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PRACTICE MANAGEMENT GUIDELINES FOR TRAUMA CARE: PRESIDENTIAL ADDRESS, SEVENTH SCIENTIFIC ASSEMBLY OF THE EASTERN ASSOCIATION FOR THE SURGERY OF TRAUMA

Michael Rhodes, MD, FACS

WITH HEALTH CARE REFORM looming on the horizon, a galaxy of plans are emerging which herald the promise of cost containment and improved efficiency. Central to many of these plans is the concept of "practice management guidelines." Although there are no compelling data to validate their effectiveness, the concept of management guidelines appears intuitively sound to many policymakers and physicians.[1]

The Institute of Medicine, an independent think tank providing advice to the Agency for Health Care Policy and Research, has published guidelines for clinical practice.[2] They define practice guidelines as systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances. The five major purposes of guidelines include (1) assisting clinical decision-making by patients and practitioners, (2) educating individuals or groups, (3) assessing the quality of care, (4) guiding allocation of resources, and (5) reducing the risks for legal liability. Management guidelines and "clinical management protocols" are terms commonly used by surgeons and researchers. "Practice parameters" are used by the American Medical Association while "critical pathways" or "clinical pathways" are favorite terms of the nursing profession. Although these terms may differ in their scope, their common objective is to provide a uniform means to an end. For the purpose of this discussion, these terms will be used interchangeably. The scope may include diseases, injuries, treatments, procedures, symptoms, signs, or specific clinical situations. Formats for guidelines may consist of free text, algorithms, decision trees, flow charts, and "if . . . then" statements.

A number of practice guidelines have been published by a variety of organizations and specialty societies (Table 1). The vascular surgery societies have recently published guidelines for carotid endarterectomy,[3] femoral-popliteal bypass,[4] and elective aneurysm resection.[5] The American College of Surgeons' Committee on Trauma has published guidelines for triage of the injured patient[6] as well as guidelines designed for the first hour of trauma resuscitation.[7]

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Guidelines may be useful to a variety of groups including patients, practitioners, purchasers of health care, legislators, and regulators. There are perceptions that health care expenditures have brought only marginal health benefits and that guidelines can help remedy the problem. Stimuli for these perceptions include (1) a wide variation in physician practice patterns and use of services, (2) research indicating inappropriate use of services, and (3) uncertainty about health outcomes achieved.

Research suggests that trauma is the nation's most costly disease, with $180 billion direct and indirect

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Table 1
List of published practice guidelines by specialty section

Visual acuity screening
Vaccination for pregnancy
Chest pain in emergency department
Indications for carotid endarterectomy
Percutaneous angioplasty
Labor and delivery after C-section
Use of autologous blood
Treatment for low back pain
Management following CABG
Triage of injured patient

CABG: coronary artery bypass graft.

lifetime costs, over $12 billion annually in hospital charges and physician fees, and an average trauma admission cost of approximately $12,000.[8] However, several studies have suggested that diagnosis-related groups (DRGs) are inadequate for trauma reimbursement.[9,10] This is particularly important since most of the critical pathways developed by other specialty societies are DRG-based. A study of 12 New York state trauma centers revealed that trauma patients cost $27.5 million more per year than non-trauma center patients with the same DRGs.[11] A recent study by Eastman et al. reported the results of a trauma economic study of 95 U.S. trauma centers showing an overall revenue loss of 15%.[12]

In his recent Scudder oration, Dr. Ben Eiseman submitted that, as trauma surgeons, our first contract to society is to provide quality care to the injured and that our second contract is to provide that care in a cost-effective manner, suggesting that we must develop practice parameters for trauma care.[13] The concept of protocols for trauma management is certainly not new. Over 20 years ago, Champion and his colleagues (then at the Shock Trauma Center in Baltimore), developed protocols for trauma care, many of which evolved into the current Advanced Trauma Life Support (ATLS) guidelines. Other prominent trauma surgeons have published examples of decision trees for specific injury in trauma-related disease.[14] Literally hundreds of immediate management algorithms for injury care have been published in the literature. Many of these are institutionally specific and are limited to initial resuscitation or surgical management. Although clinically important, they may not affect the major costs in trauma management.

The major phases in trauma care are outlined in Figure 1. What follows is a review of these phases relative to the development of practice management guidelines.

