice (4503)	X	X
Failure of Fracture/Fixation (6506)	X	X
Mortality	X	
Myocardial Infarction (3505)	X	X
No Response to Resuscitation (NRR)	X	
Pancreatitis (4505)	X	X
Pneumonia (3008)	X	X
Pneumothorax (3009–3012)	X	X
Skin Breakdown (6502–6505)	X	X
Progression of Original Neurologic Insult (7008)	X	X
Pulmonary Embolus (3014)	X	X
Renal Failure (6001)	X	X
Sepsis Like Syndrome	X	
Urinary Tract Infection (6003) (6004)	X	X
Wound Infection (5509)	X	X

	TRACS	NTDB
PERFORMANCE IMPROVEMENT		
Occurrence Date	X	
Description	X	
Peer Review Judgment	X	
Peer Review Date	X	
Status	X	
Further Explanation of a Performance Improvement Indicator	X	X
HOSPITAL OUTCOME		
Modified FIM Self-Feeding Score	X	X
Modified FIM Self-Feeding Status	X	X
Modified FIM Locomotion Score	X	X
Modified FIM Locomotion Status	X	X
Modified FIM Expression Score	X	X
Modified FIM Expression Status	X	X
Total Modified FIM Score (Auto Calculated)	X	
Discharge Date	X	X (includes death)
Discharge Time	X	
Discharge Service	X	
Hospital Disposition	X	X
Death Location	X	
Patient Directive Applied (Y/N)	X	
Organ Donation (Y/N)	X	
Autopsy (Y/N)	X	
Discharge Status (Live vs. Die)	X	X
Ventilator Support Days	X	X
Days in the ICU	X	X
Days in Hospital (Auto Calculated)	X	X
23 Hours Observation (Y/N)	X	
DRG Code	X	
Resource Utilization	X	
FINANCIAL		
Account #	X	
Primary Payor Source	X	
Secondary Payor Source	X	
Work Related Injury	X	
Actual Variable Direct Cost	X	
Actual Total Cost	X	
Hospital Charges	X	X
Reimbursed Charges	X	X
Final Billed (Y/N)	X	
Comment(s)	X	
Is Record Ready to Send to ACS (Y/N)?	X	X

* Complications as listed in Chapter 16: Performance Improvement.

CHAPTER 16

PERFORMANCE IMPROVEMENT

I. INTRODUCTION

This chapter describes the concept of monitoring, evaluating, and improving the performance of a trauma program. Although there is no precise prescription for trauma performance improvement, the American College of Surgeons Committee on Trauma (ACS COT) strongly encourages a structured effort by a trauma program to demonstrate a continuous process for improving care to the injured.

Current health care imperatives emphasize doing **more** with **less** and doing it **better** and **faster**. Although this may be difficult to translate to the care of some trauma patients, an evidence-based rather than an empiric approach presents more meaningful criteria against which our trauma care can be measured. Integration of the trauma program performance improvement into the hospitalwide program offers a reduction in labor while producing more impact on quality.

II. OPERATIONAL CONCEPTS

All hospitals in the United States are required to measure, evaluate, and improve their performance. This initiative began 25 years ago as "quality assurance" which was a retrospective chart review by nonphysicians looking for documentation of predetermined criteria alleged to reflect acceptable quality of physician performance. Quality assurance evolved through concepts known as "total quality management" and then "continuous quality improvement" to what is known today as **performance improvement** (PI). PI emphasizes a continuous multidisciplinary effort to measure, evaluate, and improve both the **process** of care and the **outcome**. A major objective of PI is to reduce **inappropriate variation in care**. Trauma centers at all levels are expected to demonstrate a clearly defined PI program for the trauma population which is integrated into the hospitalwide program.

The traditional use of empiric "audit filters" or "indicators" to measure the effectiveness of the process of care have had limited value, since many of these resource-consumptive tools do not correlate with outcome. However, some selected filters, such as those readily available in trauma registries or hospitalwide PI programs (for example, unplanned readmissions) are reasonable for trending, especially when comparative benchmarking data becomes more available. The development of expectations (criteria) from evidence-based guidelines, pathways, and protocols presents an alternative for measuring the process, expected outcomes, and consistency of care. This model also allows for measurement of the cost-effectiveness of care.

Modern PI in trauma care is a continuous cycle of monitoring, assessment, and management (Figure 1). PI must be supported by a reliable method of data collection which consistently gathers valid and objective information necessary to identify **opportunities for improvement**. The process of analysis must occur at regular intervals and include multidisciplinary review. The results of analysis should define corrective strategies and must be documented. The effect of this change is then evaluated as the cycle repeats itself.

An effective PI program must therefore contain a number of elements for successful implementation, including (1) authority and accountability for the program, (2) a well-defined organizational structure,

FIGURE 1
CONTINUOUS PROCESS OF PERFORMANCE IMPROVEMENT

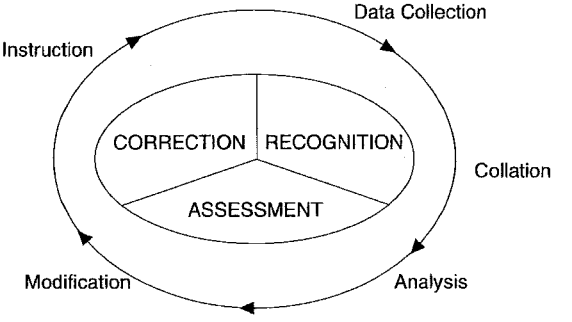
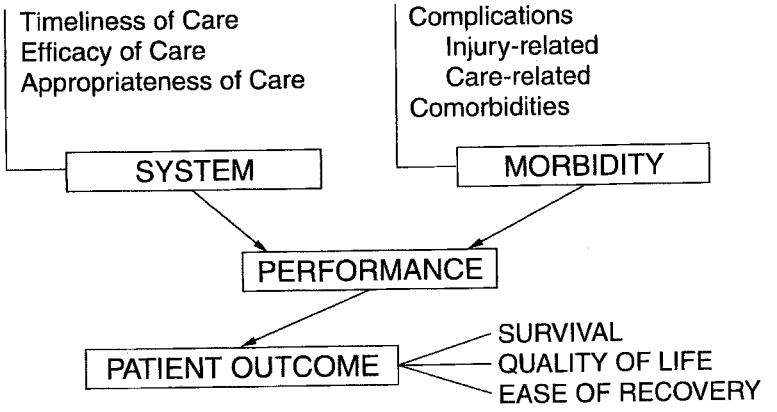


FIGURE 2
DETERMINANTS OF PERFORMANCE



(3) appropriate, objectively defined standards to determine quality of care, and (4) explicit definitions of outcomes derived from institutional standards.

III. PROGRAM CONFIGURATION

A. Administrative Accountability

Since it crosses many specialty lines, the trauma program must be empowered to address issues which involve multiple departments. The program, including trauma PI, should be approved by the hospital governing body as part of its commitment to optimal care of the injured patient. This should include adequate administrative support as well as defined lines of authority which will guarantee comprehensive evaluation of all aspects of trauma care. The trauma program must have a director with the authority and administrative support to lead the program. A trauma nurse coordinator/trauma program manager is a critical component of a trauma program. While the physician director remains responsible for the overall function of the trauma program, the trauma nurse coordinator/trauma program manager is usually responsible for logistic information, coordination of daily data processing, and monitoring of the effectiveness of interaction of all involved services, including case management and resource utilization.

TABLE 1
DEFINITION OF TRAUMA PATIENT ADOPTED BY NATIONAL TRAUMA DATA BANK (NTDB)

- Any patient with **ICDA-9-CM** discharge diagnosis *800.00–959.9*
  - –Excluding 905–909 (late effects of injury)
  - –Excluding 910–924 (blisters, contusions, abrasions, and insect bites)
  - –Excluding 930–939 (foreign bodies)
- All trauma-related hospital admissions
- All injury-related deaths in ED or after admission

B. Trauma Privilege Assessment

The trauma director must have the authority to set the qualifications for the trauma service members and to recommend changes for the trauma panel based on performance review. Evaluation of the practitioners' continuing education, resource utilization, complications, mortality rates, and participation in evidence-based guidelines, pathways, and protocols should be reviewed by the trauma director for subsequent recommendation of privileges and credentialing. The granting of privileges and credentialing are a departmental and medical staff function.

C. Population to Be Monitored

Criteria for determination of what constitutes a "trauma patient" may vary among regions. Table 1 outlines the trauma patient definition of the National Trauma Data Bank™ (NTDB™) of the ACS COT. This definition may be supplemented by at least a rudimentary data set describing all patients who present for care of any traumatic injury. This "denominator" can help to quantify the institution's service volume, enabling the trauma program to monitor injury control from an "inclusive" perspective.

D. Categories of Performance

1. General Principles

The meaning of outcome measurement varies from the perspective from which it is viewed. The patient anticipates a complete and rapid recovery; the administrator and payer review the cost of care; and the surgeon emphasizes the quality of care. No matter what the

perspective, most would agree with a goal of improving the **value** of trauma care. The spectrum of performance evaluation can extend from institutionwide variables to measures of individual practitioner performance. Figure 2 illustrates the relationship among performance variables that influence outcome. The three basic components are system of care, morbidity, and outcome. Another useful method of viewing performance is through the "value equation":

$$\text{Value} = \frac{\text{Quality of process} + \text{Quality of outcome}}{\text{Cost}}$$

Value can be increased by improving quality of process or outcome or by decreasing cost. However, a modest increase in cost which significantly improves quality can also add value. This perspective can help prioritize performance improvement initiatives.

2. Process Measures (Examples)

The following categories of process variables require defined criteria (expectations) which can be determined from consensus, institutional guidelines, or ideally, nationally derived evidence-based guidelines. Some require peer review for determination. It is practical to monitor several rather than all of the following examples.

- Compliance with guidelines, protocols, and pathways
- Appropriateness of prehospital and ED triage
- Delay in assessment, diagnosis, technique, or treatment
- Error in judgment, communication, or treatment
- Appropriateness and legibility of documentation
- Timeliness and availability of X-ray reports
- Timely participation of subspecialists
- Availability of operating room—acute and subacute
- Timeliness of rehabilitation
- Professional behavior
- Availability of family services
- Insurance carrier denials
- Consistency of outpatient follow-up

3. Outcome Measures (Examples)

- Mortality (see definition)
- Morbidity (complications; see definitions)
- Length of stay—ICU and total
- Cost
- Quality of life (for example, functional independence measure; see Chapter 12: Rehabilitation)
- Patient satisfaction

IV. DATA COLLECTION

A. The Trauma Registry

Many useful software products that facilitate the recording and analysis of injury-related data are available. The Trauma Registry of the American College of Surgeons (NATIONAL TRACS®) is one such tool developed by the ACS COT specifically to facilitate the process of continuous PI and care of the injured patient. These registries are useful for providing quantitative as well as qualitative data for trending. The ACS COT strongly encourages institutional trauma registries to participate in a regional, state, or national trauma database, such as the NTDB. This allows for comparative analysis and benchmarking. Ultimately, integration of trauma registries into hospital information systems will greatly facilitate the data-gathering process. Trauma centers with low volume (for example, less than 300 patients per year) may utilize the hospitalwide information system as a data collection tool for their trauma PI program. This is acceptable as long as the trauma patient population can be separately analyzed using the essential elements described in this chapter.

B. Concurrent Care Evaluation

Using an occurrence tracking form (see Figure 3), concerns may be brought forth from a variety of sources, including trauma nurse coordinator, nurse managers, case managers, hospitalwide PI coordinators, pathway and protocol coordinators, patient-relations personnel, risk management, and daily rounds.

C. Structured Review Processes

Focused audits and structured reports from the hospitalwide PI database can be useful. Minutes from the multidisciplinary structured review and educational processes, as outlined in the next section, is a valuable format for data collection.

V. MULTIDISCIPLINARY REVIEW

The goals of multidisciplinary review are to (1) review the performance of the trauma program, (2) provide education, and (3) provide peer review. These three activities can be accomplished in a variety of formats, depending on the volume of the trauma patients. In most Level I and some Level II trauma centers, each of the activities exists as a trauma-specific function. In some Level II and most Level III trauma centers, these activities are incorporated into departmental or medical staff functions. **It is expected that the trauma patient population can be identified for review.**

A. Trauma Program Performance Committee

This function is accomplished by a multidisciplinary committee which should ideally include representa-

FIGURE 3
PERFORMANCE IMPROVEMENT TRACKING FORM (EXAMPLE)

Demographics	**Source of information (✓)**	**Location of issue (✓)**
Date of report _____	❑ Trauma nurse coordinator	❑ Prehospital
Medical record # _____	❑ Nurse management	❑ Resuscitation
Trauma registry # _____	❑ Case manager	❑ Imaging
Attending # _____	❑ PI coordinator	❑ Lab
Floor _____	❑ Patient relations	❑ OR
	❑ Risk management	❑ PACU
	❑ Rounds	❑ ICU
	❑ Conference	❑ Floor
	❑ Registry	❑ Rehab
	❑ Other _____	❑ Other _____

Complication, occurrence, problem, or complaint:

_____

_____

_____

_____

_____

Reported to _____ **Reviewed by** _____

Determination:	**Preventability:**	**Corrective Action(s):**	
❑ system-related	❑ nonpreventable	❑ unnecessary	❑ peer review presentation
❑ disease-related	❑ potentially preventable	❑ trend	❑ resource enhancement
❑ provider-related	❑ preventable	❑ education	❑ process improvement team
❑ cannot be determined	❑ cannot be determined	❑ guideline/protocol	❑ privilege/credentialing action
		❑ counseling	❑ other _____

Comments:

_____

_____

_____

Signature _____ **Date** _____

tives from all phases of care provided to the injured patient. 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 **system-related** performance issues. Minutes should reflect the review, including, when appropriate, the analysis and proposed corrective actions.

B. Education

A periodic trauma case review or didactic conference is useful for providing corrective action. This conference usually occurs weekly in high-volume centers, but may be incorporated into existing departmental conferences on a monthly basis in lower-volume centers. When an educational conference is based in a medical staff or departmental conference, every effort should be made to include the appropriate disciplines, such as emergency medicine, anesthesiology, trauma surgery, orthopaedics, and neurosurgery.

C. Trauma Peer Review Committee

Trauma centers must be familiar with state laws governing peer review. Most peer review activities are protected from discovery; however, minutes from peer review activities should be written as if they may be read by anyone.

The peer review process can be in a committee or conference format and includes a multidisciplinary physician review of provider performance. Nonphysicians may participate at the discretion of the trauma director and in compliance with hospitalwide policies and state peer review laws. The multidisciplinary physician group should include the trauma surgeons and a representative from emergency medicine, anesthesiology, neurosurgery, and orthopaedics. There is no absolute prescription for the makeup and format of this activity which will be dependent on the patient volume and practice model. The specialists in low-volume trauma centers may be invited selectively for discussion of issues directly relating to their care. The ACS COT strongly encourages wide multidisciplinary physician participation, even for patient care issues resting outside their specific areas of expertise.

Both provider-related morbidities and mortalities should be reviewed. All mortalities should be reviewed by the trauma director or his or her designee. Based on this review, selected mortalities may then be formally presented. Morbidities should follow a similar format. It may be helpful to grade the morbidities and determine the preventability of the morbidities and mortalities (see Table 2). It is useful to determine whether the morbidity or mortality is disease-related or provider-related. Provider-related issues can be separated into credentialed providers and noncredentialed providers (see Table 3). Credentialed provider-related issues which are potentially preventable or preventable should be integrated in the hospitalwide peer review process.

VI. CORRECTIVE ACTION

Monitoring and evaluation may determine that performance meets or exceeds expectations. It may be useful to monitor trends continuously or periodically. When a consistent problem or inappropriate variation is determined, corrective actions must be taken. Examples of corrective actions may include:

- Guideline, protocol, or pathway development
- Education (for example, rounds, conferences, journal clubs)
- Enhanced resources, facilities, or communication
- Process improvement team implementation
- Counseling
- Peer review presentations
- Change in privilege or credentials
- External review

VII. CLOSING THE LOOP (RESULT)

Performance improvement means demonstrating that a corrective action has the desired effect as determined by continuous evaluation. Improvement cannot always be demonstrated with compelling data, but it can be demonstrated that significant effort to improve has occurred. Therefore, some loops may never completely close; however, demonstration of the continuous pursuit of PI is essential to all trauma programs.

