

## Comprehensive Regional Trauma/Emergency Medical Services (EMS) Delivery Systems: The United States Experience

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In the early 1970's, as an outgrowth of the American military experience, several pioneer regional trauma/EMS programs showed the way for better planning, organization, and resource deployment for trauma/EMS systems in the civilian community. The experience of the mid and late 1970's has brought an even wider implementation and modeling of trauma/EMS care systems with identification of specific patient problems, designation of trauma service centers, development of protocols, and professional teams on a regionwide basis. Currently, the acceptance of regionalized systems of care for trauma makes it a potentially manageable disease with greater prospect for developing even better systems of trauma care and control in the 1980's. The progressive impact on improving trauma care for this nation will in large part be due to the continued planning and development of regional trauma/EMS systems which have as a key focus the designation of an appropriate limited number of trauma service centers for geographic regions and the nation.

There should be little question today that hospitals having extensive experience with injured patients offer better care to these patients than hospitals receiving only an occasional trauma patient. Mortality and morbidity rates are lower in more experienced hospitals where interdisciplinary teams provide coordinated resuscitation, evaluation, and definitive operative management. The skills and teamwork employed in this complex task are improved by practice and repetition, which come only with a large volume of injured patients.

Accidental injury (trauma) was probably man's first recognized affliction and the one for which visible means of effective cure became apparent. As civilization has progressed, so has the incidence, magnitude, and severity of traumatic injuries caused by the interfacing with the environment. In a like manner, our therapeutic responses to this health problem have become increasingly complex.

Surgeons and others knowledgeable and experienced in the care of the seriously injured agree that the necessary echelons of care required by the trauma patient must be organized both within the hospital definitive care setting (trauma center) and throughout the geographic area (region) in which the traumatic incidence occurs [1]. The modern conceptualization of providing optimal care to the trauma victim, then, is to organize a comprehensive trauma program that utilizes "a systems approach" to the response to acute delivery of care, rehabilitation, and prevention of this disease [2] (Table 1).

The regional planning and development of dedicated trauma care services in designated trauma service centers has shown potential for limiting unnecessary costs through concentration of capital and personnel, improving the quality of care by maintaining the skills of trauma care teams, and establishing suitable mechanisms for transportation and referral of patients through coordination with Emergency Medical Service (EMS) systems [3, 4]. The organization of dedicated trauma care resources for the hospital treatment of the serious multi-trauma victim is ideally suited to reorganization [5, 6] and serves as a role model for regionalizing other surgical critical care services (e.g., burns [7], spinal cord injuries [8], pediatric trauma [9], reimplantation, and organ retrieval for transplantation) [10, 11].

Experience gained in the civilian community during the last decade has demonstrated that regional plans for a trauma care system should include the

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**Table 1.** Outline of a comprehensive trauma program.

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- *Regional Trauma/EMS Systems:* Conceptualization, planning, implementation, and evaluation
  - *Integrated Surgical Care:* Pre-hospital, Emergency, Surgical, Anesthesia, Specialty, Intensive, and Rehabilitation
  - *Program Evaluation and Trauma Research:* Systems, Clinical, Biomedical, and Epidemiologic
  - *Trauma Center Administration and Trauma/EMS Systems Management:* Dedicated Trauma Service and Regional Coordination
  - *Legislation and Funding:* Professional Standards, Reimbursement Issues, and Development Programs
  - *Public Education and Prevention:* Lay Advocacy Groups and Risk Reduction Efforts
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sociogeographic characterization of the system's area, patient identification by clinical category, facility categorization using nationally recognized professional standards, and the selective designation of "trauma service center" status for a limited but appropriate number and level of hospitals within the regional trauma/EMS system's area. It has also been shown that, by designation of a hospital as a trauma service center, the necessary resources and administrative changes can be made in order to establish a "dedicated" trauma care service within that institution.

This report will examine some of the key elements essential to a regional trauma/EMS system and how such a system can provide the basis for a comprehensive trauma/EMS program [1, 2, 5, 6, 11].