Transportation

In an interesting interview televised by C-SPAN in June of 1993, the CEO of Blue Cross and Blue Shield of Illinois in Chicago was asked about helicopter transport relative to health care costs.[15] He responded by saying that this represents a minuscule cost in the global health care budget and was likely cost effective by promoting regionalization of tertiary care. Despite this endorsement, the lack of specific guidelines and research to support those guidelines for utilization of EMS helicopters have led third party payers to question medical necessity. General guidelines that are intuitively sound have been suggested but have not been well studied (Table 2). Although no specific survival advantage has been demonstrated with direct on-scene helicopter transport when compared with interhospital transport of trauma patients, several investigators have demonstrated a reduced length of stay and cost per matched injury groups transported from the scene (Table 3).[16] This would suggest that development of prehospital protocols that promote direct on scene

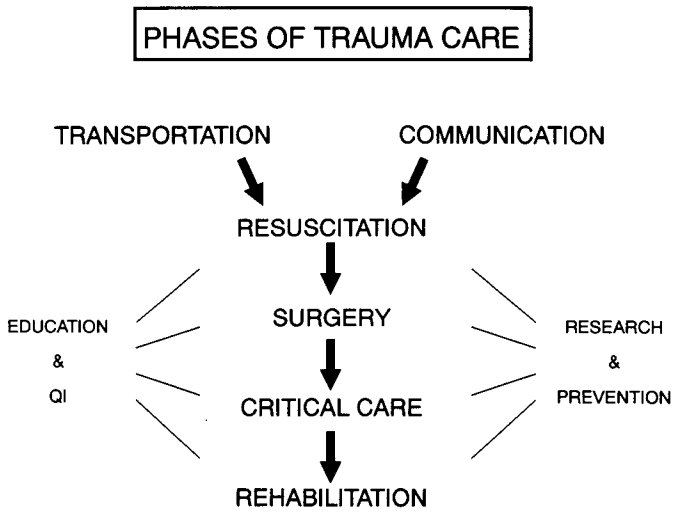

Figure 1. Clinical and analytical phases of trauma care.

Table 2
EMS helicopter triage guidelines

>20 minutes land transport time
Patient in inaccessible area
No advanced life support available
Multiple causal ties
Entrapment
To shorten exposure time

Table 3
Comparison of 1500 patients transported by direct on-scene with 404 patients transported by interhospital helicopter (1990 unpublished data)

Mode of Transport	Number (%) of Patients	Age (years)	ISS	LOS (days)	Survival
OS	1500 (79)	31.9	22.1	15.6	.82
IH	404 (21)	33.0	20.2	19.8	.85
p Value		<0.54	<0.028	<0.022	<0.24

OS: on scene; IH: interhospital helicopter; ISS: Injury Severity Score; LOS: length of stay.

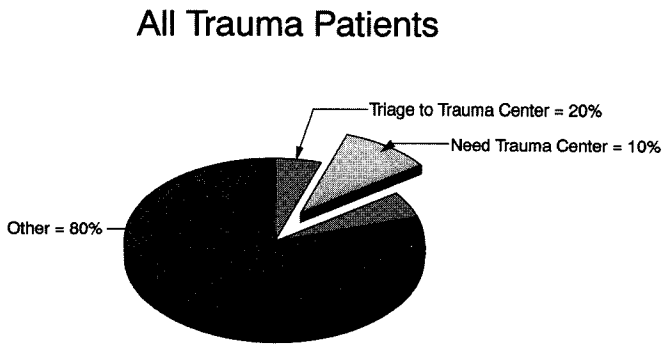

Figure 2. Twenty percent of all injuries are triaged to trauma centers in order to capture the 10% for whom the trauma center is designed.

transport to the trauma center may be more cost effective.

Communication

The communication phase of trauma care has become "high-tech" but sometimes "low-talk." As previously mentioned, field triage based on age, vital signs, anatomy, and mechanism of injury has been published by the American College of Surgeons' Committee on Trauma. These triage guidelines result in a 50% over-triage rate in order to maintain an under-triage rate of less than 10%.[17] As a result, many trauma centers are seeing 20% of the total trauma population in order to treat 10% for which they are designed (Fig. 2). For example, mechanism of injury is frequently over-interpreted, such as in patients who managed to climb out of the vehicle after crash but were subsequently interpreted as "ejected" and transported to a trauma center. Several studies have suggested a negative cost impact from over-triage and have recommended a tiered response for trauma resuscitation.[18,19] It is unlikely that the purchasers of health care will continue to accept this presumptive approach resulting in a 50% over-triage.