TABLE 2—GRADING SEVERITY OF COMPLICATIONS IN SURGERY

Grade I	Alterations from the ideal postoperative course Non–life-threatening No lasting disability Necessitate only bedside procedures; do not significantly extend hospital stay
Grade II	Potentially life-threatening No residual disability Subdivision made according to requirement for invasive procedures
Grade III	Residual disability, including organ resection or persistence of life threatening conditions
Grade IV	Death

Adapted from Clavien PA, Sanabria JR, Strasberg SM: Proposed classification of complications of surgery with examples of utility in cholecystectomy. *Surgery* 1991; 111(5): 518–526.

TABLE 3
DEFINITIONS OF TERMS

complication

Any event that deviates from an anticipated uneventful recovery from illness or surgery.

disease-related

An event or complication that is an expected sequela of a disease, illness, or injury.

morbidity

Any deviation from normal health which may be a result of a complication or may be pre-existing (sometimes called a comorbidity).

nonpreventable

An event or complication that is a sequela of a procedure, disease, illness, or injury for which reasonable and appropriate preventable steps had been taken.

potentially preventable

An event or complication that is a sequelae of a procedure, disease, illness, or injury that has the potential to be prevented or substantially ameliorated.

preventable

An event or complication that is an expected or unexpected sequela of a procedure, disease, illness, or injury that could have been prevented or substantially ameliorated.

provider-related

An event or complication resulting from care given by prehospital personnel, technicians, nurses, or physicians leading to delays or errors in technique, judgment, treatment, or communication.

credentialed provider

A health care professional whose education, training, and performance have been evaluated through an explicit process by his or her appropriate peers.

noncredentialed provider

A health care professional providing direct patient care according to his or her job description and performance standards and whose performance is assessed on a regular basis by a credentialed provider.

system-related

An event or complication not specifically related to a provider or disease, such as, operating room availability, blood availability, and diagnostic test availability.

TABLE 4
STANDARDIZED TRAUMA-RELATED DEFINITIONS*

acute respiratory distress syndrome (ARDS)
Pao_2/Fio_2 <250, decreased compliance, diffuse pulmonary infiltrates associated with normal capillary wedge pressure in an appropriate setting. "Decreased compliance" is defined as abnormal per criteria established by institution.

1. Acute onset
2. $Pao_2/Fio_2 \leq 200$
3. Bilateral infiltrates on frontal chest radiograph
4. PAWP ≤18 mm Hg when measured or no clinical evidence of left atrial hypertension

aspiration pneumonia
History of aspiration of gastric contents followed by clinical and new radiologic findings of pneumonitis within 48 hours.

bacteremia
Any positive blood culture (NOT contaminants).

cardiac arrest
Sudden cessation of cardiac activity AFTER ARRIVAL in ED, resulting in deprivation of sufficient oxygen to maintain viability of heart and brain.

coagulopathy
Uncontrolled diffuse bleeding in the presence of coagulation abnormalities (for example, increased PT or PTT, decreased platelets, or DIC) requires treatment.

compartment syndrome
Clinical evidence of increased compartment pressure with or without development of sensory or motor deficit not present on admission in a patient following blunt or penetrating extremity injury.

deep vein thrombosis (DVT) in lower extremity
Venous thrombosis proximal to or involving popliteal vein confirmed by autopsy, venogram, duplex scan, or noninvasive vascular evaluation.

residency programs provide a service function to trauma centers, but the educational experience should be the prime focus. The residency training program should emphasize direct supervision and teaching of residents by dedicated attending surgeons who have demonstrated an interest in trauma surgery. The COT believes that Level I trauma centers should support surgical residency training programs.

Those trauma centers that support residency training programs and fellowships in trauma must have a clear written curriculum for the development of trainee expertise and appropriate trainee supervision within the trauma program. Additionally, the resident should be given an introduction session to the trauma service and have at least weekly educational conferences with the trauma attending staff. At a minimum, a Level I trauma center must have a senior resident rotation in at least one of the following disciplines: emergency medicine, general surgery, orthopaedic surgery, or neurosurgery, or support a trauma fellowship consistent with the educational requirements of the American Association for the Surgery of Trauma (AAST) (see Appendix C).

In addition to ATLS, continuing medical education programs are important to maintain and enhance the knowledge and skills to care for the injured patient. Cooperative arrangements with other institutions may enhance available educational programs and reduce unnecessary duplication. Postgraduate trauma education for nurses is available. Some nurse practitioners may choose to specialize in trauma. Nurses and other allied health professionals who are involved in the trauma program must have their educational needs identified and served.

Multidisciplinary education must be ongoing in all trauma centers. Performance improvement programs should be an important part of educational activities. Intramural educational programs are an efficient means of providing information to the trauma team. Trauma centers should expend financial resources to facilitate intramural and extramural educational programs.

Successful completion of the ATLS Course is required for all general surgeons on the trauma team. If a general surgeon on the trauma team has extensive experience and recognized competence in trauma care, the trauma service director may waive the obligation for ATLS reverification.

Continuing medical education should be appropriate to the population being served. All members of the trauma team should be involved in at least 16 hours of trauma-related CME annually. Over a three-year period, one-half of these hours should be obtained outside the surgeon's own institution, (programs given by visiting professors and invited speakers are considered outside education). Other surgical specialists involved in trauma care are encouraged to participate in trauma-related CME activities on a regular basis. Computer programs in trauma education are available, and the use of computer networks may facilitate some educational efforts.

OUTREACH

Outreach is the act of providing resources to institutions and individuals that do not have the opportunities to maintain current knowledge and skills. The best outreach is done to provide better care through improved systems and education. Explanation of the principles of triage and interhospital transfer is one major objective of a good outreach program.

Public education and professional education are also important components in outreach programs. Small hospitals should have access to consultation by staff members from trauma centers to improve resuscitation resources. ATLS, PHTLS, TNCC, FNATC courses, and medical/nursing staff conferences can be provided and coordinated by the trauma center. Trauma surgeons and their colleagues in the trauma center must provide follow-up to referring doctors about specific patients to educate the practitioner for the benefit of future injured patients.

The depth of outreach activities depends on many issues within a system of care. Use of electronic technology, including computer and telemedicine links, should be considered.

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CHAPTER 17

EDUCATION AND OUTREACH

Public and professional education is the responsibility of all trauma centers in order to enhance prevention, increase knowledge, and ultimately provide better care. The impact of financial pressures to reduce educational resources is real; each trauma center should expend resources to meet the needs of its staff, prehospital providers, and lay community.

PUBLIC EDUCATION

Trauma center personnel must educate the public about injury as a significant disease and public health problem. The public and their elected representatives, armed with knowledge about injury, may provide the stimulus for change in attitude and may improve recognition for injury as a disease entity. The ability of special interest groups to generate huge resources for some rare diseases is worthy of imitation. Trauma-related activities are chronically underfunded, but through active public educational programs, this tide may be turned.

Injury prevention is the most logical means to reduce death and disability. Many educational programs are available locally and nationally. Death and disability rates have decreased when prevention efforts are accompanied by legislative activities; for example, drinking and driving, seat belt usage, and motorcycle helmet usage. Youth programs which invoke peer pressure have been successful in many areas. All trauma centers must be involved in prevention activities (see Chapter 18: Prevention).

Public education may be life- and limb-saving. The importance of early access for care of the injured cannot be overemphasized. This may be accomplished only when the public is aware of the local means of access to the trauma system. Emergency 911 systems are used commonly in the United States, but when 911 is not available, the public must be taught other means of access, such as other phone numbers, radio, and so on.

First aid courses and CPR classes (airway skills) teach basic management principles to the lay person. Good educational programs to teach simple life- and limb-saving skills and to avoid harm to the injured are needed to enhance any trauma system. Many organizations have these types of programs available and welcome the participation of trauma centers and systems personnel.

PROFESSIONAL EDUCATION

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 the basic trauma educational endeavor for health care professionals. The unique educational design of the ATLS Course provides both information and skills necessary for physicians involved in the care of the injured. The course has been taught to and by individuals who practice in all environments because it teaches a "language" that can be used by all members of the trauma team. This course is available in all 50 states through the American College of Surgeons Committee on Trauma. No other national program has been developed that formally teaches the same information in a concise format. The ATLS Course is for physicians; other courses have been developed for prehospital personnel (Prehospital Trauma Life Support [PHTLS] and Basic Trauma Life Support [BTLS]), flight nurses (Flight Nurses Advanced Trauma Course [FNATC]), and emergency nurses (Trauma Nurse Core Curriculum [TNCC]). The PHTLS and FNATC parallel the ATLS Course closely. The TNCC program provides guidelines and skills for the emergency department nursing staff. Formal residencies, fellowships in trauma, or graduate programs are not substitutes for the demonstrated value of these programs. The ATLS Course and/or comparable appropriate programs should be available. Level I trauma centers are expected to provide or participate in an ATLS Course on a regular basis.

Residency training programs are highly desirable within a trauma system. The ACS COT recognizes that

5. Systemic vascular resistance <800 dynes/sec/cm5
6. Unexplained metabolic acidosis (base deficit of <= -5 mEq/L)

Patient may have all of the aforementioned without source of infection identified.

urinary tract infection

Clean voided or catheter urine specimen with ≥10 WBC/HPF or ≥50K organisms/mL on C/S.

wound infection

Drainage of purulent material from wound or active treatment of the wound, including opening a closed wound or antibiotics for the wound.

*Consensus definitions from the Committee on Trauma Subcommittee on Quality Improvement (May 1995).

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disseminated fungal infection
Clinical picture of sepsis with isolation of fungus from the blood, ***or*** 2 or more nonhematogenous sites, ***or*** tissue biopsy, ***or*** positive fundoscopic findings.

dehiscence/evisceration
Breakdown of fascial closure confirmed by discharge of peritoneal fluid, evisceration, or palpable fascial defect.

empyema
Positive culture of purulent material from pleural space requiring thoracostomy tube drainage.

esophageal intubation
Endotracheal tube in esophagus and not immediately repositioned. Esophageal location determined by physical examination, X ray, capnography, or endoscopy.

hypothermia
Temperature ≤35°C.

intraabdominal abscess
Localized collection of purulent material in the abdominal cavity confirmed by Gram stain or culture.

jaundice
Total bilirubin ≥2.5 and AST or ALT greater than twice normal.

failure of fracture fixation
Configuration of reduced fracture changed enough to warrant reoperative reposition of fragments.

mortality
All deaths; mortality rates should be presented with a defined denominator.

$$\text{gross mortality rate} = \frac{\text{all trauma-related deaths}}{\text{all trauma admissions}}$$

$$\text{trauma service mortality rate} = \frac{\text{trauma service deaths}}{\text{all trauma service admissions}}$$

$$\text{adjusted mortality rate} = \frac{\text{trauma service deaths (excluding DOA)}}{\text{all trauma service admissions}}$$

myocardial infarction
Acute, irreversible myocardial injury and necrosis documented by increased troponin and serial T wave, S-T segment; or Q wave ECG changes; or a diagnostic radionuclide scan.

no response to resuscitation (surrogate to DOA)
Brief in-hospital CPR or interventions do not preclude DOA designation. Suggested guidelines include:

- A patient presenting to the emergency department without signs of life (absence of pulse, spontaneous movement, respiratory effort, or effective cardiac electrical activity) and
- Adult
  - blunt trauma; prehospital CPR >5 minutes; or
  - penetrating trauma—abdomen, head, neck, groin; prehospital CPR >5 minutes; or
  - penetrating trauma—chest; prehospital CPR >15 minutes; or
  - Child (age <13)
  - blunt or penetrating trauma, prehospital CPR >15 minutes (open or closed) without spontaneous pulse.

pancreatitis
Any hyperamylasemia associated with ultrasound or CT findings compatible with pancreatic inflammation.

pneumonia
Presence of fever, leukocytosis, Gram stain of sputum with a predominant organism and white blood cells, chest radiograph with a pneumonic infiltrate, and culture of sputum demonstrating a pathogen.

pneumothorax
Presence of intrapleural air.

skin breakdown
Contact pressure-induced skin breakdown.

progression of original neurologic insult
Deterioration or additional loss of function from that noted on arrival in ED.

pulmonary embolus
Embolus to the lungs documented by arteriography, nuclear scan, or autopsy.

renal failure
Creatinine ≥3.5 mg/dL; or BUN ≥100 mg/dL.

sepsis-like syndrome
At least one of the following:

1. Rectal temperature of 39°C or higher
2. WBC count >10,000/cu mm or >20% immature neutrophils
3. Suspected source of infection (gross pus in a closed space)
4. Blood pressure <80 mm Hg for 2 hours or more

CHAPTER 18

PREVENTION

"INJURY DOES NOT OCCUR BY ACCIDENT"

Trauma centers play an important role in reducing the impact of injury by participating in prevention efforts. These efforts are based on identification of specific injuries and risk factors in the community. Prevention is often the only means of dealing with this health care problem.

The trauma center should use its trauma registry to identify the pattern, frequency, and risks for injury within the community. Trauma centers, working together with prehospital providers, rehabilitation experts, local community groups, governmental agencies, national organizations, private foundations, and schools of public health, can have a significant impact on lessening the morbidity and mortality of trauma. Prevention is the component least well integrated into trauma care systems at present. Injury surveillance is infrequently recognized as a powerful tool to reduce injury. Institutions caring for injured patients must establish and aggressively pursue a leadership role in injury prevention.

Hospital-based injury surveillance identifies only those patients that survive to reach a trauma center. Since 50 percent of all patients who die of injury never reach a hospital or trauma center, improvements in the delivery and technology of trauma care cannot have an effect on these immediate deaths. A major impact on these lethal injuries can be realized only through the implementation of effective trauma prevention programs. Institutional trauma registries are not population-based and, consequently, do not accurately characterize the types and patterns of injury within a community. The prevention effort requires an accurate picture of injury occurrence. In addition, institutions, health care providers, and consumers must work together to capture and report these data to accurately evaluate potential interventions. Scientifically based and implemented injury control programs are effective[1–3] in reducing unnecessary morbidity and mortality. All trauma centers, regardless of resources, have an obligation to participate in trauma prevention.

Injury generates enormous direct and indirect cost. Effective prevention strategies have the potential to reduce these costs. Prevention efforts represent a valuable strategy in an environment of limited health care resources. Each trauma center should base the extent of its involvement upon the availability of resources. Many institutions can take advantage of existing prevention programs. Development of new programs and injury surveillance systems designed to monitor outcomes require extensive resources and may be most appropriate for centers that pursue these avenues as a primary focus of their research commitment. If trauma care is to be supported by a society with limited health care resources, a commitment to prevention is necessary.

PRINCIPLES OF INJURY SURVEILLANCE AND CONTROL

Injury prevention falls into three categories. Primary prevention strategies are designed to prevent the occurrence of the injury itself; for example, legislation to limit sale of alcohol to teenagers. Secondary prevention measures seek to limit energy transfer to the individual, thus minimizing the severity of the injury; for example, implementation of a bicycle helmet use campaign. Tertiary prevention is targeted at improving outcome following injury; for example, institution of prehospital triage to trauma centers.

Injury prevention strategies implemented at the local level are the most effective. Individuals are reached and lives saved through the actions of local "grassroots" contacts and programs. Prevention strategies are most successful when they focus on specific high-risk groups. Important criteria for a prevention program are (1) frequency of event, (2) substantial effect on society, (3) proven efficacy and age appropriateness, (4) adequate resources to implement those strategies, and (5) measurable outcome. A prevention strategy is neither complete nor defensible without some means of measuring its effectiveness in the target group.

Traditionally, prevention endeavors have focused on education, enactment/enforcement, and environmental modification. The more injury prevention relies on behavioral change, the less successful it will be. Educational strategies to accomplish prevention assume that the target audience is motivated and ready to change risk-taking behavior. High-risk individuals are often resistant to the necessary behavioral changes that would reduce their potential for injury. Educational effects deteriorate over time, requiring constant reinforcement to remain effective. Specific discrete periods of high-risk activity due to social circumstances and time of the year can be effectively targeted. This targeting is the principle behind the staging of "mock prom disasters" in high schools. The goal is to impact the high-risk group in the period just before risk of injury increases. Strategies to prevent spinal cord injury from diving, drowning in pools, holiday drinking and driving, and fireworks injuries are similar in design. Educational efforts targeted at seat belt use, bike helmet safety, or gun safety are examples of programs which, when applied continually, can be effective.