### **Magnitude and Character of the Civilian Trauma Problem in the United States**

The Industrial Revolution has mechanized our society, and, with it, the number of serious injuries from vocational and recreational activities has steadily increased. There are over 68 million injuries annually; and in 1979, 103,500 of these were fatal. Motor vehicular related deaths numbered 51,000; work related, 13,200; occurring at home, 22,000; and 2,000 were unclassified. The overall costs for this 1979 pandemic for the nation were \$75.7 billion which includes wage losses, medical expenses, insurance administrative costs, and related property damage. The loss to the nation for motor vehicular accidents alone was \$35.8 billion [12].

Accidents are currently the third most common cause of death in the United States, exceeded only by deaths from cardiovascular disease and cancer. Trauma is the leading cause of death in those under the age of 40. Between the ages of 15 and 24 years, accidents claim more lives than all other causes

combined. One-third of all hospital admissions, approximately 2 million a year, are the result of accidents. Seventeen million injured U.S. citizens required bed care for 1 day or more. It has been estimated that more than 65,000 beds (more than 22 million bed days) are required to provide inpatient care to all victims of accidental injury [12]. To put this data in perspective, consider that during the 11-year Vietnam conflict, about 43,000 American soldiers died in Southeast Asia. During that same 11 years, 25 times that number died in the United States from accidental causes, and over 10 times that number died in motor vehicular accidents (MVA) alone [12]. Of all MVA injuries, approximately 5% will be multiple or with critical injuries requiring advanced level trauma care [1, 11, 14]. EMS program experience has found empirically that 1 such trauma case will be generated from each 1,000 of population in most communities across the country [11].

The blunt trauma typically caused during a MVA is the most frequent mechanism of multi-system injury. (The major points of impact are the head, chest, abdomen, and leg bones.) Patients with this type of injury have the highest morbidity and mortality rates and are the most difficult to manage at every step, from the initial prehospital contact through the postoperative recovery period. Half the patients involved in an MVA will have craniocervical axis trauma, a quarter will have abdominal trauma, and a fifth will have some chest, heart, or great vessel injury. Most will have trauma to more than one area, most commonly to both chest and abdomen. An analysis of the part of the body injured in motor vehicular injuries in both urban and outlying areas shows that head injuries alone represent 37.8% and 30.6% of the cases, respectively. The incidence of central nervous system (CNS) trauma, when taken as a single injury or in combination with other injuries, was 62.6% in cities and 65.6% in outlying areas, with obvious implications for regionalization of multiple trauma care [13].

### **The United States Military Experience**

Despite the fact that the rate of accidental injuries has been alarming over the past 50 years, the civilian sector has just recently started efforts to develop trauma/EMS care systems, organizing specialized designated trauma service facilities and support for public service programs for the improved care of accident victims.

In the past 40 years, it was the military who made most of the advances in care of the critically injured. Trauma care improved significantly during World War II and was further refined during the

Korean and Vietnam conflicts. It was the latter 2 campaigns that offered a proving ground for the first regional Emergency Medical Services (EMS) System [15]. Well-trained paramedical personnel in the field, effective communications, rapid emergency transportation systems (helicopters), and physician specialists in well-equipped designated trauma center hospitals (MASH units), along with other technical advances in emergency care, were responsible for the marked decreases in battlefield mortality rates. In Vietnam 97.5% of patients reaching U.S. medical facilities alive survived. This record was achieved despite the fact that many mortally wounded personnel found alive on the battlefield were counted as hospital deaths. In World War II, it took an average of 10 hours to bring a patient to definitive treatment; in Korea, it was reduced to 5 hours; and in Vietnam, it was 1 hour [15].

These new concepts and techniques of proven value in war and potentially useful in peacetime are now being applied to civilian life. Until 1974, however, Illinois and Maryland were the only 2 states that had established emergency medical systems and integrated organized trauma service centers within these systems. In 1961, a pioneering clinical shock-trauma unit at the University of Maryland began studying the pathophysiologic, immuno-bacteriologic, and biochemical response to shock in humans. The first civilian trauma unit was established in 1966 at the Cook County Hospital in Chicago [16]. In that same year, the Maryland Shock-Trauma Unit extended its program of research on shock to include biochemical investigations of the severely traumatized [17]. Since then, trauma/EMS systems and trauma service centers have been formed in many other areas across the country. However, the number and availability of such services are clearly insufficient in both rural and urban communities.