In addition to improving prehospital trauma triage guidelines and promoting a tiered trauma response, timely and selective subspecialty consultation can enhance efficiency, such as selective neurosurgical consultation for trauma care using clinical management guidelines.[20] The neurosurgical community has already recognized the need for clinical management protocols for trauma.[21]

Resuscitation

The resuscitation phase of trauma care is best exemplified by the Advanced Trauma Life Support course sponsored by the American College of Surgeons' Committee on Trauma.[7] This superb course represents practice parameters for early trauma management and is an excellent lesson in the development, implementation, and analysis of practice parameters; however,

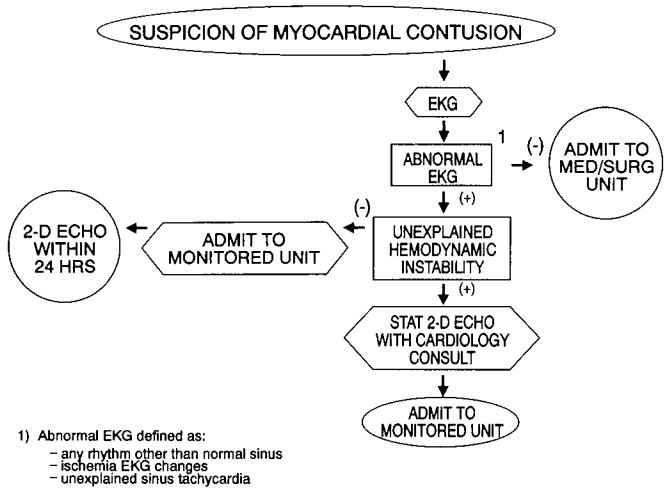

Figure 3. Screening for myocardial contusion in trauma patients requiring hospital admission.

its focus is limited to the first 60 minutes of trauma care.

There are several areas for increased efficiency in the resuscitation phase of trauma. For example, the routine pelvic x-ray film for blunt trauma advocated several years ago has now become more selective through subsequent research.[22–24] The utility of white blood cell (WBC) analysis in diagnostic peritoneal lavage (DPL) has been evaluated in three centers on over 6000 patients concluding that WBC count is of no value in blunt trauma patients lavaged within the first 4 hours of admission.[25–27] In our institution, clear DPL fluid from blunt trauma patients who are lavaged within 4 hours of injury is discarded, saving the cost of analysis. Practice parameters for the use of DPL, abdominal CT scan, abdominal ultrasound, and laparoscopy for trauma must be developed and measured on their cost effectiveness as well as clinical outcome.

"Rule out myocardial contusion" may be one of the nation's most expensive presumptive diagnoses. A simplified protocol based on hemodynamic stability and the results of the admission ECG is supported by sound research and can save unnecessary testing (Fig. 3).[28]

Surgery

In the surgical phase of trauma, direct transport to the operating room for resuscitation has been shown to improve survival for a subset of severely injured penetrating and blunt trauma patients.[29,30] This is particularly true for patients with an open pelvic fracture in which the mortality can be reduced to nearly zero using this technique.[31] Although guidelines for operating room resuscitation have been published, the practicality and cost effectiveness of this concept needs validation and modification. The mangled extremity is another example of a surgical dilemma in trauma. The futility of scoring systems has been recognized and more specific management guidelines are needed to

avoid unnecessary costly attempts at unproductive limb salvage.[32]

Early versus late tracheostomy remains controversial. Several studies have suggested improved cost efficiency of early tracheostomy in certain trauma patients.[33–35] In a retrospective study completed 5 years ago on 363 non-burn trauma patients, a mean reduction of 5 ventilator days and 7 ICU days with no difference in early or late complications was demonstrated in matched patients undergoing tracheostomy within the first 3 days of admission compared with 10 days after admission (unpublished data). A savings of over $7000 per patient charges in 1988 dollars was realized, which may well represent costs in 1994 dollars. A more recent study from the same institution demonstrated similar results.[36] A prospective randomized multicenter study is now underway to help clarify this issue (Western Trauma Association).

Percutaneous tracheostomy has now become a routine bedside procedure.[37–39] This can save expensive OR time and avoid complications of transporting patients. In our experience of over 300 cases, we have not found the added expense of the bronchoscope to be necessary. We have recently begun to preoperatively position the endotracheal tube above the cricoid by listening for turbulent air flow using a Doppler prior to preparing the neck. It is our impression that this greatly facilitates the safety and reduces the cost of the procedure by eliminating the need for the bronchoscope or surgical dissection.