Enforcement as a prevention activity requires legislation. Enforcement has the advantage over education of being an external motivating factor responsible for enhancing compliance and penalizing noncompliance. The threat of penalty replaces the awareness of consequences "taught" through education. Legislation is often thwarted by the lack of societal compliance. This lack can take the form of individual resistance, lack of enforcement, or loss of legislative commitment.

TABLE 1
POTENTIAL INSTITUTIONAL ACTIVITIES

Epidemiology Research

- Monitor progress of prevention programs[1]
- Evaluate effectiveness of prevention programs[2]
- Conduct original research in injury control
- Collaborate with epidemiologists and other institutions

Surveillance

- Collect vital statistical data
- Minimal versus expanded trauma registry data[3]
- Collaborate with other institutions in surveillance
- Special ED and field collection projects[4]

Prevention

- Designated prevention coordinator-spokesperson for injury control[5]
- Outreach activities
- Information resources for public and legislators
- Monitoring and advocacy for primary injury prevention legislation
- Training health care professions in prevention[6]
- Develop policies and practices that create a culture of health promotion and safety within the institution
- Links to departments of health and community health
- Collaboration with existing national, regional, and state programs
- Program development and implementation[7]
- Coordination and/or participation in community prevention activities

[1] Monitoring the process of programs may include issues such as number of infant car seats distributed, percentage of working smoke detectors in homes, and use of seat belts and/or motorcycle/bicycle helmets.

[2] Evaluation of effectiveness of prevention programs may include such parameters as fatalities, hospitalization rates, and severity of injuries.

[3] Expanded data on prevention include blood alcohol levels, toxic agent presence, use of restraint systems, and helmet utilization.

[4] Capability of doing special data collection projects as need is identified, such as monitoring bicycle helmet use in the community.

[5] Part of trauma care coordinator effort.

[6] Provide a primary injury prevention and control course for surgical residents and other health care providers.

[7] Can vary from coordinated bicycle helmet use campaigns, to developing public service announcements for broadcast, to injury prevention fairs, to loaner infant car seat programs.

Automatic, environmentally based strategies designed to eliminate hazards and risks for injury occurrence provide the optimal prevention and require the least amount of active participation by the individual to be effective. Examples include highway planning, automobile design, lower water heater temperatures, power take-off guards, and tractor roll-bars.

DEVELOPMENT OF A PREVENTION PROGRAM

The more defined and focused a program is, the easier and more effective it will be to implement for the individual institution. A systematic, organized approach that moves through a specific series of steps will produce the most comprehensive and effective program. Not all steps will be appropriate for each institution; however, each step should be carefully analyzed to ensure that appropriate support and data are available to help guarantee a successful program. The steps to identify and implement an injury prevention program are as follows:

1. Select a target injury population
2. Gather and analyze data
3. Develop intervention strategies
4. Formulate the plan
   a. Identify, select, and commit agencies
   b. Develop protocols and materials
   c. Orient and train agencies/individuals
5. Implement the program
   a. Monitor
   b. Support
6. Evaluate and revise

Contact and consultation with experts should be made early in the process to locate resource materials and to optimize program planning and success. Community coalitions are critical for success. The trauma center should be a leader in ongoing program evaluations.

Trauma center activities in injury control should involve epidemiology research, surveillance, and/or prevention program involvement. The extent and depth of these efforts will be determined by the resources available to a particular institution (see Table 1).

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www.aap.org

American Association for the Surgery of Trauma
www.aast.org

American College of Surgeons (ACS)
Trauma Department
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Chicago, IL 60611-3211
phone: 312-202-5342
fax: 312-202-5005
www.facs.org

American Trauma Society
8903 Presidential Parkway
Suite 512
Upper Marlboro, MD 20772-2656
phone: 800-556-7890
fax: 301-420-0617
www.amtrauma.org

Center for Injury Prevention and Control (CIPC)
CDC
4770 Buford Highway NE, MS K-65
Atlanta, GA 30341-3724
www.cdc.gov/ncipc/nciphm.htm

Children's Safety Network
National Injury and Violence Prevention Resource Center
Education Development Center
55 Chapel Street
Newton, MA 02158-1060
phone: 617-969-7100
fax: 617-244-3436
www.edc.org

Consumer Product Safety Commission
Washington, DC 20207
phone: 800-638-2772
fax: 301-504-0051
http://www.cpsc.gov

Emergency Medical Services for Children (EMS-C)
National Resource Center
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  www.ph.ucla.edu/sciprc/sciprc1.htm

Insurance Institute for Highway Safety
1005 North Glebe Road
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phone: 703-247-1500
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e-mail: iihs@highwaysafety.org
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National Highway Transportation Safety Administration (NHTSA)
400 7th Street SW
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National Safe Kids Campaign
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e-mail: info@safekids.org
www.safekids.org

Rural Injury Prevention Resource Center
National Farm Medicine Center
1000 North Oak Avenue
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fax: 715-389-4950
http://www.marshmed.org/nfmc/

Think First Foundation
22 S. Washington Street
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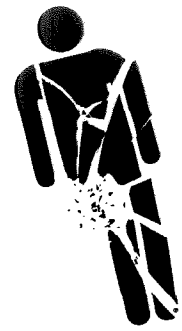
CHAPTER 19 RESEARCH



Research, which is involved in the advancement of knowledge, is critical to improving the care of the trauma patient. Traditionally, research has been one of the components that has distinguished a Level I trauma center from other trauma centers. The infrastructure and support system of Level I trauma centers often enable them to be the most effective in the area of research. This chapter will attempt to outline some of the components of a successful research program, such as (1) type of research designs; (2) analysis of data, reporting, and disseminating research findings; and (3) obtaining funding for research.

The research portfolio of a hospital seeking ACS verification or regional designation should be balanced to reflect a number of different interests. Questions regarding the physiology of injury are best answered using rigorous scientific methods in basic research laboratories, whereas clinical research is a common area of research in hospitals that treat large numbers of trauma patients. Focused research in the intensive care unit often provides a "bridge" between basic laboratory research and clinical care The development of large relational databases facilitates evidence-based research involving the epidemiology of injury, the effect of trauma systems on patient outcomes, the design of trauma systems, and efficacy of prevention programs.

Regardless of the type of research, the scientific method is critical to the design and conduct of a successful research project. An initial literature search is important so that the researcher does not merely recapitulate what has already been stated in the literature. It is also critical that an initial hypothesis be generated in order to allow construction of the research design and proper analysis of the data. Although hypotheses may be easier to formulate in controlled laboratory experiments, they are just as important in clinical research. An open-ended approach that "looks at" a problem without a focused hypothesis or valid research question often leads to difficulties with data analysis or may introduce substantial bias into the study, which invalidates the conclusion. The hypothesis for the research project must be clearly stated prior to collecting and analyzing the data.

STUDY DESIGN AND DATA ANALYSIS

When conducting a clinical research project on a specific problem in trauma, the investigator must select an appropriate study design. For example, if a particular therapy is being tested or compared with others, the best design is a prospective randomized double-blind trial with large numbers of patients. On the other hand, when multiple physiologic events are being analyzed in a small number of intensive care unit patients, the various physiologic data can be compared. Finally, the investigators studying the epidemiology of injury or specific injury types using large computerized databases should understand the methods of data collection, sources of bias, and the complex statistical analyses required in such studies. Although these databases may contain patients, discrete data points are limited by logistics of data collection. Unfortunately, because of this paradox, these studies are usually limited to phenomenologic studies. Nonetheless, the power of computer databases enables relatively rapid testing of preliminary hypotheses. Further focused analyses usually require traditional chart review or prospective studies to test hypotheses.

DATA ANALYSIS

The advice of a statistician prior to data collection helps avoid bias and/or wasted efforts in research projects. Studies involving large databases often require multiple logistic regression analysis and more complex data transformations (for example, neural networks). The value of involving an experienced statistician as a consultant or co-investigator cannot be overemphasized. An experienced statistician should be involved as a consultant at the start of the project, not later when data may be muddled. Collaborations between trauma surgeons and social scientists have been very productive in a number of Level I trauma centers in the U.S.

RESEARCH ACTIVITY

Any trauma center program should involve research that evaluates local results (see Chapter 15: Trauma Registry and Chapter 16: Performance Improvement). Trend analysis of morbidity and mortality and assessment of selected filters of quality of care help discern patterns over time. Often, data tracking with a trauma registry will raise new research questions. True outcomes research involves assessing rehabilitation status, return to work, late complications, and socioeconomic factors. These studies are critical to move clinical trauma research beyond studies focused solely on mortality.

In many centers, the trauma nurse coordinator and the trauma registrar act as part of the research team by accumulating data and developing reports on a regular basis. When clinical studies are contemplated, a clinical research nurse or clinical specialist should coordinate the selection of patients, adherence to protocol, specimen acquisition in a timely fashion, generation of reports, and maintenance of quality research control.

The research commitment of an institution is helpful in differentiating a Level I trauma center from other institutions caring for injured patients. A Level I trauma center must have a research committee, an identifiable Institutional Review Board process, active research protocols, surgeons involved in extramural educational presentations, and an adequate number of peer-reviewed scientific publications.

FUNDING

Research requires funding. Ideally, the administration of a trauma center should contribute to the research effort with money or personnel. Most of the funding for the trauma research program will come from extramural sources. Several funding mechanisms exist to allow interested individuals or institutions to become involved in research. There are several sources for external funding, such as the National Institutes of Health, the Centers for Disease Control, the National Highway Traffic Safety Administration, Agency for Health Care Policy and Research, the Department of Transportation, and private foundations. These programs are highly competitive, but they have been extremely valuable in preparing academic surgeons and young investigators for a career in trauma. In conducting a research program, development of multidisciplinary interactions with basic scientists, clinicians, and social scientists within one's own institution are invaluable.

A number of these funding sources are in jeopardy at the moment. Private foundations occasionally can be a source of funding. There are a number of programs (for example, Robert Wood Johnson Clinical Scholars Program) that may not be able to provide the funding, but can provide support in kind and invaluable educational experiences for fellows interested in trauma.

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CHAPTER 20

MASS CASUALTIES

Good standards of medical care serve as the best guidelines in responding to disasters. The closer one can hold to standard procedures in the care of disaster victims, the more successful will be the response. The guidelines provided in *Resources for Optimal Care of the Injured Patient* provide a basis for disaster planning. Unfortunately, the demands intrinsic to disaster situations often exceed the resources, capabilities, and orderly procedures of any single hospital.

A disaster is a sudden event with a variable mixture of four factors: injury to or sickness of human beings, destruction or contamination of property, overwhelming demand on local response resources, and disruption of organized societal mechanisms.

Mass casualties may be the result of manmade disasters or natural disasters. Manmade disasters include war and terrorist activities, chemical and nuclear accidents, fires, structural collapse, and major transportation calamities. Natural disasters typically generate a larger number of casualties than manmade disasters and include floods, earthquakes, hurricanes, volcanoes, and tornadoes. Disasters may also be categorized by severity. Level I disasters are readily managed using local resources; Level II disasters require help from adjacent jurisdictions; Level III disasters require use of state and/or federal resources.

HOSPITAL PRIORITIES

Hospitals should have a plan that differentiates multiple and mass casualty events. The difference between these events is largely dependent on local resources: Two severely injured patients may overwhelm the resources of a small rural facility, whereas a large trauma center may be able to provide simultaneous care for many severely injured patients. If a hospital is able to manage the number of casualties with local resources, this is termed a multiple casualty event. Multiple casualty events occur more frequently than mass casualty events, which typically require support from all area hospitals.

Hospitals must rapidly mobilize their resources in response to a mass casualty event. These resources include personnel, equipment, supplies, and bed space. To mobilize these resources efficiently and tailor them to the magnitude of the event at hand, careful preplanning and published protocols must exist. Drills should be based on one of the most likely mass casualty events to happen in that locale (that is, airplane crash for a hospital nearest to an airport) and are ideally performed in conjunction with other hospitals and local emergency medical services (EMS).

Hospital disaster plans should address internal and external events. An event which disables key care providers can quickly limit the ability of the hospital to respond. This problem is magnified if parts of the physical plant are destroyed (especially the emergency department [ED] or operating rooms).

OBSTACLES TO OPTIMAL CARE

Communication is the key to optimal patient care. 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, which interfere with effective communication. Cellular phone systems are quickly overwhelmed and are not a substitute for routine telephone service. Mobile radios with an adequate number of designated frequencies and amateur radio operators are important resources. Other common obstacles are loss of power and potable water. More facilities are using "just-in-time" low inventory systems; therefore, access to a stockpile of up-to-date emergency supplies is critical.

STATE AND NATIONAL RESOURCES

Hospitals must be familiar with state and federal disaster resources. The National Guard can be mobilized through state or local officials. The National Disaster Medical System is a partnership of govern-

ment and private organizations that supplements 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 (DOD). States are mandated by FEMA to have individual disaster plans; 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 hospital a key entity in every disaster response.

HOSPITAL DISASTER PLAN

The individual facility does not operate in isolation when facing a mass casualty event. Even the trauma and EMS systems within which the hospital operates do not exist alone and without possibility of outside assistance. Care must be taken to avoid conflicting disaster plans in any given jurisdiction. Disaster planning must include integration with outside agencies and neighboring hospitals and trauma systems.

Hospital disaster plans must cover 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. The magnitude of the mass casualty event will define the magnitude of the medical response—regional, state, or national. The individual hospital must plan not only for its expected role in event of a local disaster, but also for a Level II or Level III disaster within the region or adjacent regions.

The plan should be simple, graded in its response, and able to deal with both multiple and mass casualties. Surgeons are the best qualified physicians to provide in-house leadership for trauma-related disasters because they have the most comprehensive knowledge of hospital resources.

The hospital disaster plan should include (1) prearranged agreements with the controlling regional emergency operating center and other regional disaster response agencies, including, but not limited to, police, fire, military, utilities, Red Cross, and Salvation Army; (2) an organized response of the hospital for the management of casualties transported from the disaster site; (3) disaster site triage team 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 medical and administrative operational team should have complete familiarity with the plan. The hospital medical staff and personnel should at least have knowledge of the plan.

PREPARATION AND PLANNING

1. **Establish a hospital disaster committee consisting of:**
    a. Chair-physician
    b. Vice-chair-administrative representative
    c. Medical staff representatives from surgery, anesthesiology, pathology, radiology, and emergency medicine
    d. Radiation safety officer
    e. Nursing staff representatives (ED, OR, ward)
    f. Security representative
    g. Communications representatives
    h. Social service representative
    i. Public relations representative
    j. Supply representative
    k. Chaplain
2. **Document potential disasters for the region**
    a. Evaluate local geography, demography, industry, and epidemiology for hazards
    b. Determine the regional history of natural hazards
    c. Sources of information about hazards could include the fire department, law enforcement agencies, National Oceanic and Atmospheric Administration, United States Army Corps of Engineers, and Department of Transportation (hazardous material on highways and railroads)
3. **Establish interagency and interinstitutional agreements**
4. **Determine realistic institutional capacity and capability**
    a. Determine maximum number of beds, categories (ICU, ward, adult, pediatric, burn), and locations
    b. Develop a protocol to assess inpatients for potential early discharge or relocation to make beds available to casualties
    c. Plan mechanism to place hold on elective and nonurgent surgery
5. **Determine desired and available basic and disaster supplies, including hospital inventory and emergency stockpile**
    a. Blood supply—arrangements should be made with the Red Cross and other suppliers of blood and included in simulation exercises

b. Stockpiles of reinforcement supplies available on a 24-hour basis should be located among commercial sources, other institutions, the military, and the Federal Emergency Management Agency, so that they can be obtained readily by telephone

c. Food, water, and energy needs should be considered for specific disasters—consider sources, amounts, and lengths of time

d. Establish minimum daily emergency need for water

6. Develop flow chart of mass casualties through hospital areas, ensuring that

a. Patient flow is unidirectional (to avoid bottlenecks in ED and radiology)

b. Patient traffic does not enter and leave any area through the same door

7. Designate hospital space for

a. Patient unloading area

1) Ground vehicles require careful traffic control with provision for buses and trucks

2) Helicopters need a designated landing area

b. Triage criteria should be developed according to types of injured patients seen and number of victims involved in the disaster

c. A triage area should be designated. Depending on the configuration of the hospital, access to the triage area, and the number of patients involved, this may or may not use the emergency department. (For mass casualties, an area other than the emergency department should be used; the ED should be reserved for patient care.)

d. Critical stabilization area (usually the emergency department)

e. Preoperative area, immediate and delayed

f. Operative area

g. Postoperative area

h. Burn treatment area

i. Minor surgery area

j. Hazardous chemical or radioactive material decontamination areas and receptacles for contaminated materials

k. Expectant area

l. Morgue

m. Psychiatric area within the institution or at nearby schools, hotels, or motels for psychiatrically trained medical, nursing, social service, and security personnel to work with

1) Individuals from the disaster area, including rescue personnel

2) Individuals disturbed by news generated by the disaster

3) Family, friends, and others

n. Press conference room with space for many telephones and for minor amenities outside the patient-care perimeter

o. Record and evidence area

p. Recruitment and assignment office to assist in assessing and assigning volunteers

q. Disaster Support Center, including

1) Administrative control center

2) Communications center

8. Develop a system to call up and assign personnel to designated patient-care areas. Call-up needs should consist of both an internal and external call-up. Emergency department and other in-hospital personnel will be assigned as hospital first-responders for key posts until external call-up can be effected. Keep assignments flexible and updated. Do quarterly update of telephone number rosters. A designated reporting area away from the emergency department for sign-in must be established.

