

Trauma—A Controllable Disease in the 1980's (Fourth Annual Stone Lecture, American Trauma Society)

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INTRODUCTION

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 65 million injuries annually; and of these 104,000 in 1977 were fatal, a 3% increase from 1976 by approximately 3,000 deaths, with a death rate of 48.1 per 100,000. The lowest annual injury rate so far on record was that of 1976. In 1977 there were 1,900,000 disabling vehicular injuries and 49,500 vehicular related

deaths, an increase of 5% from 1976. The overall costs for this 1977 pandemic for the nation were \$62 billion which includes wage losses, medical expenses, insurance administrative costs, and property damage from moving motor vehicular accidents. The loss to the nation for motor vehicular accidents alone was \$30.5 billion (1).

Accidents are currently the third most common cause of death in the U.S., exceeded only by deaths from cardiovascular disease and cancer. Trauma is the leading cause of death in those under 40. Between the ages of 15 and 24 years, accidents claim more lives than all other causes combined, nearly five times more than the next leading cause of death. In age categories 1 and 44 years, accidents are not only the leading cause of death, but the subgroups of motor vehicle, fire, drownings, ingestions, falls, and other causes are the prime effects. There was a generally improving trend for the accident death rate in this country between 1912 and 1977; the rate per 100,000 population reduced from 82 to 46, a 41% decline. The 68% reduction, from 79 to 25 per 100,000 in the nonmotor death rate, was offset in part by the sevenfold increase in motor vehicle death rate, from 3 to 23 per 100,000 for the same period (1).

One third of all hospital admissions, approximately two million a year, are the result of accidents. Seventeen million U.S. citizens injured required bed care for one 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 (1).

Despite the fact that over the past 50 years the rate of accidental injuries has been alarming, the civilian sector is just now starting efforts to develop trauma care systems, organize specialized designated care facilities, and support 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 two latter campaigns that offered a proving ground for the first regional Emergency Medical Services (EMS) System (2). Well-trained paramedical personnel in the field, good communications, rapid emergency transportation systems (helicopters),

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and physician specialists in well-equipped designated trauma center hospitals (MASH units), along with other technical advances in emergency care, were responsible for a marked decrease in battlefield mortality.

Until recently, these new concepts and techniques, however valuable in war and potentially useful in peacetime, were not applied to civilian life. Until 1974, Illinois and Maryland were the only two states that had established emergency medical systems and integrated organized trauma center services into 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 man. The first civilian trauma unit was established in 1966 at the Cook County Hospital in Chicago (3). In that same year, the Maryland Shock-Trauma Unit extended its program of research on shock to include biochemical investigations of the severely traumatized (4). Since then, trauma systems and services have been formed in many other areas across the country. But 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 Medical Services and the beginning of the civilian systems approach to improve trauma care were initiated in 1966 by the now classic 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 (5). Most of the work in existence today with the national initiatives relevant to EMS and trauma care were outlined in this farsighted document. The basic building blocks and blueprint for an improved trauma care program were outlined in this white paper.

Federal Assistance to EMS and Related Programs. 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 guarantee a nationally coordinated and comprehensive system of 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 passed: "To amend the public health service act to provide assistance and encouragement for the development of comprehensive areawide Emergency Medical Services Systems." The Act instructed the Secretary of The Department of Health Education and Welfare to designate the lead agency role to the Division of Emergency Medical Services for program administration, technical assistance, and grant awards for developing regional EMS systems (6).

The Emergency Medical Services Systems (EMSS) Act of 1973 and as amended in 1976 is perhaps the most important factor affecting the development of EMS systems in this country. Before its passage, little attention had been paid to the need for improved emergency services systems. The EMSS Act has provided a better definition of Emergency Medical Services with the identification of 15 system operating components and the call to improve the emergency death and disability statistics of the nation. This Act called for the development of, and not only certain components of, a comprehensive system which would only foster unorganized and ineffective Emergency Medical Services (6, 7).

Current Issues in Trauma Systems and Specialized Trauma Services. Interested surgeons, physicians, hospital administrators, Health System Agencies, and the EMS authority must be aware of the rationale for the establishment and organization of specialized trauma service centers as well as the methodology for their planning, implementation, and operations within regional EMS systems. Key issues involved in the process are:

- the relationship of the regional trauma system to the Emergency Medical Services System
- the regional categorization of hospital trauma care capability and designation of trauma service centers
- trauma service center organization and operations
- financial impact of trauma services on sponsoring institutions and other hospitals throughout the region
- management and coordination of the regional trauma care system by interdependent management of communication networks and building trauma teams
- clinical and systems impact evaluation and program monitoring of trauma systems and trauma services
- establishing monitoring control measures and in-depth evaluation of trauma through trauma centers of excellence.

The Relationship of a Trauma Center System to the EMS System. A standard mortality curve showing an emergency against time with eventual death in time if therapy is withheld for the emergency event is shown in Figure 1. The severity and magnitude of multiple trauma require a well-coordinated regional trauma system and definitive care in a designated advance care trauma center. For spinal cord and burn injuries, a time/mortality curve might be appropriate. It is obvious that each medical emergency has its own time/death constraints and requires specific and appropriate medical care. In all severe cases, death will eventually and statistically prevail if definitive care is not provided within these time constraints. As we are now starting to better understand the "natural history of traumatic disease," mortality and morbidity controls can be better conceptualized and implemented.