Critical Care

The critical care phase of trauma is clearly the most complex and resource consumptive of all trauma care phases.[40] It would appear that cost effective approaches in the critical care environment would have the most impact on our national health care budget. The ICU is a dynamic environment that involves numerous individuals. Multiple consultants, constantly changing orders, defining who is in charge, rotating staff, and the demands of training programs are all problems contributing to inefficient care. "Consultorrhea" is a particularly bedeviling problem which may well be treated by global fees.

Shoemaker has demonstrated a reduction in complications, length of ICU stay, and mortality using shock resuscitation protocols.[41] Civetta has suggested that remedies such as principles of management and written guidelines can produce a 56% reduction in laboratory tests, saving approximately $2 million per year in a 12-bed intensive care unit.[42] A recent prospective study in 18-ICU beds utilizing guidelines for laboratory and x-ray studies resulted in a 25% reduction in targeted tests, saving $150,000 per year with no change in outcome.[43] Another recent prospective study of the structure and organization in nine ICUs found that the best practices occurred in those with specific guidelines and protocols.[44]

Table 4
List of clinical management protocols for ICU

Chest tube management
Ventilatory weaning
Extubation
Stress ulcer prophylaxis
DVT prophylaxis
Agitation and sedation
Non-urgent albumin transfusion
Pain management
Enteral feeding
Diarrhea
Antibiotic prophylaxis
Invasive line
Chemical paralysis
Gastric tube management
Timed fluid challenge
Cervical spine evaluation
Substance abuse evaluation

A protocol may be defined as a uniform way of approaching a problem which, on average, will lead to an anticipated optimum outcome for the patient. As Shoemaker has suggested, "a protocol is tentatively proposed as a potentially useful approach to a complex clinical arena fraught with emotionally held opinions, anecdotal descriptions, and judgmatic opinions often repeated in the form and manner of a party line."

Concerns have emerged that clinical management protocols may be rigid, unthinking, cookbook, oversimplified, and cumbersome with unattainable consensus. In fact, clinical management protocols can be dynamic (i.e., ready to change rapidly), efficient, cost effective, educationally based, and incorporated into research and quality improvement activities. A number of very smart clinicians have suggested elegant schemes for decision-making in critical care.[45,46] Most of these provide a sound clinical framework for diagnostic and treatment approaches, but are not based on cost effectiveness nor necessarily targeted toward the high cost areas.

In 1989, the trauma/surgical critical care service at the Lehigh Valley Hospital began to develop protocols relative to those ICU activities that were routine and potentially costly. Many of these were born from a need to solve problems frequently revealed by the quality improvement effort. Table 4 outlines the clinical management protocols or management guidelines which have been investigated. Note that none of these protocols are disease or injury oriented, but instead are aimed at high dollar activities occurring daily in the ICU environment.

Figure 4 outlines the phases of the clinical management protocol process. Development teams for each protocol are responsible for reviewing the literature and presenting the protocol in a conference format for review. The teams are multidisciplinary consisting of a

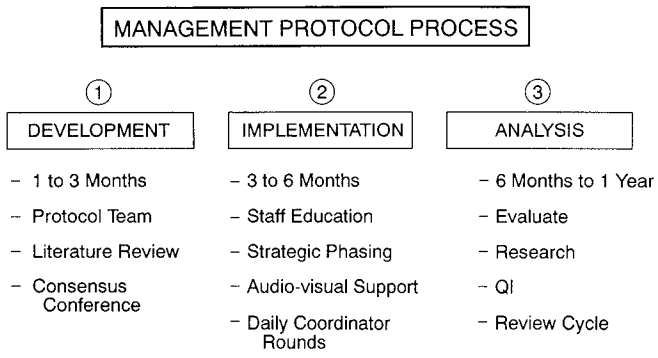

Figure 4. Clinical management protocol process.

trauma surgeon, a clinical nurse specialist, a pharmacist, and a clinical management protocol coordinator. Each team is responsible for presenting its protocol to gain consensus by the modified consensus rule.[47] Each protocol contains an overview statement, an algorithm or decision tree, and a reference list.

Development of a clinical management protocol in the ICU is relatively simple when compared with the implementation of that protocol which requires strategic phasing, audiovisual support, a high profile workbook and daily coordinator rounds. Strategic phasing can best be exemplified by simultaneous implementation of protocols for diarrhea and enteral feeding which are interdependent, as are many of the protocols. Audiovisual support and a high profile workbook are mandatory study materials for unit personnel, including rotating house staff. The daily coordinator rounds ensure accurate implementation and are the cornerstone to success. Distributing a developed protocol to everyone and hoping for the best will fail.