### **The Emergency Medical Services Systems (EMSS) Concept**

The modern era of emergency services and the beginning of the civilian systems approach to improve trauma care were initiated in 1966 by the white paper, "Accidental Death and Disability: The Neglected Disease of Modern Society," prepared by the National Academy of Sciences/National Research Council (NAS/NRC) Committees on Shock and Trauma [18]. Most of the work in existence today with the national initiatives relevant to EMS and trauma care was recommended in this farsighted document. The basic building blocks and blueprint for an improved trauma care program and most of the developments relevant to EMS and

trauma care in existence today were outlined in this document. However, in retrospect, a major deficiency of the NAS/NRC report was the lack of emphasis for the concept of "systems." There was no attention given to methods and approaches that would soon prove to be essential in implementing the very important 29 recommendations of the report or in the actual integration of these components in an effective operational system of trauma/EMS care delivery. This major step would be taken not at the national conference tables but through pioneering EMS and trauma systems programs then being initiated in a very few places across the country.

### **Early Pioneering Trauma/EMS Systems**

Late in the 1960's and early in the 1970's, the need for and the conceptual design of the "systems approach" to improve the delivery of emergency medical care began to emerge. The initial EMS clinical delivery systems were designed by physicians and surgeons in order to respond to specific types of emergency patients' needs (i.e., trauma, burns, and spinal cord injuries) by applying appropriate effective medical and surgical treatments in other than a classic in-hospital environment. Through different organizational structures and by radically different technologies and personnel, previously proven clinical treatments were being tested and delivered in the pre- and inter-hospital field by Emergency Medical Technicians-Ambulance (EMT-A) and Advanced Life Support Emergency Medical Technicians-Paramedic (EMT-P) through physician-supervised extra-hospital care programs for a wide variety of conditions, but especially trauma. Hospitals were being categorized and those with special expertise and commitment were being designated as trauma, burn, and spinal cord injury centers on a regional basis.

The regionalization of trauma for critical injuries was initially developed statewide in Illinois by Boyd for multiple and severe injuries subsequent to an announcement by Governor Richard B. Ogilvie in a special message on health on April 1, 1971 [19]. As the Illinois Trauma Program developed, a program of patient transfer and burn center care was started by Warphea in 1971 for the 4 burn units and major burn center (Cook County Hospital) in Chicago, utilizing a central bed registry and patient distribution program.

In 1972, Meyers of the Midwest Regional Spinal Cord Injury Care Systems at the Northwestern Memorial Hospital and Rehabilitation Institute of Chicago (McGaw Medical Center—Northwestern University), working in collaboration with the Illi-

nois Trauma Program, established a 200-mile macro-regional catchment program for acute (less than 6 hours) spinal cord injuries (SCI) [20]. R.A. Cowley in 1973, assisted by an executive order from Governor Marvin Mandel, expanded the existing Shock-Trauma Program of the University of Maryland statewide and established the Maryland Institute for Emergency Medical Services (MIEMS) [21].

While these regional trauma/EMS systems utilized the EMS systems components and personnel somewhat differently, appropriate to the needs of patients, their examples became working and observable models and were to become the catalysts of a national effort to conceptualize, plan, and implement regional trauma/EMS systems. These early efforts and their apparent successes were also in part responsible for the initiation of the Department of Health, Education and Welfare's (DHEW) EMS System's demonstration program [22] and subsequent passage of the Emergency Medical Services Systems (EMSS) Acts of 1973 (P.L. 93-154) [23], as amended in 1976 (P.L. 94-573) [24], and in 1979 (P.L. 96-142) [25].