9. Personnel requirements

a. Hospital disaster commander and emergency operating center liaison plus at least two alternates based in the Disaster Support Center

b. The triage physician should be an experienced surgeon who has the knowledge necessary for optimally using the resources required to care for severely injured patients. Physicians need to be available for field triage as a part of a disaster site medical team and for in-house triage as assigned by the disaster commander.

c. Physicians, nurses, a radiation safety officer, and administrative staff are assigned to specific patient-care areas. Develop an instruction packet for use in each patient-care area describing their specific functions during a disaster.

d. A chief security officer in charge of the perimeter and other security to assist in identifying various people, control the press, act as morgue

officer under the pathologist's supervision, and inventory victims' valuables and evidentiary materials

e. Public relations-media person—one individual using the press conference technique should be the sole communication link with the press

f. Patient transport personnel

10. Provision for food and rest for disaster personnel

11. Communication system compatible with other EMS elements (consider the possibility that the present system might be overwhelmed or disrupted)

a. Interagency operating center

1) Emergency operating center

2) Fire department, law enforcement agencies, and ambulance and helicopter services

3) Decide the method of radio frequency selection to be used by each agency

b. Intrahospital system

12. Establish medical record and patient identification systems, including identification of triage category

13. Define institutional and staff security

a. Secure perimeter of hospital

b. Secure perimeter of patient-care area

c. Provide for ready access to all areas of hospital through elevator control and in-hospital crowd control

d. Personnel security (control and identification)

e. Designated area for members of the press

f. Regional hazard assessment

1) Radiation protection

2) Hazardous material protection

3) Emphasize neutrality in riot situations

14. Debrief and counsel disaster and rescue personnel on a routine basis

15. Critique each disaster response and modify the plan to reduce future errors

16. Transfer arrangements

a. Optimal transfer protocols are included in Chapter 4

b. Protocols must include the flexibility needed for disasters

MASS CASUALTY TRIAGE

Mass casualty 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 point in time. By definition, there are inadequate resources to care for this number of patients in the usual manner. The correct concept is to do "the greatest good for the greatest number." Many mass casualty triage classification schemes exist. A simple and useful method of triage involves four categories:

1. Immediate or emergency (needs treatment of life-threatening injuries)
2. Delayed or urgent (can wait 1 to 2 hours or more before treatment)
3. Minimal or ambulatory (can wait many hours for treatment)
4. Expectant or expected to die (given current patient load and resources)

The names and number of triage categories are not as important as the fact that all care providers have an understanding of the system being used. Color-coded triage tags are useful in identifying triage categories (that is, red for immediate, yellow for delayed, green for minimal, and gray for expectant). Patients who are dead need transport to the morgue or other designated area.

Triage of mass casualty patients is not a one-time exercise. Triage may occur at several levels and needs to be both accurate and repetitive. Disaster scene triage may initially be performed by experienced paramedics. Later, an on-site physician may retriage if evacuation of victims is prolonged. Hospital triage requires an experienced surgeon familiar with current hospital resources, including operating room capacity. The resuscitation area and the preoperative holding area are potential sites of secondary triage. Understanding retriage is essential. Patients who have been placed into the expectant category because of lack of resources in a mass casualty scenario may become immediate category patients once operating room resources become available and no further patients are expected to arrive. This is only one of many possible scenarios that serves to underscore the need for repeated triage.

DISASTER SITE MEDICAL TEAMS

A regional disaster plan must provide for an on-site Incident Command Post that includes the presence of a medical director when mass casualties are involved.

The medical director or the disaster director should, if needed, authorize and request on-site medical disaster teams from appropriate hospitals in the region and coordinate transportation from each hospital to the site. These on-site or forward-area teams usually include physicians, nurses, and paramedics who are necessary if (1) victims cannot be extricated promptly, (2) transportation routes are blocked, and (3) the casualties are numerous and complex. All hospitals within a region should cooperate to develop such a capability. At least one institution from each region should maintain the capability of on-site medical disaster teams.

DISASTER RESPONSE EXERCISES

1. Organize a simulation of a potential disaster. Set up the scene, moulage "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 exercise.
4. Critique hospital disaster response after each exercise.
5. Modify disaster plan by lessons learned.
6. Repeat the exercise at least twice a year, recognizing that the response to disasters will never be perfect.

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CHAPTER 21

ORGAN PROCUREMENT ACTIVITIES

Remarkable innovations in surgical technique, organ preservation, and immunosuppression have produced improvements in graft and patient survival following organ transplant. The major limitation to the field of transplantation is the profound shortage of organ donors. The demand for solid organ transplants in the United States has risen 16% per year, but the number of actual donors remains stable at 4,500 per year. More than 40,000 patients await solid organ transplant; many more patients die awaiting transplant than actually receive organs. Only one-third of potential donors ultimately donate organs; the most common reason for lack of donation is family refusal. Other reasons include nonidentification of patients by medical personnel as potential donors, failure to discuss organ donation with the family to donate, or inadequate preservation of the potential organ donor. The trauma surgeon plays a key role in identification of potential organ donors, contacting the organ procurement organization (see Appendix E) and maintaining homeostasis in the brain-dead patient awaiting organ harvesting.

LEGAL CRITERIA FOR DONATION

Uniform Anatomical Gift Act

The Uniform Anatomical Gift Act (UAGA) allows individuals over the age of 18 years to donate organs and tissues for transplantation and other purposes. Passed in 1968 and adopted by all 50 states and the District of Columbia by 1970, the UAGA is the basis for uniform donor cards, notations on driver's licenses, and other documents. The UAGA also grants the next-of-kin permission to donate the organs and tissues of a deceased family member in the following priority:

- Spouse
- Adult son or daughter
- Either parent
- Adult brother or sister
- Legal guardian
- Person charged with disposal of the body

Consent for organ and tissue donation is obtained from the *highest priority individual*, either immediately before or after the pronouncement of death. The family must be appropriately informed about the decision that they are making. Although a signed and witnessed donor card is an irrevocable legal document, it is still customary to discuss donation with family members and to obtain their consent.

Required Request

In 1986, the Task Force on Organ Transplantation issued a report outlining the major obstacles with organ donation and transplantation. They found that health care professionals were inconsistent in informing families of their options to donate organs and tissues for transplantation. The task force recommendation of "required request" to ensure that families were routinely provided the option to donate has been enacted in nearly all states; the family **must** be offered the option to donate.

In addition to state legislation, the Omnibus Budget Reconciliation Act of 1986 requires hospitals to develop policies and procedures to ensure that families are informed of their option to donate. Noncompliance with this federal act could jeopardize a hospital's participation in Medicare and Medicaid reimbursement.

Uniform Determination of Death Act

The cessation of heartbeat and respiration was once been required to pronounce the death of a patient, but **brain death** has evolved as a new definition. By 1980, the Uniform Determination of Death Act updated criteria for brain death. Criteria for brain death allow death to be defined as complete and irreversible cessation of brain and brainstem function. When brain death occurs, in essence, all structures above the foramen magnum have irreversibly ceased to function. A person may be pronounced dead by a qualified physician if it is determined that the person has sustained either (1) irreversible cessation of circulatory and respiratory function or (2) irreversible cessation of all functions of the brain, including the brainstem. **The**

clinical diagnosis of brain death may be based upon[1]:

1. Documentation of coma with known etiology
2. Irreversible condition
3. No motor response to painful stimuli
4. Apnea with $Paco_2$ >60 mm Hg
5. No spontaneous movement (spinal cord reflexes may be present)
6. No brainstem reflexes (pupils nonreactive to light, absent corneal reflexes, absent gag reflex, absent cough reflex)
7. No increase in heart rate following administration of 2 mg of atropine IV
8. Absence of hypothermia, hypotension, and hypoxemia
9. Nontherapeutic levels of CNS depressants or neuromuscular blockers
10. Absence of toxic or metabolic disorders

In addition to the clinical evaluation of brain death, a number of laboratory tests may aid in confirmation of brain death, but are not mandatory under most circumstances. These tests include cerebral angiogram, EEG, cerebral blood flow study, or evoked response testing.

Management of the Potential Donor

When irreversible brain injury seems apparent, vigorous supportive measures to maintain organ perfusion and function in a potential donor are essential. The major principles for maintenance of the potential organ donor include resuscitation in the event of cardiac arrest, adequate organ perfusion, volume replacement, diuresis, avoidance of infection, and maintenance of normothermia. Organs which can be transplanted include heart, lung, liver, kidneys, pancreas, and small bowel. Tissue donation, on the other hand, does not require maintenance of adequate tissue perfusion. Tissues which can be transplanted include bone, cornea, skin, cartilage, and heart valves.

MEDICAL CRITERIA FOR DONATION

Potential organ donors are previously healthy individuals who meet the following general criteria:

1. Term newborn to 70 years of age
2. Brain death imminent or present, with intact heartbeat and circulation
3. Absence of systemic infection or actively transmissible disease such as viral hepatitis, tuberculosis, HIV, CMV. (Hepatitis-positive organs can be transplanted to hepatitis-positive recipients.)
4. Absence of cancer (except brain tumor)
5. No known history of intravenous drug use

The medical suitability of any potential donor will be determined by the local organ procurement organization (OPO) or transplant team.

ROLE OF THE ORGAN PROCUREMENT ORGANIZATION

When a patient is identified as meeting the basic medical and legal criteria for donation, the local OPO should be notified. Donor referrals are generally accepted 24 hours a day, and potential donors can be discussed by contacting the OPO. OPOs are nonprofit organizations, designated by the federal government to coordinate the recovery and transportation of donor organs to transplant centers within their service area. Early referral is recommended to assess donor suitability, coordinate medicolegal requirements, initiate necessary laboratory tests, and ensure collection of complete data. Referrals can be expedited if the following patient data are available: patient history, diagnosis and date of admission, patient height and weight, blood group system, hemodynamic data, urinalysis, laboratory data, current medications, and culture results. The major functions of the OPO include:

1. Responding to calls from hospital staff when potential donors have been identified
2. Discussion of donation with family members
3. Confirmation of documentation of brain death in accordance with state and hospital policy
4. Coordination of the surgical recovery, including the coordination of surgical teams
5. Communication with the donor family about the outcome of donation
6. Provision of ongoing education to hospital staff about the criteria for donation
7. Reimbursement of the donor hospital for costs associated with the donation
8. Working with the area transplant centers for the location of organs

Each OPO has specific criteria for donation and programs for hospitals in their service area. Consult the United Network for Organ Sharing at 1-800/666-1884 for the name of the OPO within your area, or refer to the list of OPOs in respective states in Appendix E.

[1]All criteria are not required at every institution. For example, administration of atropine is not performed at some centers.

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CHAPTER 22

VERIFICATION/ CONSULTATION PROGRAM

The American College of Surgeons has a long history of activities to improve the care of the injured patient. The education of those entrusted with the responsibility for the management of the injured patient and the development of standards for optimal care have been the major thrusts of the American College of Surgeons Committee on Trauma (ACS COT) since its inception. In recent years, the *Resources for Optimal Care of the Injured Patient* publication outlining the resources necessary for optimal care has been used as a guide for the development of trauma care throughout the United States.

The **designation** of trauma facilities is a political process enacted by bodies of government duly authorized to designate. Establishing trauma systems, selecting participating institutions, and designating the role of those institutions in the system are the responsibilities of local, regional, or state health care system agencies. The necessary steps to ensure that communication and transportation systems mesh with the designated trauma centers require a focus on the entire system. Medical leadership is essential to these processes.

The American College of Surgeons verification/consultation program is designed to (1) assist hospitals in evaluation and improvement of trauma care and (2) provide information regarding institutional capability, performance, and system development to aid those who are responsible for developing and maintaining these systems.

Trauma is a surgical disease! Therefore, the commitment of surgeons to the improvement of trauma care is mandatory. The verification/consultation program is one of **verifying** trauma care capability and performance of an institution. This is best accomplished by an on-site review of the hospital by a team of surgeons experienced in the field of trauma and by using the guidelines set forth in the current ACS *Resources for Optimal Care of the Injured Patient*. The on-site review of an institution's capability in trauma is a constructive process designed to assist in providing the optimal care available for the injured patient.

The Board of Regents of the American College of Surgeons has authorized the Committee on Trauma to offer two levels of review by either a core or multidisciplinary team: consultation and verification.

CONSULTATION

The COT will provide a hospital consultation visit at the request of a hospital, community, or state authority to assess trauma care or to prepare for a verification review. The standard core two-surgeon team or a multidisciplinary team may be requested.

A consultation visit follows the same format as a Verification Review, but provides recommendations rather than a judgment that compares the hospital to a standard. Very few hospitals that have sought verification after a consultation visit have been unsuccessful.

VERIFICATION

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

Unless the verification visit is approved by the designating authority, a verification review will not be performed at a hospital if there is a designating authority. If there is **no designating authority** in the geographic area, individual hospitals desiring verification of their trauma capabilities may directly request a verification site visit.

Multidisciplinary Review

The on-site review is usually conducted by two surgeons (core team) from the ACS COT. In some instances, there is a requirement or desire that trauma capability be evaluated by a multidisciplinary team. The ACS COT can assist in this process. The multidisciplinary team will still be led by two general surgeons. Other

members may include a neurosurgeon, orthopaedic surgeon, anesthesiologist, emergency department physician, trauma coordinator, medical records coordinator, or hospital administrator.

Multidisciplinary Team—Special Circumstances

The requesting agency may also develop the multidisciplinary team. If the multidisciplinary team is assembled by anyone other than the ACS COT, no official report or verification by the COT can be provided. However, if two trauma surgeons of the multidisciplinary team are selected by the ACS COT, they may perform a simultaneous ACS verification review as long as the ACS review process is followed. In such an event, a separate ACS COT verification certificate would be issued.

VERIFICATION/CONSULTATION PROCESS

Following the receipt of a request (application for site visit) and the completion of the prereview questionnaire and hospital resources checklist, a review team of two surgeons acceptable to the hospital will be selected, and a mutually acceptable date for the review will be established. The COT state or provincial chair and region chief will be notified. All reviewers will be from out-of-state or province unless there is a special request for an in-state or province reviewer. General surgeon reviewers are selected from present and past members of the COT, state chairs, and region chiefs.

Consistency of the review process is facilitated by

1. *A prereview questionnaire* which allows the site visitors to have a better understanding of the existing trauma care capabilities and the performance of the hospital and medical staff before beginning the review
2. *Guidelines for the site visitors* to conduct the review consistently, in which evaluation of the quality improvement activities and review of medical charts are emphasized
3. *An organized agenda* for the review so that all reviews are performed in an efficient manner
4. *An outline for writing the report* in a standard format
5. *Final review of the report by the Verification/ Consultation Committee (VRC)*

Prereview Meetings

A prereview meeting facilitates an efficient on-site review process. The review team will wish to meet with the trauma director, trauma coordinator, and hospital administrator. Other individuals may be invited who are needed to clarify the prereview questionnaire and describe existing trauma center activities. The meeting is intended to include discussion of the overall trauma program, clarification of the prereview questionnaire, specific concerns, unique features of the institution, discussion of the local trauma system, and clarification of the review process.