Evaluating the performance of the protocol is the analysis phase. In many instances, incorporation of quality improvement filters as well as research studies into the protocols seem to be a natural fit. As part of the analysis phase, there is a mandatory review of the protocol in 6 months to 1 year, which can result in substantial changes to the protocols, thus promoting flexibility.

When starting this effort, we had a group of trauma and critical care surgeons representing a variety of educational and clinical backgrounds. Each had his or her own strong opinion as to the best management techniques for many of these routine activities. Each surgeon was assigned to his or her own protocol and thereby developed a built-in incentive to yield on the protocols of others in order to gain acceptance of his or her own.

A ventilator weaning protocol took 2 years to develop and an additional 6 months for full implementation. It has already been through the analysis cycle twice and subsequently modified. A protocol for stress ulcer prophylaxis has a significant potential cost savings. Use of costly H_2 blockers seems to generate a life of its own. There appears to be scientific support for either antacid or no therapy in the vast majority of trauma patients.[48,49] A deep venous thrombosis (DVT) prophylaxis protocol is continuously challenged; for example, the DVT protocol development team is now studying the use of prophylactic filters for high risk patients. In our institution, utilization of albumin was second only to antibiotics in terms of pharmacy costs, totaling close to $500,000 annually. A protocol was developed for nonurgent albumin transfusion and is currently in the implementation phase.

The oldest and one of the most interesting protocols is for chest tube management. One can only imagine the differences between the "clampers" and the "yankers" during the development phase. The development team had a tough sell on this protocol, since there was little science to support anyone's position. Although the total trauma team did not agree with some of the components, they did agree to give it a trial and examine the results. It is recognized that this protocol is not perfect, but all those caring for the patient now have a predictable method which we presume, without data, reduces logistical snags thereby promoting more timely tube removal and discharge from the hospital. Through our quality assurance review which is tied to this protocol, the incidence of recurrent pneumothorax after chest tube removal has virtually been eliminated. An example of a clinical management protocol including an overview statement, algorithm, and reference list is displayed in the Appendix of this text.

Rehabilitation

Rehabilitation is the phase of trauma care in which health care reformers may be most interested. Critical pathways, management guidelines, or practice parameters should, when possible, be all-inclusive to effect the patient from the time of injury to his or her return to work. Outcome studies on quality of life after the trauma center suggest that the majority of survivors return to productive lives after aggressive acute and rehabilitative trauma care.[50,51] In addition, victims of moderate to minor injuries can benefit from early detection of potential return to work impediments.[52] After review of unexpected deaths in the non-ICU trauma ward, we developed two four-bed observation rooms without cardiac monitoring.[53] Patients recovering from head injuries or elderly patients, particularly those with tracheostomies, need to be observed. One person, such as a nursing assistant or LPN, can suction, turn, and monitor the patients during their post-ICU stays. I am suggesting that because of our changing health care environment and the profound impact of elderly trauma patients on society, we may be returning to the open ward system of the 1950s and 1960s wherein multiple patients can be observed by fewer people. The risk of spreading infection, which was a concern on the open wards of the past, can be markedly reduced with

modern infection control techniques. Most patients in a clinical condition that would allow them to enjoy the luxury and privacy of a semi-private room are going to have their care as outpatients. The need for the hotel room-like atmosphere now seen in many hospitals will likely abate.

Education

The ATLS course has formed the educational basis of core trauma resuscitation throughout the world. Practice management guidelines or clinical management protocols can form a substantial portion of the curriculum for the education of trauma/surgical critical care staff. Each protocol provides an excellent framework for study of a particular problem, disease, or treatment.

Research

Clinical management protocols have been the hallmark of research efforts for decades. Therefore the development of protocols should be a natural fit to research efforts that are required by level I trauma centers. More multi-institutional studies, such as those produced by Western Trauma Association[54–57] and now underway in the Eastern Association for the Surgery of Trauma and the American Association for the Surgery of Trauma, need to be completed, since protocol development is hampered in many instances by lack of appropriate science.

Quality Improvement

Quality assurance, and now quality improvement, are not going to go away. Although the cost effectiveness of quality assurance efforts in trauma has been challenged,[58] incorporating quality improvement efforts into the practice parameters and clinical protocols seems prudent from a cost-effective perspective.