In 1971, Congressional hearings were held in support of the development of a comprehensive EMS law. The proposed law contained program guidelines and technical assistance measures that would strive for a nationally coordinated and comprehensive system of regionalized emergency health accessibility and care for every citizen of this nation. Accordingly, the Emergency Medical Services Systems Act of 1973 (P.L. 93-154) was the following: "To amend the public health service act to provide assistance and encouragement for the development of comprehensive areawide Emergency Medical Services Systems" [23]. The Act instructed the Secretary of The Department of Health, Education and Welfare (DHEW) to designate the federal "lead agency" role to the Division of Emergency Medical Services (DEMS) for program administration, technical assistance, and grant awards for developing regional EMS systems and was, perhaps, the most important single factor affecting the development of trauma/EMS systems in this country. Before its passage, little attention had been paid to the need for improved emergency services systems. The EMSS Act(s) provided a better definition of emergency medical services with the identification of 15 systems operating components. This Act(s) called for the development of comprehensive systems rather than continuing to foster unorganized and ineffective emergency medical services. During testimony to Congress in 1971, the special problems of the trauma patient, the need for a regionalized system of care, and the key EMS systems components (facilities, critical care units,

and transfer of patients) crucial to a successful trauma program aimed at the survival of the critically ill and injured patients (trauma, burns, and spinal cord injuries) were delineated. Clinically specific and medically controlled adaptations of the EMS system components are essential to effective systems planning and programming [26]. In trauma, the key EMS components are facilities categorization, trauma center designation, and the implementation of transfer and triage protocols, which direct the transportation modalities (e.g., helicopter or ground ambulance) that deliver patients to definitive care at a designated trauma care center. The nationally designated 303 regional EMS geographic areas addressed trauma as the major clinical problem by developing their best systems response and definitive care plans for the adult multiple injured patient usually with an associated CNS injury [11]. This trauma/EMS systems planning included the vertical categorization of hospital resources and the selective designation of a limited but appropriate number and level of trauma centers for each regional trauma/EMS system. Trauma facilities categorization standards initially developed in Illinois [2-4] in 1970 and later expanded upon by the American College of Surgeons [5, 6] both identified 3 levels of hospital capability that would provide "optimal" care for the seriously injured. The comparable nomenclature, capabilities and functional responsibilities for the 3 levels of trauma centers are outlined in Table 2.

### **Trauma/EMS Systems and Specialized Trauma Service Centers**

In trauma, the lethal event may be forestalled by early and sustained resuscitation and stabilization. With a trauma/EMS response, communications, and transportation, and initial basic field care, time will be saved and the eventual death forestalled. Emergency medical services and trauma/EMS system care are not a single act. They consist of a complex but organizable sequence of many activities that must be a coordinated process, with each phase having a different effect on mortality. Each act saves time.

The process begins with the notification of the authorities of an injury and a prompt response by an ambulance team. The EMT-A and EMT-P are capable of assessing the patient's medical problems, starting an intravenous line for fluid and drug administration, establishing an adequate airway, and other measures designed to stabilize the patient such as anti-shock (MAST) trousers application [27]. They then establish medical control communications with the trauma service center to seek

**Table 2.** Nomenclature, capabilities and functional levels of trauma centers.

- *Local Trauma Center:*<sup>a</sup> Resuscitation and initial care within its capabilities (Minimal, ACS III)<sup>b</sup>
- *Areawide Trauma Service Center:*<sup>a</sup> Resuscitation, initial care, and standard operative, intensive care management, within its capabilities (Intermediate, ACS II)<sup>b</sup>
- *Regional Trauma Service Center:*<sup>a</sup> Resuscitation, initial care, standard operative, intensive care management and specialized care. Education and investigation for all trauma professionals and problems within the region, within its capabilities (Optimal, ACS I)<sup>b</sup>

<sup>a</sup>State of Illinois [2-4]. <sup>b</sup>American College of Surgeons [5,6].

instructions on patient treatment and triage and to notify the facility of the estimated time of arrival [26].

In response to these communications, the in-house dedicated trauma service team assembles before the arrival of the patient in the Trauma Resuscitation Unit (TRU) of the trauma service center. The team consists of a trauma surgeon, specialists, anesthesiologist, emergency medicine physician, and nurses trained in their trauma specialties. These personnel function as a team whose initial purpose is to stabilize the cardiorespiratory function of the patient. Their efforts are governed by written protocols previously agreed upon and familiar to all team members. All necessary equipment is available in the TRU. Once the patient is stabilized, the trauma surgeon team leader establishes priorities for progressive definitive treatment. Subsequent care depends on the type and severity of the patient's injuries and may include surgery, intensive care, or long-term rehabilitation.