The *on-site review* requires approximately six hours and includes an exit interview to discuss the reviewers' findings and conclusions. All trauma care areas of the hospital will be visited. Emphasis is placed on evaluating medical records of trauma patients and correlating patient care with the performance improvement program. The medical records will be requested seven to 10 days prior to the site visit. The reviewers will prepare a report which reflects the statements made at the exit interview. This report will be forwarded to the VRC.

The VRC reserves this final approval to ensure consistency of the reports, accurate interpretation of the findings, well-documented conclusions, and professionalism in the final report. This final process may modify the conclusions of the individual site reviewer's report to maintain a consistent interpretation of the resources document.

Confidentiality of the whole review process ensures an institution that the program is designed to be a constructive process in which a hospital can place its trust.

Appeal Process

If the hospital does not agree with the review process or the final report, it may appeal to the VRC. When the disagreement cannot be resolved, a new review team may be sent for a repeat review. An appeal may eventually be referred to the COT Executive Committee.

APPLICATION FORMS AND SITE-VISIT INFORMATION

Requests for verification or consultation information should be addressed to

American College of Surgeons
Trauma Department
Verification Review Program
633 N. Saint Clair St.
Chicago, IL 60611-3211
312/202-5456

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CHAPTER 23

TRAUMA FACILITIES CRITERIA

The following table shows levels of categorization and their essential (E) or desirable (D) criteria.

	Levels I	II	III	IV
INSTITUTIONAL ORGANIZATION (see Chapter 5)				
Trauma program	E	E	E	E
Trauma service	E	E	E	—
Trauma team	E	E	E	E
Trauma program medical director	E	E	E	D
Trauma multidisciplinary committee	E	E	E	D
Trauma coordinator/TPM	E	E	E	E
HOSPITAL DEPARTMENTS/DIVISIONS/SECTIONS				
Surgery	E	E	E	—
Neurological surgery	E	E	—	—
Neurosurgical trauma liaison	E	E	—	—
Orthopaedic surgery	E	E	E	—
Orthopaedic trauma liaison	E	E	E	—
Emergency medicine	E	E	E	—
Anesthesia	E	E	E	—
CLINICAL CAPABILITIES (Specialty Immediately Available 24 hours/day)				
Published on-call schedule	E	E	E	E
General surgery	E	E	E	D
Published back-up schedule	E	E	D	—
Dedicated to single hospital when on-call	E	E	D	—
Anesthesia (see Chapter 11)	E	E	E	D
Emergency medicine[1]	E	E	E	—
On-call and promptly available 24 hours/day				
Cardiac surgery	E	D	—	—
Hand surgery	E	E	D	—
Microvascular/replant surgery	E	D	—	—
Neurologic surgery	E	E	D	—
Dedicated to one hospital or back-up call (see Chapter 8)	E	E	D	—
Obstetrics/gynecologic surgery	E	E	D	—
Ophthalmic surgery	E	E	D	—
Oral/maxillofacial surgery	E	E	D	—
Orthopaedic surgery	E	E	E	D
Dedicated to one hospital or back-up call (see Chapter 9)	E	E	D	—
Plastic surgery	E	E	E	D
Critical care medicine	E	E	D	—
Radiology	E	E	E	D
Thoracic surgery	E	E	D	—
CLINICAL QUALIFICATIONS				
General/trauma surgeon (see Chapter 6)				
Current board certification	E	E	E	—
16 hours CME/year	E	E	D	D
ATLS completion	E	E	E	E
Peer review committee attendance >50%	E	E	E	—
Multidisciplinary committee attendance	E	E	E	—
Emergency medicine (see Chapter 7)				
Board certification	E	E	D	—

	Levels I	II	III	IV
Trauma education: 16 hours CME/year	E	E	D	—
ATLS completion	E	E	E	E
Peer review committee attendance >50%	E	E	E	—
Multidisciplinary committee attendance	E	E	E	—
Neurosurgery (see Chapter 8)				
Current board certification	E	E	—	—
16 hours CME/year	E	E	D	D
ATLS completion	D	D	D	D
Peer review committee attendance >50%	E	E	E	—
Multidisciplinary committee attendance	E	E	E	—
Orthopaedic surgery (see Chapter 9)				
Board certification	E	E	D	—
16 hours CME in skeletal trauma	E	E	D	D
ATLS completion	D	D	D	D
Peer review committee attendance >50%	E	E	E	D
Multidisciplinary committee attendance	E	E	E	—
FACILITIES/RESOURCES/CAPABILITIES				
Volume Performance				
Trauma admissions 1,200/year	E	—	—	—
Patients with ISS >15 (240 total or 35 patients/surgeon)[2]	E	—	—	—
Presence of surgeon at resuscitation	E	E	E	D
Presence of surgeon at operative procedures	E	E	E	E
Emergency Department (ED)				
Personnel				
Designated physician director	E	E	E	D
Equipment for resuscitation for patients of **all ages**				
Airway control and ventilation equipment	E	E	E	E
Pulse oximetry	E	E	E	E
Suction devices	E	E	E	E
Electrocardiograph-oscilloscope-defibrillator	E	E	E	E
Internal paddles	E	E	E	—
CVP monitoring equipment	E	E	E	D
Standard IV fluids and administration sets	E	E	E	E
Large-bore intravenous catheters	E	E	E	E
Sterile surgical sets for				
Airway control/ cricothyrotomy	E	E	E	E
Thoracostomy	E	E	E	E
Venous cutdown	E	E	E	E
Central line insertion	E	E	E	—
Thoracotomy	E	E	E	—
Peritoneal lavage	E	E	E	D
Arterial catheters	E	E	D	D
Ultrasound	D	D	D	D
Drugs necessary for emergency care	E	E	E	E
X ray availability 24 hours/day	E	E	E	D
Cervical traction devices	E	E	E	D
Broselow tape	E	E	E	E
Thermal control equipment				
For patient	E	E	E	E
For fluids and blood	E	E	E	D
Rapid infuser system	E	E	E	D
Qualitative end-tidal CO_2 determination	E	E	E	E
Communication with EMS vehicles	E	E	E	E
Operating Room				
Immediately available 24 hours/day	E	D[3]	D	D
Personnel				
In-house 24 hours/day	E	D[3]	—	—
Available 24 hours/day	—	E	E	E
Age-specific equipment				
Cardiopulmonary bypass	E	D	—	—
Operating microscope	E	D	D	—

	Levels I	II	III	IV
Thermal control equipment				
For patient	E	E	E	E
For fluids and blood	E	E	E	E
X ray capability, including c-arm image intensifier	E	E	E	E
Endoscopes, bronchoscope	E	E	E	D
Craniotomy instruments	E	E	D	—
Equipment for long bone and pelvic fixation	E	E	E	D
Rapid infuser system	E	E	E	D
Postanesthetic Recovery Room (SICU is acceptable)				
Registered nurses available 24 hours/day	E	E	E	—
Equipment for monitoring and resuscitation	E	E	E	E
Intracranial pressure monitoring equipment	E	E	D	—
Pulse oximetry	E	E	E	E
Thermal control	E	E	E	E
Intensive or Critical Care Unit for Injured Patients				
Registered nurses with trauma education	E	E	E	—
Designated surgical director or surgical co-director	E	E	E	D
Surgical ICU service physician in-house 24 hours/day (see Chapter 11)	E	D	D	—
Surgically directed and staffed ICU service	E	D	D	—
Equipment for monitoring and resuscitation	E	E	E	—
Intracranial monitoring equipment	E	E	—	—
Pulmonary artery monitoring equipment	E	E	E	—
Respiratory Therapy Services				
Available in-house 24 hours/day	E	E	D	D
On call 24 hours/day	—	—	E	D
Radiological Services (Available 24 hours/day)				
In-house radiology technologist	E	E	D	D
Angiography	E	E	D	—
Sonography	E	E	E	D
Computed tomography	E	E	E	D
In-house CT technician	E	D	—	—
Magnetic resonance imaging	E	D	D	—
Clinical Laboratory Service (Available 24 hours/day)				
Standard analyses of blood, urine, and other body fluids, including microsampling when appropriate	E	E	E	E
Blood typing and cross-matching	E	E	E	E
Coagulation studies	E	E	E	E
Comprehensive blood bank or access to a community central blood bank and adequate storage facilities	E	E	E	E
Blood gases and pH determinations	E	E	E	E
Microbiology	E	E	E	E
Acute Hemodialysis				
In-house	E	D	—	—
Transfer agreement	—	E	E	E
Burn Care—Organized				
In-house or transfer agreement with Burn Center	E	E	E	E
Acute Spinal Cord Management				
In-house or transfer agreement with Regional Acute Spinal Cord Injury Rehabilitation Center	E	E	E	E
REHABILITATION SERVICES				
Transfer agreement to an approved rehabilitation facility	E	E	E	E
Physical therapy	E	E	E	D
Occupational therapy	E	E	D	D
Speech therapy	E	E	D	—
Social Service	E	E	E	D
PERFORMANCE IMPROVEMENT				
Performance improvement programs	E	E	E	E
Trauma registry				
In-house	E	E	E	D
Participation in state, local, or regional registry	E	E	E	E
Orthopaedic database	D	D	—	—
Audit of all trauma deaths	E	E	E	E

	Levels I	II	III	IV
Morbidity and mortality review	E	E	E	E
Trauma conference—multidisciplinary	E	E	E	D
Medical nursing audit	E	E	E	E
Review of prehospital trauma care	E	E	E	D
Review of times and reasons for trauma-related bypass	E	E	D	D
Review of times and reasons for transfer of injured patients	E	E	D	D
Performance improvement personnel dedicated to care of injured patients	E	E	D	D
CONTINUING EDUCATION/OUTREACH				
General surgery residency program (see Chapter 17)	E	D	—	—
ATLS provide/participate	E	D	D	D
Programs provided by hospital for:				
Staff/community physicians (CME)	E	E	E[4]	D
Nurses	E	E	E	D
Allied health personnel	E	E	E	—
Prehospital personnel provision/participation	E	E	E	D
PREVENTION				
Injury control studies	E	D	—	—
Collaboration with other institutions	E	D	D	D
Monitor progress/effect of prevention programs	E	D	D	D
Designated prevention coordinator-spokesperson for injury control	E	E	D	—
Outreach activities	E	E	D	D
Information resources for public	E	E	D	—
Collaboration with existing national, regional, and state programs	E	E	D	—
Coordination and/or participation in community prevention activities	E	E	E	D
RESEARCH				
Trauma registry performance improvement activities	E	E	E	—
Research committee	E	D	—	—
Identifiable IRB process	E	D	—	—
Extramural educational presentations	E[5]	D	D	—
Number of scientific publications	E[6]	D	—	—

[1] When emergency medicine specialists are not involved with the care of the injured patient, these criteria are not required.

[2] The mechanism to calculate ISS should be through use of AIS 90 and handcoding.

[3] An operating room must be adequately staffed and immediately available in a Level I trauma center. This is met by having a complete operating room team in the hospital at all times, so if an injured patient requires operative care, the patient can receive it in the most expeditious manner. These criteria cannot be met by individuals who are also dedicated to other functions within the institution. Their primary function must be the operating room.

An operating room must be adequately staffed and available when needed in a timely fashion in a Level II trauma center. The need to have an in-house OR team will depend on a number of things, including patient population served, ability to share responsibility for OR coverage with other hospital staff, prehospital communication, and the size of the community served by the institution. If an out-of-house OR team is used, then this aspect of care must be monitored by the performance improvement program.

Brasel KJ, Akason J, Weigelt JA: The dedicated operating room for trauma: A costly recommendation, *J Trauma* 1998; 14: 832–838.

[4] In areas where the Level III hospital is the lead institution, these educational activities are an essential criteria. When the Level III is in an area that contains other hospital resources, such as a Level I or II, then this criteria is no longer essential.

[5] Four Educational Presentations per year for the program. These presentations must be given outside the academically affiliated institutions of the Trauma Center.

[6] Publications should appear in peer-reviewed journals. *Index Medicus* listing is preferable. In a three-year cycle, the minimum acceptable number is 10 for the entire trauma program. This must include a minimal activity of one publication (per review cycle) from the physicians representing each of the four following specialties: emergency medicine, general surgery, orthopaedic surgery, and neurosurgery.

APPENDIX A

ACS STATEMENT ON MANAGED CARE AND THE TRAUMA SYSTEM

Congress passed Public Law 101-590, the Trauma Care Systems Planning and Development Act, in 1990. The value of implementing trauma systems through statewide planning has been recognized and has already demonstrated that these organized regional systems result in dramatic improvements in patient outcomes. These systems are designed so that patients with catastrophic injuries will have the quickest possible access to an established trauma center or a hospital that has the capabilities to provide comprehensive emergency medical care. These systems ensure that the severely injured patient can be rapidly cared for in the facility that is most appropriately prepared to treat the severity of injury.

Unfortunately, in some situations, managed care systems or insurers have interfered with and defeated the purpose of trauma system networks because

A. The managed care system or insurer may not authorize treatment for a severely injured patient unless there is prior authorization. On many nights and weekends, prompt prior authorization is almost impossible to obtain. Trauma is by definition an emergency condition, and treatment cannot wait for such delays.

B. The managed care system or insurer may deny coverage unless the patient is transferred either to a hospital with which there is an existing contract or to a hospital where specific doctors who are already contracted to the health care entity have privileges and practice medicine. This forced triage may not be appropriate for the severity of the patient's injury and, therefore, may not be in the injured patient's best medical interest.

C. In many instances in which care has been provided at a trauma center, reimbursement from the managed care system or insurer has been denied or severely limited.

Trauma systems have been designed to provide the most rapid, coordinated medical services to injured patients. The American College of Surgeons believes that managed care plans and insurers should be required to allow their patients to be treated in trauma centers or emergency facilities when true medical emergencies arise. Delaying or denying approval in such circumstances, or requiring transfer to another facility as a condition of payment, may seriously compromise the effective medical treatment of a severely injured patient.

Agreement upon the following principles should ensure that any patient brought to a trauma center will receive the best possible medical care:

1. No impediment to prompt acute trauma care, as determined by the regional trauma system, should be permitted.
2. Approval for treatment should be automatic when admissions or transfers are deemed necessary by the physician or surgeon at the trauma facility.
3. Prompt reimbursement for all trauma care at trauma centers that have been verified by the American College of Surgeons and/or verified by the state should be the norm.
4. Managed care systems and trauma centers should establish agreements to ensure that transfer does not interrupt continuity of vital medical care for injured patients and result in avoidable complications.
5. There should be no barriers to the exchange of data allowing for procedures to monitor the quality of performance and verification of the outcome of the care of trauma patients.
6. A mechanism for the rapid and appropriate resolution of conflicts should be in place.

Trauma centers and managed care agencies should coordinate their efforts to obtain long-term outcome and cost data in order to promote optimal patient management. All decisions to transfer a patient should require a physician-to-physician request and should be based on the patient's condition and the appropriateness of the receiving facility's resources relative to the

patient's needs. The final decision to transfer the patient should remain with the trauma surgeon, who, as attending physician, has the best information regarding the patient's injuries, condition, and needs.

These types of patient care guarantees should be incorporated in licensing requirements for managed care health systems and insurers in all states.

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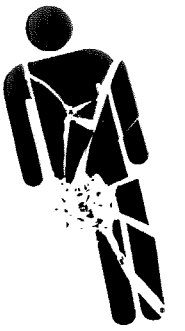
APPENDIX B

GUIDELINES FOR THE MANAGEMENT OF SEVERE HEAD INJURY*



	STANDARDS	GUIDELINES	OPTIONS
I. Trauma systems and the neurosurgeon		All regions in the United States should have an organized trauma care system.	Neurosurgeons should have an organized and responsive system of care for patients with neurotrauma. They should initiate neurotrauma care planning, including prehospital management and triage, maintain appropriate call schedules, review trauma care records for quality improvement, and participate in trauma education programs. Trauma facilities treating patients with severe or moderate head injury must have a neurosurgery service, an in-house trauma surgeon, a neurosurgeon promptly available, and a continuously staffed and available operating room, intensive care unit, and laboratory with proper equipment for treating neurotrauma patients.
II. Integration of brain-specific treatments into the initial resuscitation of the severe head-injury patient			The first priority for the head-injured patient is complete and rapid physiologic resuscitation. No specific treatment should be directed at intracranial hypertension in the absence of signs of transtentorial herniation or progressive neurologic deterioration not attributable to extracranial explanations. When signs of either transtentorial herniation or progressive neurologic deterioration not attributable to extracranial explanations are present, however, the physician should assume that intracranial hypertension is present and treat it aggressively. Hyperventilation should be rapidly established. The administration of mannitol is desirable, but only under conditions of adequate volume replacement. Sedation and neuromuscular blockade can be useful in optimizing transport of the head-injured patient. However, both treatments interfere with the neurologic examination and should be avoided if possible.