Prevention

Does trauma prevention work? From 1980 through 1992, annual motor-vehicle related trauma fatalities dropped from 51,000 to 39,000 despite an increase in miles traveled.[59] This significant decrease is at least in part attributed to the reduction in alcohol related fatalities, as well as the promulgation of trauma centers, seat belts, and airbags. The escalation of interpersonal violence, especially in inner cities, presents our next challenge. Dr. C. William Schwab and members of this organization have responded to that challenge.[60] As current President, I am committing the Eastern Association for the Surgery of Trauma to support that effort.

Table 5
Injury specific critical paths

Cerebral concussion
Penetrating neck injury
Isolated rib fractures (age <55 years)
Isolated closed femur fracture
Isolated spleen injury—nonsurgical
Isolated liver injury—nonsurgical
Renal contusion
Isolated traumatic pneumothorax

Summary and Recommendations

The development of clinical management protocols, practice parameters, management guidelines, or critical pathways for trauma is feasible. The American College of Surgeons' Committee on Trauma has already taken the lead in this regard relative to prehospital triage and the initial resuscitation of the patient with multiple injuries. Specific emphasis needs to be directed toward the most costly phase of trauma care, that is, the critical care environment. Clinical management protocols designed for *process* rather than *disease* may have the highest yield. Protocols require a strict definition, they should be consensus based, and follow a structured process of development, implementation, and analysis. To be useful, they must be dynamic, efficient, and practical. Part of the ICU clinical management protocols will be institution specific so that one institution cannot copy another institution's protocols and expect them to work without going through the development and implementation phases necessary to gain institutional buy-in. However, these protocols can be used as a framework for other institutions to move through the process.

Purchasers of health care, as well as policymakers, are going to also require injury-specific practice parameters for trauma care. These should preferably begin with specific clinical conditions such as cerebral concussion, penetrating neck injury, torso or extremity trauma, chest wall injury (such as isolated rib fracture), femur fracture, splenic or hepatic trauma that does not require surgery, and renal contusion (Table 5). More complex parameters can then be developed. Specific practice parameters for the patient with multiple injuries will be generic and very difficult to implement. Clearly, these processes should be developed and guided by our trauma specialty societies, such as the Eastern Association for the Surgery of Trauma, the American Association for the Surgery of Trauma, the Western Trauma Association, the American College of Surgeons[3] Committee on Trauma, the Joint Committee on Neurotrauma and Critical Care of the Neurosurgical Societies, and the Orthopaedic Trauma Association. It is likely that clinical management guidelines in some form will be necessary for trauma centers to effectively compete for health care contracts.

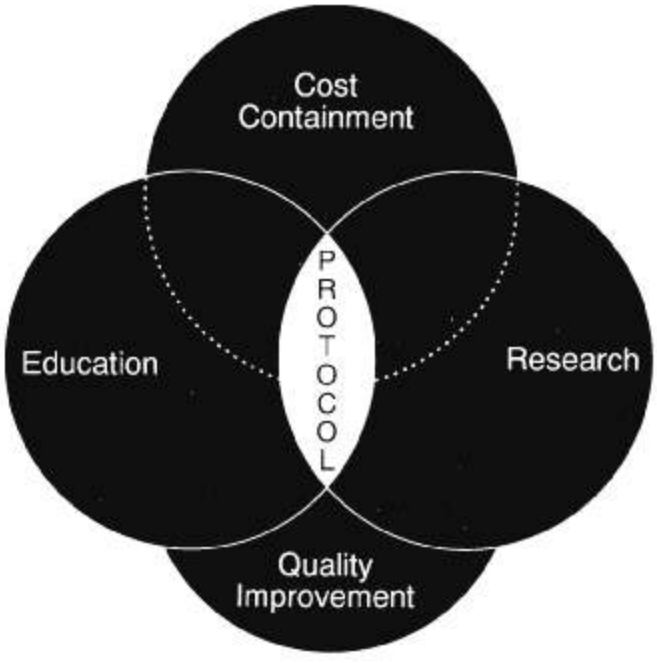

Figure 5. Integration of clinical management protocols into other mandatory trauma center activities.

Quality improvement, cost containment, education, and research are already mandatory elements for trauma centers and trauma systems. Incorporating these activities into the clinical management protocols can make this otherwise labor intensive process more palatable and potentially very productive (Fig. 5). The impact on risk management by reducing liability is also a potential benefit.[61]

In the past, nursing guidelines have been developed separately from physician guidelines for patient care. These were frequently asynchronous and counterproductive. It is time we bury the concept of physician protocols and nursing protocols and invigorate the concept of patient management protocols (Fig. 6). We all speak of collaboration; here is our chance to give that word substance.