All phases must be correctly employed by the trauma/EMS system in a sufficiently short space of time for the patient to get the best chance with the best possible results. This critical time period has been established as the "golden period" after onset of injury [21]. These trauma/EMS system operations must be specific for the patient management plan of each regional system and must follow the triage and treatment protocols for the area. Adequate definitive medical/surgical trauma care is just not available everywhere. It is necessary, therefore, to transport trauma patients by direct or successive triage to well-equipped designated trauma service centers. This is now being done as protocols for field identification, resuscitation, and transportation to designated trauma centers are being put into operation [1, 26].

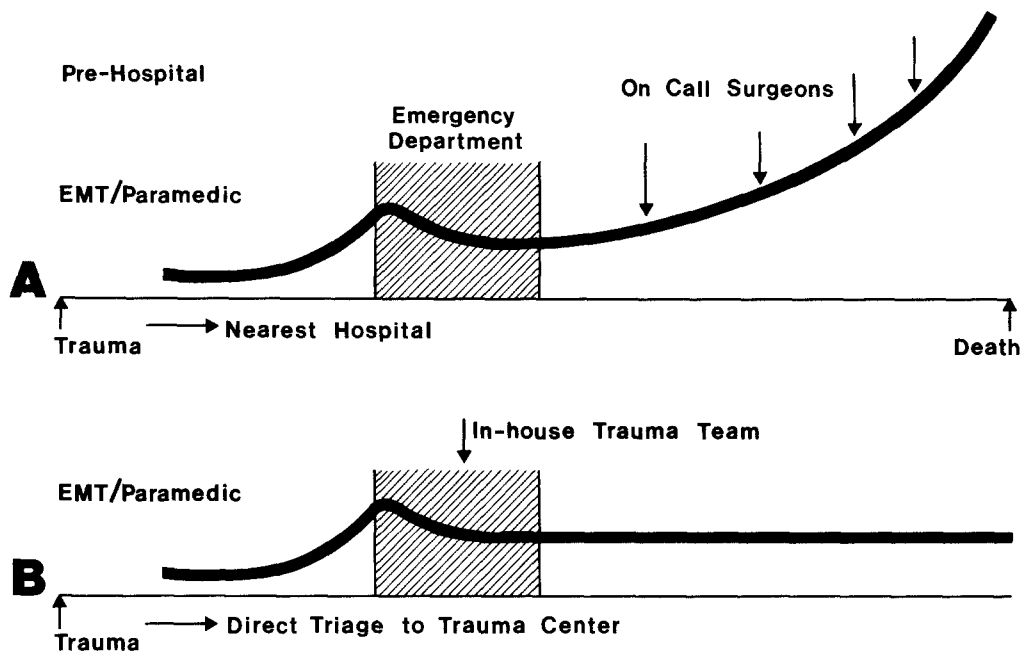
In every region in this country there is at any time a fixed number of surgical specialists (general, orthopedic, thoracic, and neurosurgical) who can

be immediately assembled to provide team care to the seriously injured. In many communities where these critical surgical specialists reside, their impact is ineffective, diluted by an "on-call" response system at all hospitals in the area. This relative lack of surgical availability is unfortunate for the trauma patient who "selects" the wrong hospital.

In this country, there are vast rural areas that have infrequent accidents, but collectively account for over 80% of highway-related deaths. By developing regional EMS systems with less sophisticated trauma service centers in these non-urban trauma/EMS regions, up to 50% [28] of the vehicular trauma deaths can be prevented if adequate resuscitation, transportation, and proper surgery are performed within the organized trauma service centers of the trauma/EMS region.