	STANDARDS	GUIDELINES	OPTIONS
III. Resuscitation of blood pressure and oxygenation		Hypotension (systolic blood pressure less than 90 mm Hg) or hypoxia (apnea or cyanosis in the field or a Pao_2 less than 60 mm Hg) must be scrupulously avoided, if possible, or corrected immediately.	The mean arterial pressure should be maintained above 90 mm Hg throughout the patient's course to attempt to maintain cerebral perfusion pressure greater than 70 mm Hg.
IV. Indications for intracranial pressure monitoring		Intracranial pressure monitoring is appropriate in patients with severe head injury with an abnormal admission CT scan. Severe head injury is defined as a Glasgow Coma Score of 3 to 8 after cardiopulmonary resuscitation. An abnormal CT scan of the head is one that reveals hematomas, contusions, edema, or compressed basal cisterns. Intracranial pressure monitoring is appropriate in patients with severe head injury with a normal CT scan if two or more of the following features are noted at admission: age over 40 years, unilateral or bilateral motor posturing, systolic blood pressure less than 90 mm Hg. Intracranial pressure monitoring is not routinely indicated in patients with mild or moderate head injury. However, a physician may choose to monitor intracranial pressure in certain conscious patients with traumatic mass lesions.	
V. Intracranial pressure treatment threshold		Intracranial pressure treatment should be initiated at an upper threshold of 20–25 mm Hg.	Interpretation and treatment of intracranial pressure based on any threshold should be corroborated by frequent clinical examinations and cerebral perfusion pressure data.
VI. Guidelines for cerebral perfusion pressure			Cerebral perfusion pressure should be maintained at a minimum of 70 mm Hg.
VII. Use of hyperventilation in the acute management of severe traumatic brain injury	In the absence of increased intracranial pressure, chronic, prolonged hyperventilation therapy ($Paco_2$ of 25 mm Hg or less) should be avoided after severe traumatic brain injury.	The use of prophylactic hyperventilation ($Paco_2$ less than 35 mm Hg) therapy during the first 24 hours after severe traumatic brain injury should be avoided, because it can compromise cerebral perfusion during a time when cerebral blood flow is reduced.	Hyperventilation therapy may be necessary for brief periods when there is acute neurologic deterioration, or for longer periods if there is intracranial hypertension refractory to sedation, paralysis, cerebrospinal fluid drainage, and osmotic diuretics. Jugular venous oxygen saturation, arterial jugular venous oxygen content differences, and cerebral blood flow monitoring may help to identify cerebral ischemia if hyperventilation resulting in $Paco_2$ values less than 30 mm Hg is necessary.

	STANDARDS	GUIDELINES	OPTIONS
VIII. Use of mannitol in severe head injury		Mannitol is effective for control of raised intracranial pressure after severe head injury. Limited data suggest that intermittent boluses may be more effective than continuous infusion. Effective doses range from 0.25–1 g/kg of body weight.	The indications for the use of mannitol prior to intracranial pressure monitoring are signs of transtentorial herniation or progressive neurologic deterioration not attributable to systemic pathology. Serum osmolality should be kept below 320 mOsm when there is concern for renal failure. Euvolemia should be maintained by adequate fluid replacement. A Foley catheter is essential in these patients.
IX. Use of barbiturates in the control of intracranial pressure		High-dose barbiturate therapy may be considered in hemodynamically stable, salvageable severe head injury patients with intracranial hypertension refractory to maximal medical and surgical intracranial pressure-lowering therapy.	
X. Role of glucocorticoids in the treatment of severe head injury	The use of glucocorticoids is not recommended for improving outcome or reducing intracranial pressure in patients with severe head injury.		
XI. Nutritional support of brain-injured patients		Replace 140% of resting metabolic expenditure in nonparalyzed patients and 100% resting metabolism expenditure in paralyzed patients using enteral or parenteral formulas containing at least 15% of calories as proteins by the 7th day after injury.	The preferable option is use of jejunal feeding by gastrojejunostomy for ease of use and avoidance of gastric intolerance.
XII. Role of antiseizure prophylaxis following head injury	Prophylactic use of phenytoin, carbamazepine, or phenobarbital is not recommended for preventing late posttraumatic seizures.		It is recommended as a treatment option that anticonvulsants may be used to prevent early posttraumatic seizures in patients at high risk for seizures following head injury. Phenytoin and carbamazepine have been demonstrated to be effective in preventing early posttraumatic seizures. The available evidence, however, does not indicate that prevention of early posttrauma seizures improves outcome following head injury.

XIII. Recommendations for intracranial pressure monitoring technology:
In the current state of technology, the ventricular catheter connected to an external strain gauge is the most accurate, low-cost, and reliable method of monitoring intracranial pressure. It also allows therapeutic cerebrospinal fluid drainage. Intracranial pressure transduction via fiberoptic or strain gauge devices placed in ventricular catheters provide similar benefits, but at a higher cost.
Parenchymal intracranial pressure monitoring with fiberoptic or strain gauge catheter tip transduction is similar to ventricular intracranial pressure monitoring, but has the potential for measurement drift.
Subarachnoid, subdural, and epidural monitors are currently less accurate.
**J Neurotrauma* 1996; 13(11): 641–734.

APPENDIX C

GUIDELINES FOR TRAUMA CARE FELLOWSHIPS

Preamble

For some years, the American Association for the Surgery of Trauma and the Committee on Trauma of the American College of Surgeons have been concerned about the education of general surgeons whose primary interests focus on the care of the injured patient. A joint working group between the two groups was formalized in 1989. In the spring of 1990, the committee presented these preliminary considerations to the Committee on Trauma and the Board of Managers of the American Association for the Surgery of Trauma:

> The objectives of the Trauma Care Fellowship should be to provide a year of advanced training and education in a teaching role in the management of trauma victims. The intent is for the individual to learn about systems of trauma care, how they are developed and administered, and how to achieve the goals of such a trauma program. The Fellowship should include experience in resuscitation, teaching and operative management, and postoperative care in the SICU of adult and pediatric trauma victims. It should be structured so that it augments the training of general surgery residents in the parent program. Specifically there should not be competition between the Fellow and the General Surgery Chief Residents for management of the trauma patients. The Fellowship must provide understanding of the proper structure and administration of pre-hospital care including the medical supervision and communication systems.

A Trauma Care Fellowship should be so structured to:

1. Fulfill the requirements for admission to the examination for the Added Qualification of Critical Care given by the American Board of Surgery as outlined by the RRC for General Surgery in their "Surgical Critical Care Special Requirements."
2. Provide the fundamentals for developing leadership in trauma care preparing the Fellow for a directorship of a trauma program and system.
3. Be based in a Level I ACS verified trauma center.
4. Be in an institution which has a fully approved general surgery residency training program.
5. Begin after the successful completion of a five year general surgery residency with a trauma experience as required by the criteria of the ABS.

A proposal for a Trauma Care Fellowship following these guidelines was constructed and submitted to the Residency Review Committee for Surgery for consideration. In response, the RRC replied that it did not intend to include trauma care fellowships under the umbrella of surgical critical care residencies. The joint committee readdressed the issue with the intent of providing guidelines which would be useful to individuals desiring to provide training for future surgical leaders in trauma care. The document presented here is the result of deliberations of the committee outlined above. These guidelines for trauma care fellowships have been endorsed by the Board of Managers of the American Association for the Surgery of Trauma.

This document may become even more relevant since, at its February 1992 meeting, the RRC for Surgery proposed modifications of the special requirements for surgical critical care effective July 1, 1993. These changes are intended to provide more flexibility in program organization and allow juxtaposition of residency education in surgical critical care with education in trauma, burns, and, conceivably, transplantation. The changes in the special requirements are outlined in the spring 1992 newsletter of the Residency Review Committee for Surgery and indicated that the modified requirements will provide more flexibility in program organization by not requiring that the twelve (12) months be consecutive and by allowing one three-month rotation that includes operative experience, for example, on a transplant unit or a trauma unit, as long as the training in critical care takes precedence and the operative experience of general surgery residents is not adversely affected. This change may facilitate the juxtaposition of surgical critical care programs with

existing trauma, burn, transplant, or analogous fellowships. In addition, minimal incidental operative experience is not excluded from the other nine months of surgical ICU rotation, provided the experience does not interfere with the critical care training—which must take precedence—and does not adversely affect the operative experience of the general surgery residents.

Hopefully, these guidelines will help interested individuals and institutions in establishing a trauma care fellowship which can be juxtaposed to or coordinated with a residency in surgical critical care and provide an appropriate pathway for individuals who desire to develop leadership potential in the areas of surgical critical care of injured patients.

GUIDELINES FOR TRAUMA CARE FELLOWSHIPS

Introduction

Optimal care of patients with severe multi-system injuries requires an interactive multidisciplinary team. This team care requires skillful and knowledgeable leadership which is ideally provided by a general surgeon. This document describes guidelines for fellowships designed to prepare post-residency physicians (primarily general surgeons) to provide such leadership and to play a major role in trauma systems and the global care of trauma patients.

These guidelines are intended to complement trauma fellowships in other surgical specialties, such as orthopedic surgery, which provide care to the severely injured patient.

I. GENERAL CHARACTERISTICS

A. Trauma care is a specialized area of surgery dealing with critically injured and ill patients. Fellowship programs in trauma care must provide the educational resources appropriate for the development of proficiency in managing critically injured patients and for supervising Trauma Services and surgical critical care units. The training program must be an integral part of and must be administratively attached to an accredited core program in general surgery with a volume of trauma patients and trauma care organization that meet the guidelines of the ACS/COT for a Level I Trauma Center.

B. Graduate training in trauma care shall be of at least one year's duration. The training will be accomplished after satisfactory completion of an approved graduate educational program in General Surgery.

II. DURATION AND SCOPE OF TRAINING

A. The one-year training period must be devoted exclusively to educational activities related to the care of critically injured patients and to the administration of Trauma Services and of surgical critical care units. Surgical care of trauma patients must include primary educational activities on a Trauma Service and in intensive care units located in an institution which has been approved by the RRC for Surgery as an integrated institution, as defined in the Special Requirements of General Surgery with the core general surgery or pediatric surgery residency program. The Core Surgery Residency Program should provide its chief residents a trauma experience which will remain at or above 50 index cases per chief resident after implementation of the trauma care fellowship. An index trauma case is defined as: a patient with major torso or vascular injuries requiring celiotomy, thoracotomy, or vascular repair by the general surgery trauma service or care in the ICU by that service for more than 48 hours. Training may include assignments to a cardiac/thoracic unit, a burn unit, a surgical nutrition unit, a neurosurgical unit, or other trauma related rotations.

B. The one year training period shall not include more than one interruption.

C. Although the program is to be a minimum of 12 months duration, part of this time requirement (up to 4 months) can be satisfied by participation in an associated critical care fellowship.

III. OBJECTIVES

A. Because the completion of an accredited surgical residency training program should qualify the surgeon to care for the basic problems of critically ill and injured surgical patients, training offered by the trauma care fellowship must allow the trainee to acquire an *advanced* level of skill in management of critically injured patients.

Such an advanced level of skill may be obtained from the management of the following: 1) operative and non-operative therapy of injured patients; 2) pre- and post-operative care of injured patients who require critical care; 3) patients of all age groups, particularly those with critical injuries complicated by chronic cardiac, respiratory, renal, or metabolic dysfunction.

In addition, this advanced level of skill will include 1) the use of advanced technology and instrumentation to monitor the physiologic status of trauma patients of all ages; 2) knowledge of organizational and administrative aspects of a trauma care system;

3) activities which foster development of skills in teaching and in research related to trauma and critical care; 4) ethical, economic, and legal issues as they pertain to trauma care.

B. In addition, it is expected that individuals completing training in trauma care will be able to do the following:

1. Organize and direct a Trauma Service. This includes the ability to appoint, train, and supervise specialized personnel; establish policies and procedures for management of trauma patients and administration of the service; and coordinate the activities of the service with other administrative units.
2. Teach the special body of knowledge required for the comprehensive management of the trauma patient.
3. Develop research in the various areas of trauma care such as prevention, acute care, and rehabilitation.

IV. ORGANIZATION OF THE STAFF

A. The trauma care fellowship must be under the direction of a surgeon who meets the qualifications of a Trauma Service Director as defined in the 1990 ACS Optimal Resources Document, Chapter 7.

B. The trauma care program director and surgical teaching staff must have unrestricted privileges regarding the admission, treatment, and discharge of their own patients on the surgical and/or pediatric critical care units.

C. The director shall have administrative responsibility for the Trauma Care Fellowship and shall be responsible for all residents and teaching staff of the program and shall determine their duties. (See Section VII.)

D. The Trauma Service teaching staff must be specifically qualified and involved in care of the injured patients and must provide the program director with regular evaluations of the trainee(s). (Ref: Chapters 6 and 7 of *Resources for Optimal Care of the Injured Patient*, ACS/COT 1990.)

E. The Trauma Service teaching staff must have real and demonstrated interest in teaching and set an example for trainees by documented scholarly pursuits, including 1) participation in their own continuing surgical education, 2) participation in regional and national surgical scientific societies, 3) presentation and publication of scientific studies, 4) demonstration of an active interest in research as it pertains to trauma and/or critical care problems.

F. In the teaching environment of the surgical care unit, it is recognized that the teaching staff in surgery, the surgical specialties, and anesthesia may all be involved in the care of trauma patients; therefore, collegial relationships must exist between the surgical director of the critical care unit and the Trauma Fellowship teaching staff in order to enhance the educational opportunities for all residents and trainees. Overall responsibility for care of the critically ill trauma patient will remain with the responsible surgeon as defined in Chapter 8 of *Resources for Optimal Care of the Injured Patient*, ACS/COT 1990.

V. CLINICAL AND EDUCATIONAL FACILITIES AND RESOURCES

A. The Trauma Service must function as a unit which has a sufficient number of knowledgeable personnel and the necessary institutional support to care for injured patients. (Ref: Chapters 6 and 7 of *Resources for Optimal Care of the Injured Patient*, ACS/COT 1990.)

B. Personnel should include specifically trained nurses and technicians who are skilled in trauma care.

C. A critical care unit must be located in a designated area within the hospital, constructed and designed specifically for the care of critically ill/injured patients. (Ref: Chapter 8 of *Resources for Optimal Care of the Injured Patient*, ACS/COT 1990.)

D. Objectives of a Trauma Care Fellowship can best be achieved when the program is based within an institution which has approved training programs in the surgical specialties and in disciplines that particularly relate to surgery, such as internal medicine, radiology, pathology, and anesthesiology.

E. An adequate hospital or university library must be readily available to provide access to information for patient care of scholarly pursuits.

F. Conveniently located and adequate space for conferences and study are essential.

G. The record-keeping and quality assurance programs must comply with the ACS/COT Level I Trauma Center criteria.

VI. THE EDUCATIONAL PROGRAM

A. Curriculum Overview—The program must provide the opportunity for fellows to learn in depth the following aspects of trauma care.

1. Coordination, evaluation, and supervision of a trauma care system, including prehospital care and transport.

2. Evaluation, resuscitation, and operative or nonoperative management of critically injured patients of all ages.
3. Physiology, pathophysiology, diagnosis, and therapy of disorders of the cardiovascular, respiratory, gastrointestinal, genitourinary, neurologic, endocrine, musculoskeletal, and the immune systems.
4. Metabolic, nutritional, and endocrine effects of critical illness, including shock, sepsis, and multiple organ failure.
5. Hematologic and coagulation disorders.
6. Thermal, electrical, and radiation injury.
7. Monitoring and medical instrumentation.
8. Pharmacokinetics and dynamics of drug metabolism and excretion.
9. Ethical and legal aspects of trauma care.
10. Biostatistics and design of experiments.