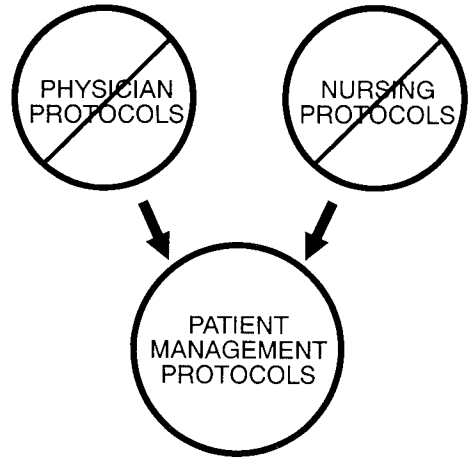

Figure 6. Patient management protocols will replace physician and nursing protocols.

I would like to express my appreciation to the members of the Eastern Association for the Surgery of Trauma for the privilege of serving as your President. Due to a combination of unique circumstances, I will have had the great opportunity to serve on the Board of this organization longer than any other individual has had or likely will have in the future. In that capacity, I have come to appreciate the great fortune of having four distinct personalities all committed to one goal who came together to found this Association.[60] I have observed that each board has its own sense and that the outstanding board members we have had are extraordinarily sensitive to the membership and its will. When you, the members, look about you, you will see the finest there is in trauma and critical care in the eastern half of the United States.

I wish to thank the Lehigh Valley Hospital for its vision and commitment to provide the best trauma care to its region. I owe a special debt of gratitude to my fellow trauma team leaders, orthopaedic surgeons, neurosurgeons, fellows, residents, as well as a dedicated nursing staff, for their persistence over the past 15 years. Most importantly, I thank my family and all of our families for their understanding of the competition for our time by the severely injured and their families.

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APPENDIX

CLINICAL MANAGEMENT PROTOCOL FOR CHEST TUBE MANAGEMENT

Appendix A

Chest Tube Management: Overview

Hundreds, if not thousands, of chest tubes are placed every day in the United States as part of trauma care. Although the indications and technique of placement have been fairly standardized, subsequent management, daily evaluation, and removal have received little attention. This seemingly insignificant aspect of trauma care can consume a large amount of nursing and physician time and may lengthen hospital stay.

Increased morbidities such as empyema and recurrent pneumothorax after removal may be problems.

The timing of chest tube removal should be based on clinical observations and an understanding of basic wound healing. Antibiotics, drainage devices, suction versus water seal, clamp versus no clamp, techniques of removal, and time of removal are all issues of debate among trauma and thoracic surgeons. There are few compelling data to support any specific argument. This clinical management protocol for chest tube maintenance and removal represents a consensus based on a review of the literature as well as the combined clinical experience of the trauma team.

Appendix B

Chest Tube Management: Nodes Explanation of Nodes

Nodes 1 & 2

A fully expanded lung brings the visceral and parietal pleura together which enhances the normal process of healing.

Nodes 3 & 4

Cessation of the air leak is one criterion used to assess whether the parenchymal site of the leak has sealed against the parietal pleura with full expansion of the lung. A patient receiving positive pressure ventilation is given an extra day on suction as a precaution against barotrauma. *The tube may require less time on suction with sharp-penetrating trauma (knife, needle puncture).

Check for air leak in underwater seal system a minimum of q4h. If bubbling is present, momentarily clamp chest tube near insertion site. If bubbling *continues*, air leak is from system. Check system and connections. If bubbling *stops*, air leak is from patient's chest. Release clamps after checking for air leaks.

Node 5

The chest tube system is placed on underwater seal to determine if the lung is adequately healed and can stay expanded without suction. A chest x-ray film is ordered in 4–6 hours to determine if the lung stays fully expanded.

Chest film should be ordered before 12 noon.

Node 6

Less than or equal to 125 mL of fluid drained from the pleural space in 24 hours is usually the result of irritation to the pleura by the tube. Most fluid can be reabsorbed spontaneously.

Node 7

Clamping the tube simulates its removal, allowing the clinician to evaluate the patient before the tube is actually removed. Clamping the chest tube allows for identification of a persistent air leak or re-accumulation of fluid. When chest tubes are ordered to be clamped, use only smooth clamps since metal teeth can damage the tube. Apply a second clamp pointed in the opposite direction of the first to ensure an adequate seal.