A designated trauma service center is one component of an emergency medical service system's approach to trauma victims, but it deserves special discussion. It has been the practice throughout the country for ambulance services to take the injured patient to the nearest hospital. In many situations, especially in urban and metropolitan communities, this is no longer appropriate [1, 29]. Medical personnel interested in trauma care, trained in the management of trauma victims, and organized specifically to provide optimal care produce better results than a hospital or institution that views the care of trauma patients as another of its general services. The hospital that serves as the trauma service center has additional trauma/EMS systems responsibilities as outlined in Table 1.

Experience has shown that the regionalization models of trauma/EMS systems and the trauma service center categorization and designation process will be characteristically different for dissimilar geographic regions [1]. Varying systems models for Urban-Suburban regions (Model X), Rural-Metropolitan regions (Model Y), and Wilderness-Metropolitan regions (Model Y') utilize and maximize the trauma care potential of these very different types of socio-geographic regional trauma/EMS systems. The regionalization of trauma calls for the implementation of specific patient care transfer and admission policies for major trauma, burns, and spinal cord injuries so that designated hospitals can maintain their clinical proficiency and be more cost-effective as prescribed by national professional categorization standards [5-9]. The basic 303 trauma/EMS regions can now, by an appropriate facilities categorization and designation process, establish larger macro-regions through aggregation of these regions for highly special trauma service centers for burns, spinal cord injuries (SCI), pediatric trauma, reimplantation, and hyperbaric oxygen treatments. It has been estimated that some 75-90 macro-



The Golden Period (60 minutes) in an Urban (Model X) system with 20 minutes in the pre-hospital phase and Non-Designated Hospital (A) and Designated Trauma Center (B) system.

Fig. 1. Pathophysiologic dynamics of the "golden period" (Model X).

trauma/EMS regions would be appropriate for the nation [11].

### Pathophysiologic Dynamics of the Golden Period

The "golden period" is the immediate time after injury when resuscitation and stabilization will be most beneficial to the patient. All shock and trauma laboratory models as well as clinical investigations of human shock and traumatic states have established the multiplier effect of shock from blood loss, physical injury of any kind, and the length of time that elapses from onset of injury to the attempts of resuscitation.

As shown in Fig. 1 (Case B), the in-house trauma team is immediately available and can control the traumatic disease process early on in the course of treatment. In a non-designated but otherwise adequate general hospital, the time variable for arrival of the on-call surgeon and his or her ability to establish the trauma team has a significant effect on the pathophysiologic status of the trauma patient (Case A).

In both situations, it is a given fact that the pre-hospital and emergency department (E.D.) care is comparable. The variable time that it takes an on-call operative surgeon to institute essential resuscitative control will be reflected in the way the patient

with ever-increasing pathophysiologic derangements responds to surgery, anesthesia, and postoperative intensive care.

A similar sequence of events happens in Rural and Wilderness-Metropolitan model (Y and Y') trauma/EMS regional systems (Fig. 2). Given that the pre-hospital and initial hospital treatment programs are comparable and, for this example, have been equally effective in stabilizing the trauma patient and controlling his or her pathophysiologic systems, experience has shown that the trauma/EMS regional system, with designation of trauma service centers and written transfer agreements, (Case B) will more expeditiously transfer critical trauma cases with better inter-hospital medical care; the patient will arrive at the designated advanced level trauma service center in a more physiologic state; and the arrival will be anticipated by the in-house trauma team. Unfortunately, experience has repeatedly shown that in the non-regionalized trauma/EMS systems (Case A), there are delays in initiating the trauma patient transfer, arranging for the inter-hospital transport vehicle, equipment, and personnel, all of which results in patient deterioration while waiting and during transfer. Again, the problems of the on-call surgeon at the second non-trauma center facility provides for a much worsened condition of the patient that will certainly be accountable for the pessimistic course of the trauma patient.