B. Critical Care Skills—For the comprehensive care of the trauma patient, the fellow must have the opportunity to become proficient and demonstrate proficiency in critical care skills that include the following:

1. Neurological: The performance of complete neurological examination; use and interpretation of intracranial pressure monitoring techniques; evaluation of cerebral function, perfusion, and metabolism; assessment of CNS viability.
2. Respiratory: The use of intubation and maintenance of the airway including tracheostomy; management of endotracheal tubes; endoscopic techniques related to the tracheo-bronchial tree; techniques for weaning from mechanical ventilation; suction techniques; use of bronchodilators and humidifiers; chest physiotherapy; monitoring airway and intrathoracic pressures; interpretation of sputum cultures; performance of bedside pulmonary function tests; application of appropriate oxygen therapy; management of pneumohemothorax; insertion of chest tubes; use of the various mechanical ventilators and other devices to support gas exchange; and interpretation of blood gases.
3. Circulatory: Open or closed cardiac resuscitation; invasive monitoring techniques using peripheral and central arterial and venous catheters and lines, pulmonary artery catheterization, pericardiocentesis, and insertion of transvenous pacemakers; computations of cardiac output and of systemic and pulmonary vascular resistance; monitoring and interpretation of electrocardiography; use of infusion pumps and vasoactive agents in the management of critical illnesses; application and regulation of cardiac assist devices and use of non-invasive blood flow monitoring devices, such as Doppler ultrasound, to assess cardiovascular functions.
4. Renal: The evaluation of renal function and utilization of peritoneal dialysis, hemofiltration, and hemodialysis.
5. Gastrointestinal: The prevention and management of GI bleeding; techniques of endoscopy of the stomach, duodenum, and esophagus; management of gastrointestinal feeding and draining devices (e.g. gastrostomy tubes, jejunostomy tubes, biliary drainage tubes); and non-operative management of fistulas and stomas.
6. Hematologic: The use of autotransfusion; the prevention and management of hypothermia; the management of massive transfusions; and the appropriate use of blood component therapy.
7. Infectious Disease: The diagnosis and management of infection and sepsis; techniques of isolation; interpretation of cultures, and selection and management of therapy; control of nosocomial infections, and protection of health care providers.
8. Nutritional: Application of parenteral and enteral nutrition and the monitoring and assessment of metabolism and nutrition.
9. Monitoring/Bioengineering: Use and calibration of transducers, amplifiers, and recorders.
10. Musculoskeletal: Use of splints, traction and special beds for the immobilizing injuries of the spine and extremities, and physiologic support of patients with such injuries.
11. Psychosocial: Counseling family and patients (e.g. prognosis, bereavement, living wills, organ donation); supporting the health care team.

VIII. EVALUATION

A. Trainees:

1. The trainees must be evaluated by regular written reports covering the development of their knowledge, skills, relationships with other colleagues and staff, and administrative and teaching abilities.
2. Regular meetings (at least every 6 months) shall be held between the program director and trainee to provide feedback and evaluation.

3. The trainees shall evaluate the program, the program director, and faculty on a regular basis (at least every 6 months).

B. Program Director:

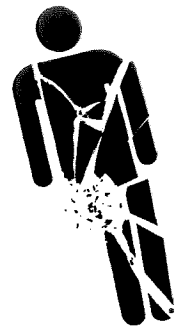
The Trauma Care Fellowship director is responsible to (and should be evaluated by) the director of the core general surgery residency program regarding teaching, scholarly research productivity, patient care activities, and administrative capabilities.

C. Program:

The program shall be evaluated by an institutional review committee at least every 3 years.

The preceding guidelines are reprinted with permission from Guidelines for trauma care fellowships. *J Trauma* 1992; 33(4): 491-494.

APPENDIX D RESUSCITATION



Resuscitation of the trauma patient is the key phase in acute injury care that links the prehospital and hospital environments. The word "resuscitate" derives from the Latin resuscitare, "to awaken," and means "to revive from apparent death or unconsciousness" (from *Webster's Third New International Dictionary*). Though the actual reviving begins as soon as basic life support (BLS) or advanced life support (ALS) procedures are underway, most physicians think of resuscitation as the period immediately after the arrival of the patient at the hospital. The resuscitation, similar to all other phases of trauma care, requires surgical commitment and leadership. This appendix will provide an overview of trauma resuscitation with specific reference to the organization, personnel, and resources necessary to develop an effective multidisciplinary trauma resuscitation team.

Ideally, resuscitation is an intense period of medical care where initial and continuous patient assessment guides, concurrent diagnostic and therapeutic procedures, and, at times, even the commencement of surgery to save life or limb. Resuscitation is the group of coordinated actions performed to secure airway, support breathing, and restore circulation. A dynamic period, it requires the trauma surgeon and trauma team to rapidly develop a differential diagnosis based on the effectiveness of treatment and the results of available diagnostic studies. The surgeon must be present to direct this most crucial activity. Similar to the surgeon's approach to the operating room suite, the trauma surgeon must ensure that the optimal resuscitation space, personnel, and equipment are always present and ready for the injured patient.

Survival after severe injury depends on reestablishing and maintaining adequate tissue oxygenation. This simple fact imposes critical time limitations on the initiation of resuscitation. In most environments, considerable time has already elapsed prior to hospital arrival. Often, 30 minutes or more have been spent in the "prehospital" area, and, therefore, the first minutes within the emergency department or trauma center are crucial and require the utmost organization. Preplanning and coordination between prehospital, emergency department, and in-hospital resources and personnel are essential. Based on mutually accepted prehospital triage and "trauma alert" guidelines, a trauma team consisting of designated and dedicated personnel must be available to respond 24 hours a day. Trauma care protocols must be known by all team members prior to patient contact.

The resuscitation of severe injury victims requires cognitive, psychomotor, and management skills, the improvement and maintenance of which demand continued evaluation through performance improvement. Quality improvement indicators and filters should thus include those specific for resuscitation. Team members should evaluate, discuss, and critique the resuscitation retrospectively to ensure efficiency and proficiency of the team and its individual members. This should be done in a multidisciplinary fashion at periodic intervals to facilitate recall of the events and circumstances of the resuscitation. Resuscitation documentation, flow sheets, and physician forms ideally should be designed to allow systematic recording of pertinent information that is coordinated with predesigned quality improvement filters.

SPACE: TRAUMA RESUSCITATION AREA

The emergency department should have a large space designated as the trauma resuscitation area. If the number of trauma patients is significant or there is little or no prehospital notification of patient arrival, this space must be *dedicated* to the trauma patient. The space should be large enough to allow assembly of the full trauma team plus necessary equipment such as a ventilator and/or portable X-ray machine. The area should be well-lighted and have independent room-temperature control devices or heating elements. Materials and equipment necessary for the various jobs of team members should be openly displayed, well labeled, and kept in close proximity to the team members who will need them. Examples of this practice

include airway and intubation equipment kept at the head of the stretcher, intravenous devices and blood-drawing equipment placed near the two sides of the stretcher, and chest tube trays located at the sides adjacent to the thorax (see Figure 1).

Access to this large space should be relatively limited, and the space should not be confining to team personnel. The design should prevent nonessential personnel from disrupting the resuscitation. In addition, there should be a physical or visual barrier to the entrance beyond which universal precautions are employed: eye protection and fluid-impervious gowns and gloves. Ideally, for busy trauma centers, the space should be able to handle simultaneously two to three patients. If the facility is limited, protocols must be in effect to adapt the space for a two-patient resuscitation or for performing a "split" team resuscitation in two different spaces. Last, the space must be designed to allow ease of cleaning and resetup for additional trauma patients. Proper handling of patient's clothes, valuables, and biocontaminated materials must be ensured.

EQUIPMENT

Instrument or procedure trays to perform invasive procedures, such as emergency thoracotomy, chest tube insertion, and peritoneal lavage, should contain only the instruments necessary to perform the task correctly. Sterile wrappings should be easy to remove and should reveal instruments that are not clamped together but, rather, that are held in predesigned tray locations separated by foam compartments or brackets. Scalpel handles should be preassembled with blades and protective covers; sutures should also be included.

Ideally, intravenous fluids should be stored in thermostat-controlled warmers. Large-bore catheters and tubing, as well as warming/infusion devices, should be mandatory. Chest tube drainage containers that allow easy setup with autotransfusion devices should be used. Hemodynamic and cardiac monitoring, as well as pulse oximetry, are necessary and should be strategically placed to facilitate ease of viewing. A mechanical ventilator should be immediately available, and the equipment and drugs necessary for emergency paralysis and intubation, pain control, advanced cardiac life support, and antimicrobial coverage should be secured within the resuscitation area.

The space, resuscitation equipment, and personnel should be prepared for the treatment of children as well as of adults. Equipment unique to the control of the pediatric airway must be available. Reference materials for pediatric drugs, dosages, and cardiac resuscitation should be displayed or immediately available.

The resuscitation area must contain adequate phones, phone lines, and/or intercoms. This space quickly becomes a command center and requires an adequate means to send and receive communications and data. In some busy centers, "hot lines" should be considered between the resuscitation area and the blood bank and/or operating room. Large wallboards displaying team members' names and roles, as well as key hospital phone numbers and on-call personnel are helpful. Data such as laboratory results should be communicated to the trauma team and simultaneously recorded on a standardized part of the patient record (flow sheet) or wallboard. Last, communication to and from the resuscitation area should pertain only to the trauma patient at hand. Phone calls from the police, media, press, or to team members about other responsibilities must be deferred or referred.

COMMUNICATION

Efficient communication is the key to an integrated trauma system. Key points of communication for the resuscitation involve the following:

- Prehospital/hospital link for direct medical command and early hospital notification
- Trauma team alert and activation
- Prehospital provider and trauma team information transfer
- Trauma team and intrafacility personnel communication
- Interfacility communication

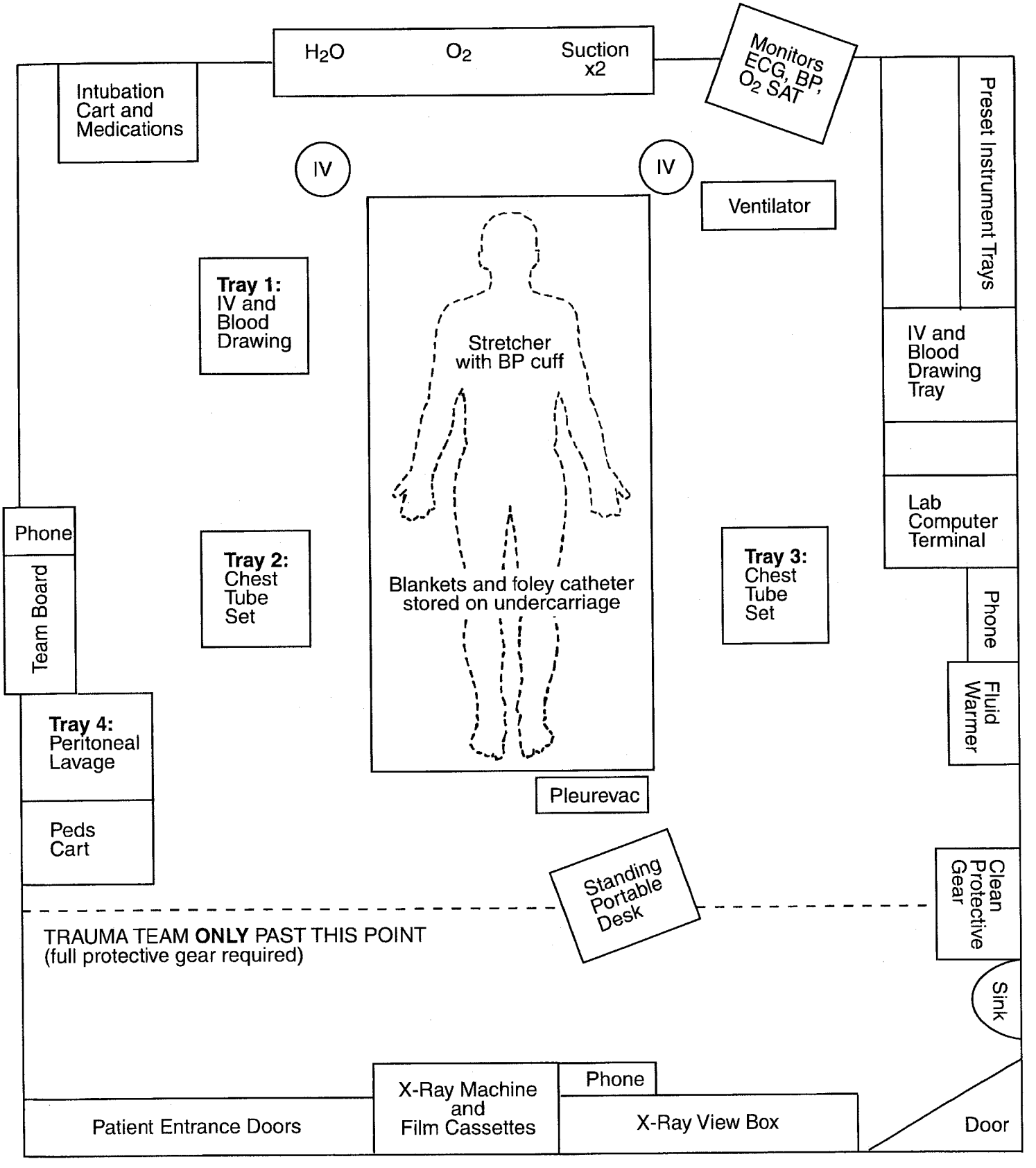
The radio or phone communication between prehospital and hospital (emergency) personnel must (*a*) be dedicated to medical emergencies, (*b*) ensure availability of direct medical direction, and (*c*) provide the earliest possible notification to the hospital's emergency department or trauma center that a seriously injured patient is about to arrive.

The trauma alert should be activated based on predetermined field and hospital trauma triage guidelines. A multiple beeper system should announce the alert with either a voice or digital printout message. The trauma alert should activate and assemble the team. In most instances, the team will be responding from both inside and outside the hospital. The key, then, is early communication to ensure the arrival of all team members with the patient.

The transfer of the patient from prehospital provider to trauma team requires accurate and concise communication of vital data upon arrival. These data should include age, mechanism of injury, vital signs, observed and suspected injuries, and any therapies, treatments,

FIGURE 1
TRAUMA BAY SETUP

An example of a trauma resuscitation bay containing a single stretcher, strategically placed equipment, and coordinated team member positions and job descriptions.



or medications rendered. In addition, environmental factors, times, and any other relative circumstances should be relayed. The trauma team leader will integrate this information into the assessment and treatment plan and disseminate it to all members of the trauma team in a timely fashion. The prehospital provider must leave a completed ambulance run sheet with the team, and, if possible, this should include patient identification and the identification of all emergency medical services (EMS) and public safety agencies involved in the prehospital phase.

TEAM

The trauma team may vary in size and composition, however, one physician must be in charge and provide overall direction. That responsible surgeon should assume command of the trauma team and move the team efficiently through the various phases of the resuscitation. In some trauma centers, the team may consist of as many as seven to 10 members, all responding from within the hospital. In other trauma centers, the organization of the team will likely be based on a rapid communication system that notifies surgeon and team members to respond and supplement an emergency physician and nurse. In some trauma centers, these may be the only in-house personnel. Regardless of size, the keys are organization and protocols that guarantee the rapid assembly and efficient working of the trauma team.

The exact composition of the trauma team will vary according to the "local rules" designed by the trauma service director and the hospital trauma committee (see Chapter 5, page 24). Each team member should have defined roles.

Each individual trauma team member must accomplish numerous tasks if the overall goal of patient assessment and stabilization is to occur. These activities include assessment of ABCs (airway, breathing, and circulation) with simultaneous life support, diagnosis of injuries, acquisition of laboratory specimens, initial radiographic survey, and communication and mobilization of any and all necessary hospital resources. Coordination of the multiplicity of tasks can best be accomplished if each team member has assigned responsibilities (see Figure 2).