Clamping should be performed in early morning to facilitate chest tube removal between 6 AM and 10 PM, when more personnel are available.

Nodes 8 & 10

Respiratory distress is manifested by: tachycardia; dyspnea; tachypnea; unequal breath sounds; chest/pleuritic pain.

Node 9

A chest x-ray film is obtained 6 hours post-clamping to verify that the lung is fully expanded and no air or fluid has re-accumulated.

Appendix C
Chest Tube Management: Bibliography

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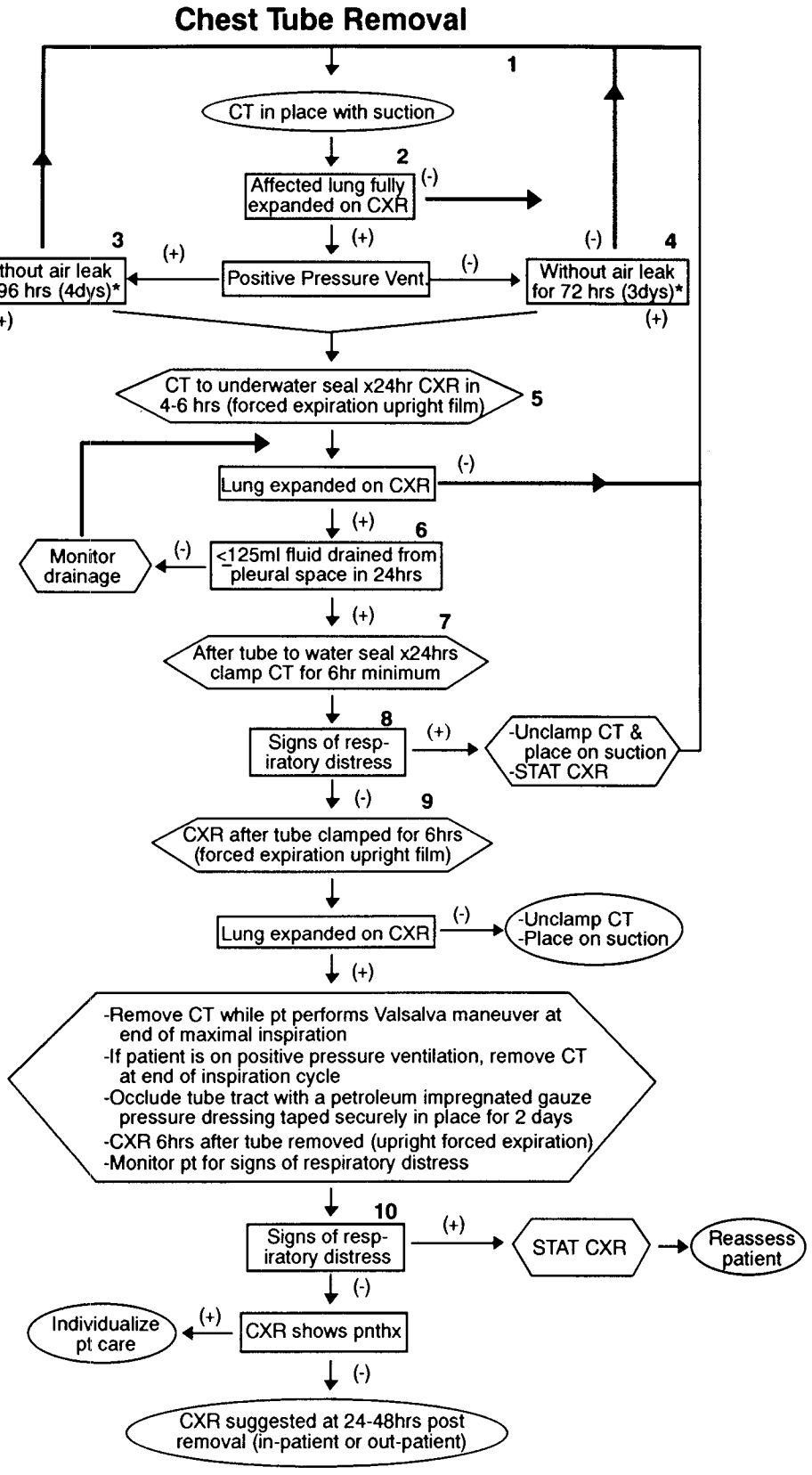

Clinical management protocol for chest tube removal in trauma patients.