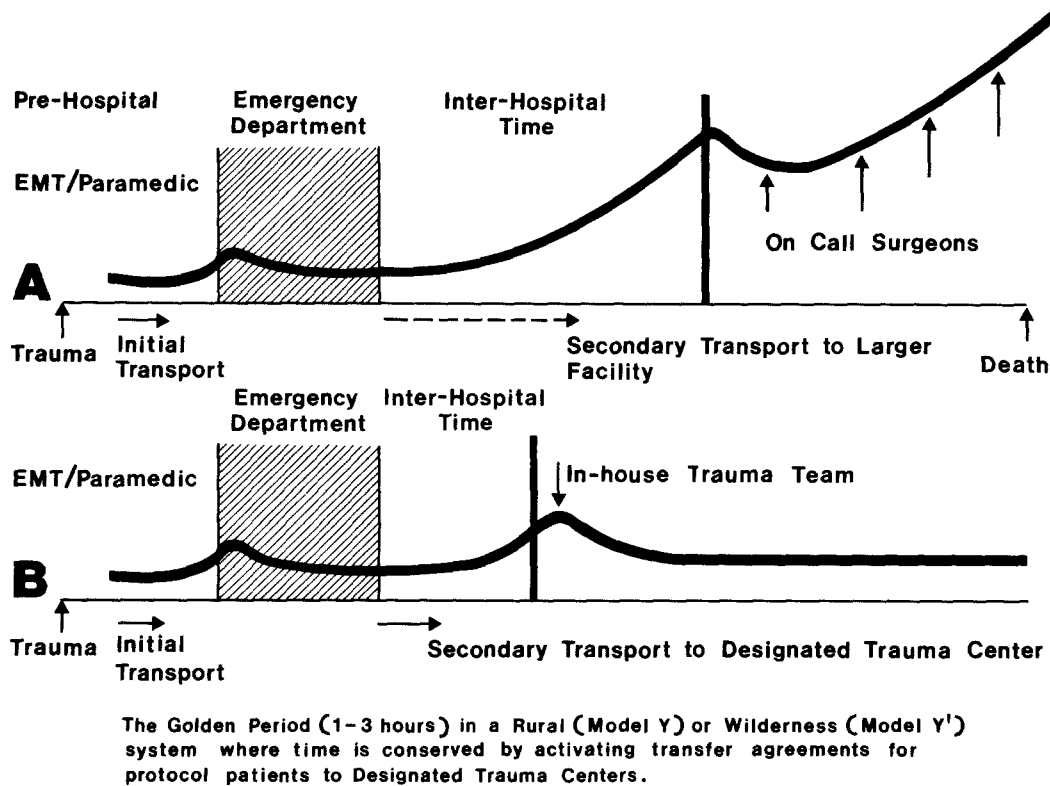


Fig. 2. Pathophysiologic dynamics of the "golden period" (Models Y and Y').

### Treatment, Triage, and Transfer Protocols

Written treatment protocols provide a uniform, highly specific set of guidelines for the management of trauma patients throughout the trauma/EMS regional system. They are developed by the trauma center director to enhance conformance with optimal standards of care [1, 11, 30, 31]. Triage and transfer protocols are the written expression of the trauma/EMS system transportation design. They identify patients according to severity and define to which facilities they are to be evacuated [32]. They are essential if critical trauma patients are to receive optimum care in time. In Urban areas, (Model X), critically injured trauma patients are identified and triaged in the pre-hospital phase directly to designated treatment trauma service centers, bypassing other facilities. (See Table 3.) In Rural and Wilderness areas (Model Y and Y') trauma patients are brought to the closest hospital, triaged at the emergency department, and secondarily, depending on their severity, transferred to designated trauma service centers.

### Clinical and Systems Impact Evaluation

A literature review of the documented effectiveness of a regional or areawide trauma system finds relatively few reports. The study by Frey in 1969 on

the resuscitation and survival of victims in motor vehicle accidents showed that by even the most conservative estimates, 18% of patients involved in those accidents would have been salvageable based on autopsy studies and the utilization of standard techniques [33]. In the Springfield region of Illinois, Boyd reported that hospital categorization and designation of a selected number of trauma centers reduced the overall highway fatalities by 15% in 1971 [2, 24]. A subsequent report by Boyd from the same region, using comparable time periods before initiating the trauma program and 2 years later, showed a 29% reduction in highway fatalities for the region [35, 36]. These studies were done in what is now considered a basic life support program before many of the system components were in place, such as training of EMTs and radio communications networks. The number of critical patients directed to trauma centers increased 60% after designation of these centers and 75% of all nonsurviving accident victims went to the regional trauma center.