TASK ALLOCATION: "SEQUENTIAL AND SIMULTANEOUS" RESUSCITATION

The traditional work pattern, taught in the Advanced Trauma Life Support® (ATLS®) curriculum, is set with the background trauma team composed of a physician and nurse. They proceed in a stepwise approach of assessment and treatment: airway, then breathing, then circulation, and so on. Tasks are allocated one after the other in a "sequential fashion" for the resuscitation. This method is simple and desirable for a team in which a limited number of providers are available to perform all of the cognitive and motor tasks. This stepwise progression is safe, efficient, and applicable to situations in most hospitals. Even in facilities with larger trauma teams, this type of resuscitation sequence serves as a safe basis for other more complex resuscitation techniques.

In hospitals where personnel resources allow the assembly of a multidisciplinary team, the work pattern may be more "simultaneous" in that a number of professionals perform tasks concurrently with coordination through a central team leader. The team leader must observe many simultaneous activities, review data, and direct and coordinate diagnostic studies and interventions. Team members must understand their individual tasks and stay within the role defined by that task, unless otherwise directed by the team leader. Resuscitation can proceed more quickly in this scenario, but team discipline and order must be high priorities to ensure proficiency and safety.

Regardless of the team size or work pattern, each "position" on the team needs a job description that delineates tasks. With experience and through an active performance improvement process, the team should refine each role. This refinement process may include video recording and subsequent review to optimize team performance. The same process can be used to define necessary physical space requirements, optimize equipment location, and modify behavior.

Resuscitation is a vital component of trauma care that requires the utmost in organization and coordination of space, personnel, and equipment. As in all phases of trauma care, resuscitation requires surgical leadership and direction. The resuscitation, if well planned and organized, should optimize the patient's chances of survival, minimize morbidity, and ensure both efficiency and proficiency of the trauma team. Poorly organized, this phase of acute trauma care may be chaotic and potentially harmful to the patient. Regardless of the size or composition of the team, the most important facet is the development of protocols and job descriptions. These, in turn, must be understood by prehospital providers, as well as by key hospital leaders. Once organized, resuscitations should undergo constant study, constructive criticism, and continuous performance improvement.

FIGURE 2
EXAMPLE OF A MULTIDISCIPLINARY TRAUMA TEAM

Team members are strategically placed around the stretcher based on their tasks. They are coordinated with equipment placement within the resuscitation bay (see Figure 1).

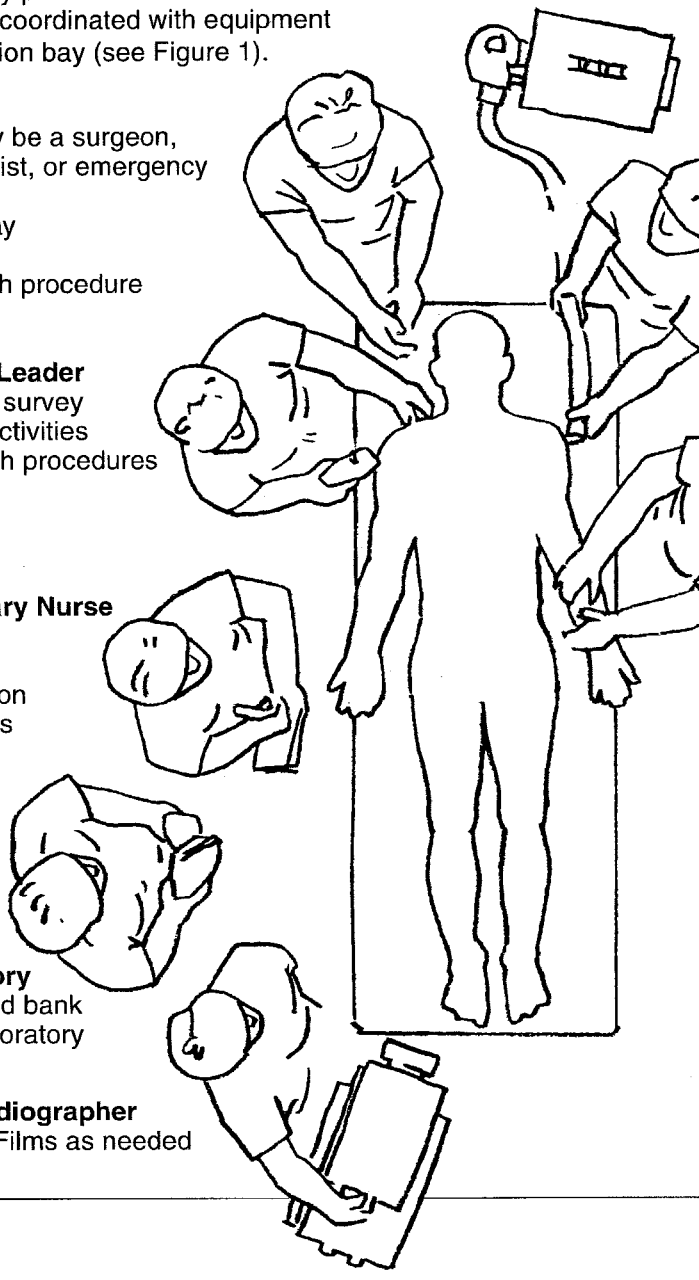
Airway Control/MD (may be a surgeon, anesthesiologist/anesthetist, or emergency physician) **or RN**
- Establishes clear airway
- Intubates
- Performs or assists with procedure

Trauma Surgeon/Team Leader
- Initial assessment and survey
- Coordinates all team activities
- Performs or assists with procedures

Registered Nurse/Primary Nurse
- Calls alert
- Prepares area
- Records vital information
- Assists with procedures

Blood Bank or Laboratory
- Brings blood from blood bank
- Carries samples to laboratory

Radiographer
- Films as needed



Respiratory Therapist
- Assists with airway control
- Places monitoring devices
- Sets up ventilator

Registered Nurse
- Takes vital signs
- Venous access/blood drawing
- Passes equipment
- Assists with procedures

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APPENDIX E

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Fax: (617) 244-8755

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1540 CATON CENTER DRIVE
SUITE R
BALTIMORE, MD 21227
Main: (410) 242-7000
Fax: (410) 242-1871

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SPRINGFIELD, NJ 07081
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Fax: (973) 379-5113

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2000 HAMILTON STREET
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PHILADELPHIA, PA 19130-3813
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Fax: (215) 557-9359

CENTER FOR ORGAN RECOVERY & EDUCATION
(Formerly Pittsburgh Transplant Foundation)
RIDC PARK
204 SIGMA DRIVE
PITTSBURGH, PA 15238-2825
Main: (412) 963-3550
Fax: (412) 963-3563

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ORGAN PROCUREMENT DIVISION
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FALLS CHURCH, VA 22042
Main: (703) 641-0100
Fax: (703) 641-0211

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301 SOUTH 20TH STREET
SUITE 1001
BIRMINGHAM, AL 35233-2033
Main: (205) 731-9200
Fax: (205) 731-9250

ARKANSAS REGIONAL ORGAN RECOVERY AGENCY
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Fax: (501) 372-6279

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GLOSSARY

AACN
American Association of Critical Care Nurses

AANN
American Association of Neuroscience Nurses

ACEP
American College of Emergency Physicians

ACGME
Accreditation Council for Graduate Medical Education

ACLS-Certified
Individuals certified by the American Heart Association in Advanced Cardiac Life Support techniques

ACS COT
American College of Surgeons Committee on Trauma

AIS
Abbreviated Injury Scale—an anatomic severity scoring system

ALS
Advanced life support, including techniques of resuscitation, such as intubation, intravenous access, and cardiac monitoring

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

asystole
Absence of spontaneous cardiac activity

ATLS® Course
Advanced Trauma Life Support® Course of the American College of Surgeons

BLS
Basic life support techniques of resuscitation, including simple airway maneuvers, administration of oxygen, and intravenous access

board-certified
Physicians certified by appropriate specialty boards recognized by the American Board of Medical Specialties

burn patient referral
In general, patients for referral are so-called "major burns," described as burns involving 20 percent or greater body surface area (BSA) in an adult, or 10 percent or greater BSA in a child; additionally, burns of lesser BSA in patients with concomitant serious disease—for example, cirrhosis, diabetes, and cardiac disease—should be considered for transfer, as should special problems, such as inhalational injuries and burns involving hands, feet, face, and genitalia (*see* Chapter 14)

bypass (divert status)
Transport of an EMS patient past a normally used EMS receiving facility for the purpose of accessing more readily available or appropriate medical care

CCRN
Critical Care Registered Nurse certification from the American Association of Critical Care Nurses

CDC
Centers for Disease Control and Prevention in Atlanta, GA—a federal agency committed to epidemiologic surveillance, control of disease processes, particularly those secondary to infection or trauma, and prevention

certificate of special competency or added qualifications
Recognition of specialized education in selected areas of care and acknowledged by the American Board of Medical Specialties

CME
Continuing medical education courses for physicians in practice

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

comorbidity
Significant cardiac, respiratory, or metabolic diseases that stimulate the triage of injured patients to trauma centers

consultation program
American College of Surgeons Committee on Trauma program in which trauma care capability and performance of a hospital or group of hospitals is evaluated to improve local trauma care or prepare for a verification visit

continuing medical education (CME)
Defined educational activities for practicing physicians, often resulting in approved credit hours from the AMA, state medical society, a medical school, or hospital

credentialing
Approval of a physician as a member of the trauma team, based on a review of the individual's training and experience by the trauma service director and the appropriate service chief

"D"
Desired requirement for trauma facilities

demonstrated commitment
Provision of evidence (visible and written) that clearly demonstrates an institutionwide commitment to trauma care

disaster
Sudden event with a variable mixture of injury to or sickness of human beings, destruction, or contamination of property, overwhelming demand on local response resources, and disruption of organized societal mechanisms

"E"
Essential requirement for trauma facilities

EMS
Emergency medical services—the arrangement of personnel, facilities, and equipment for the effective and coordinated delivery of emergency care required to prevent and manage incidents that occur from a medical emergency or from an accident, natural disaster, or similar situation

EMT-P
Emergency medical technician-paramedic—an individual who is trained to provide emergency medical services and is certified as such by the local authorities in accordance with the current national standard

ENA
Emergency Nurses Association

FEMA
Federal Emergency Management Agency—an entity for aiding in relief efforts after disasters

field triage
Classification of patients according to medical need at the scene of an injury or onset of an illness

GCS
Glasgow Coma Scale—a scoring system that defines eye, motor, and verbal responses in the patient with injury to the brain

General Surgery Accredited Residency Program
Programs approved by the Accreditation Council for Graduate Medical Education

hospital criteria
Essential or desirable characteristics that help categorize Level I, II, or III trauma centers or a Level IV trauma facility

ICD-9
Ninth edition of *International Classification of Diseases*—a standard coding system that includes all injuries and disease processes

ICP
Intracranial pressure, often monitored in patients with severe injuries to the brain

immediately available
Implies the *physical* presence of the health professional in a stated location at the time of need by the trauma patient

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

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

injury control
Programs designed to teach potential victims how to avoid injuries

interhospital transfer
The transfer of a patient from a resource-limited facility to a trauma center able to provide a higher level of care

ISS
Injury Severity Score—the sum of the squares of the Abbreviated Injury Scale scores of the three most severely injured body regions

lead agency
An organization that serves as the focal point for program development on the local, regional, or state level

lead hospital
A trauma center that serves as the focal hospital to provide system leadership and development. This hospital should provide medical direction, training, public education, injury prevention, and systemwide performance improvement programs.

Level I trauma center
Regional resource trauma center that has the capability of providing leadership and total care for every aspect of injury from prevention through rehabilitation

Level II trauma center
Hospital that provides initial definitive trauma care regardless of the severity of injury, but may not be able to provide the same comprehensive care as a Level I trauma center and does not have trauma research as a primary objective

Level III trauma center
Hospital that provides assessment, resuscitation, emergency surgery, and stabilization while arranging for transfer to a Level I or II facility that can provide further definitive surgical care

Level IV trauma center
Medical facility that provides the stabilization and treatment of severely injured patients in remote areas where no alternative care is available

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

medical direction, direct
Voice communications between prehospital personnel and the emregency physician who directs the care

medical direction, indirect
Medical direction conducted by protocols developed by physicians

Model Trauma Care Systems Plan
Plan for the development of trauma systems in the United States that was described in the 1990 Trauma Care Systems Planning and Development ACT (PL 101-590)

morbidity
The relative incidence of disease

mortality
The proportion of deaths to population

multidisciplinary trauma review committee
Committee composed of the trauma service director and other physician members of the trauma service that reviews trauma deaths in a system or hospital

multiple or mass casualty triage
Specialized techniques of triage used when large numbers of injured patients are concentrated in one area

NATIONAL TRACS®
National Trauma Registry Project of the Committee on Trauma, American College of Surgeons

OSHA
The Occupational Safety and Health Administration of the United States Department of Labor

over-triage
Directing patients to trauma centers when they do not need such specialized care. Over-triage occurs because of incorrect identification of patients as having severe injuries when retrospective analysis indicates minor injuries.

PALS
Pediatric Advanced Life Support Course developed and sponsored by the American Heart Association and the American Academy of Pediatrics—covers the knowledge and skills necessary for the initial management of pediatric emergencies, including trauma

pediatric trauma center
Children's hospital fulfilling the criteria for comprehensive trauma care outlined in this document

Pediatric Trauma Score
An injury scoring system used in some centers caring for pediatric patients

pediatric trauma surgeon
Certified pediatric surgeon with a commitment to trauma or certified general surgeon with special training and documented CME relevant to pediatric trauma care

postgraduate year (PGY)
Classification system for residents in postgraduate training—the number indicates the year they are in during their postmedical school residency program; for example, PGY1 is 1 year after graduation from medical school

promptly available
Implies the *physical* presence of health professionals in a stated location within a short period of time, which is defined by the trauma system (director) and continuously monitored by the performance improvement program

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

regional resource trauma center
A Level I tertiary care facility that is central to the trauma care system

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

rehabilitation
Services that seek to return a trauma patient to the fullest physical, psychologic, social, vocational, and educational level of functioning of which he or she is capable, consistent with physiologic or anatomic impairments and environmental limitations

research
Clinical or laboratory studies designed to produce new knowledge applicable to the care of injured patients

response time
Interval between notification and arrival of general surgeon or surgical specialist in the emergency center or operating room

resuscitation
Intense period of patient assessment and medical care to save life or limb

RFP
Request for proposal from lead agency or authoritative body to hospitals and health professionals in a region where a trauma system is to be developed

RTS
Revised Trauma Score, a prehospital/emergency center scoring system in which numerical values are assigned to differing levels of Glasgow Coma Scale, systolic blood pressure, and respiratory rate

trauma
A term derived from the Greek word for "wound"—it refers to any bodily injury (*see* **injury**)

trauma call roster
The listing of surgeons assigned to provide trauma care, including date of coverage and alternate surgeons

Trauma Care Systems and Planning Act
The law that amended the Public Health Service Act to add Title XII-Trauma Programs. The purpose of the legislation is to assist state governments in developing, implementing, and improving regional systems of trauma care and to fund research and demonstration projects to improve rural EMS and trauma care (PL 101-590).

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

trauma center designation
The process by which a properly authorized agency identifies and selects facilities to care for severely injured patients within a trauma care system

trauma coordinator/trauma program manager
A designated individual with responsibility for coordination of all activities on the trauma service and works in collaboration with the trauma service director

trauma fellowship
Formal advanced postresidency training in the care of injured patients (*see* Appendix C)

trauma patient
An injured patient

trauma prevention programs
Internal institutional and external outreach educational programs designed to increase awareness of methods for prevention and/or avoidance of trauma-related injuries

trauma program
An administrative unit that includes the trauma service and coordinates other trauma-related activities; for example, injury prevention, public education, CME activities, and so on

trauma registry
Database to provide information for analysis and evaluation of the quality of patient care, including epidemiologic and demographic characteristics of trauma patients

trauma service
A clinical service established by the medical staff that has oversight of and responsibility for the care of the trauma patient

trauma service director
Physician designated by the institution and medical staff to coordinate trauma care

trauma team
A group of health care professionals organized to provide care to the trauma patient in a coordinated and timely fashion

triage
French word meaning sorting or sifting; implies priority

TRISS
Trauma Score/Injury Severity Score—the likelihood of patient survival based on a regression equation that includes patient age, ISS, RTS, and the type of injury (blunt or penetrating)

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

verification programs
American College of Surgeons Committee on Trauma program in which trauma care capability and performance of an institution are evaluated by experienced on-site reviewers

INDEX