Otten, in the Peoria region of Illinois, has documented a 50% decrease in deaths of the most serious highway injuries seen [28]. Before the trauma program there were 93 deaths for every 1,000 serious motor vehicular injuries as field-classified by the state police. This has since dropped to 46 deaths per 1,000 victims using the same serious injuries category. At the same time, a tripling of admissions to the designated regional center either

**Table 3.** An example of a typical trauma triage protocol for a regional and areawide trauma/EMS Center System

Patients with the following field diagnosis will be directly transported to the nearest trauma center after field assessment and confirmation with medical control.

1. CNS injury with
  - a. localizing neurologic findings
  - b. coma of any level
  - c. open head injury
2. Unstable chest injury with
  - a. penetrating or sucking crush injuries
  - b. severe respiratory/cardiovascular distress
3. Shock, hypotension, or incipient hypotension
4. Ventilatory obstruction or impairment
5. Unstable abdominal trauma with penetrating injuries
6. Amputation, complete or partial extremity

All other trauma will be directed to closest appropriate receiving facility.

directly or by transfer had occurred. Cowley documented the effectiveness of the statewide helicopter program at the Maryland Institute for Emergency Medical Services, and reports a progressive fall in the mortality rate for patients transported by helicopter to the Shock-Trauma Center from 50% to below 20% for a very seriously injured group [37]. West and Trunkey compared motor vehicle trauma victims who die after arrival at hospitals in both Orange and San Francisco counties of California. All victims in San Francisco County were brought to a single trauma center while in Orange County they were transported to the closest receiving hospital. Approximately two-thirds of the non-CNS related deaths and one-third of the CNS-related deaths in Orange County were judged as potentially preventable. Only one death in San Francisco County was so judged. Trauma victims in Orange County were younger on the average, and the magnitude of their injuries was less than of patients in San Francisco County [38]. Meyer has shown the effectiveness in decreased morbidity, length of hospital stay, and medical care cost of spinal cord injured "systems" patients treated within 6 hours through the Illinois trauma and spinal cord injury system, as compared to "non-systems" or delayed entry patients [20]. Seelig et al. studied which factors contributed to recovery after surgical intracranial decompression of 82 consecutive comatose patients with traumatic acute subdural hematoma (ASDH) who were treated in a single center under a uniform protocol. The delay from injury to operation was the factor of greatest therapeutic importance. Patients who underwent surgery within the first 4 hours had a 30% mortality rate, as compared with 90% in those who had surgery after 4 hours ( $p < 0.0001$ ). They concluded that if patients with traumatic ASDH were taken directly to hospitals

equipped to diagnose and remove the hematoma within four hours of injury, mortality rates could be reduced considerably [39]. Mortality and morbidity are clearly lower in the trauma patient when he or she is delivered to a more experienced hospital with a greater volume of experience [40].

## Résumé

Au début des années 1970 grâce à notre expérience dans l'armée plusieurs projets d'avant garde ont montré la voie pour aboutir à un meilleur système de traitement des blessés civils. L'expérience ultérieure, depuis le milieu jusqu'à la fin de la même décennie, nous a permis d'identifier les problèmes spécifiques posés par les différents blessés de désigner des centres de traumatologie, de développer des protocoles thérapeutiques, de former des équipes sur une base régionale. La fait d'appliquer ces principes a abouti à une amélioration du traitement des blessés. La création au cours de la nouvelle décennie sur une base géographique régionale de ces centres de traumatologie ne peut être que profitable.

Il ne fait aucun doute aujourd'hui que ces centres offrent de meilleurs soins que ceux dispensés dans les formations chirurgicales classiques. La morbidité et la mortalité grâce au traitement pluridisciplinaire: réanimation, appréciation exacte des lésions, traitement opératoire adéquat diminue de façon très sensible. L'habileté et le travail en commun de ces équipes se sont améliorés en fonction même de l'extension de la pratique et de la répétition des différents actes qui offrent ces centres spécialisés où aboutissent les blessés.

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