In trauma, the lethal event may be forestalled by early and sustained resuscitation and stabilization. The time of death is different according to the magnitude and variety of trauma pathology. With EMS response, com-

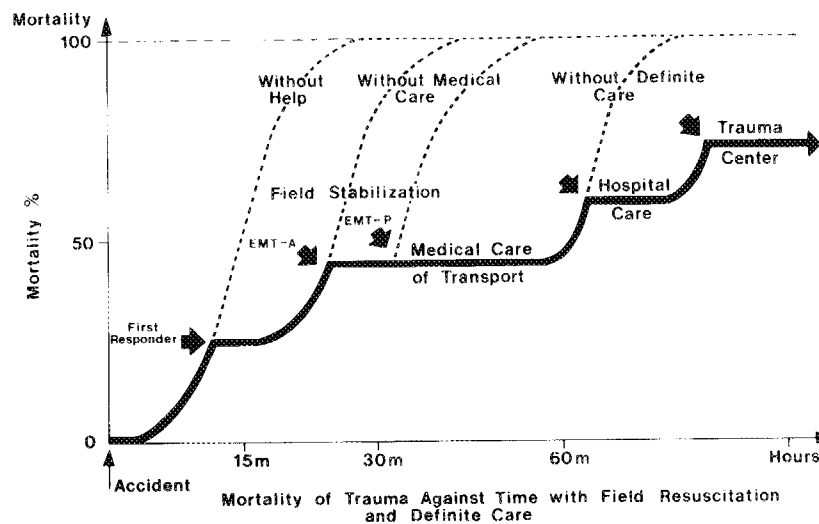


FIG. 1

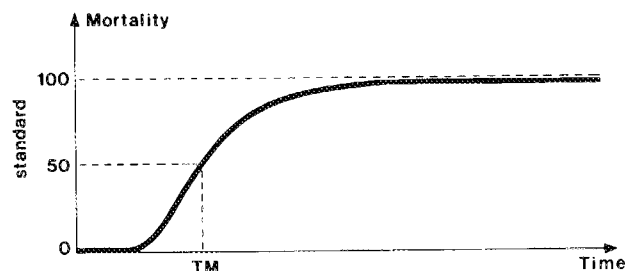
munications and transportation, and initial basic field care, time will be saved and the eventual death forestalled (Fig. 2).

Emergency medical services and trauma 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. Many of these simple acts can be performed by trained first responders or rescue squads. More sophisticated care by basic EMT-A's and advanced EMT-Paramedics will further stabilize even the critically injured as they are extricated and begin to move correctly through the system.

In major trauma only the sophisticated definitive care by medical/surgical personnel with knowledge, skills, and equipment will permanently stabilize the mortality time impact and provide a final life-saving outcome. This indispensable, sophisticated, intensive medico-surgical capability is available only at trauma centers. All phases must be correctly employed by the trauma system in a sufficiently short space of time for the patient to get the best chance with the best possible results. These operations must be specific for each regional EMS/trauma system's patient management plan and 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 successive triage to well-equipped trauma service centers. This is now possible and is being done as protocols for field identification, resuscitation, and transportation to designated trauma centers are being put into operation.

Effective planning for a trauma/EMS system is best accomplished by starting small in areas where knowledge and rationale exist and where some impact can be realized within a relatively short period of time. Trauma/EMS system programming lends itself to this approach as outlined below:



Standard mortality curve for emergency medical events against time when the patient is left without care.

TM: Time of 50% mortality

FIG. 2

- set a simple plan for the region
- implement that plan regionwide
- obtain professional cooperation and support
- apply technological advances as appropriate
- monitor and redefine the trauma network over time.

Effective response to a trauma emergency requires a system, preplanned at the regional level, that rapidly deploys properly trained and equipped personnel. The trauma system must ensure that patients are taken to hospitals capable of continuing and expanding life-support activities begun at the scene. This would not be the nearest hospital in urban areas, but will be so in rural and wilderness regions. Ensuring delivery of critically ill and injured patients to appropriate hospitals requires the communities to inventory, categorize, and designate emergency care facilities for specific care capabilities and responsibilities. Having established the hospitals best prepared to resuscitate and treat the critically ill and injured, a community should adopt triage protocols for the delivery of these patients to these facilities while under medical control. The plan, once implemented, must be monitored by obtaining and evaluating critical data such as trauma patient tracers.

While it is the intent and obligation of an EMS system

to meet the needs of all patients, an EMS system must plan specific strategies for the most critical emergencies that occur within its area of responsibility and must utilize hard and soft resources to deal with these specific life-threatening conditions. Therefore a major emphasis must be placed on improved access and care of the most critical patient categories of trauma, burn, and spinal cord injury.

There have been some 304 EMS regions designated for the country. This provides "wall to wall" contiguous geographic coverage for all EMS services. The basic patient model for the EMS regions is the trauma patient requiring an advanced level of care. Many of the injuries have a CNS component.

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. 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 (1).

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 massively injured. In many communities where these critical surgical specialists reside, their impact is ineffectively 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. A collateral problem of this "itinerant" on-call approach is that it does not foster sound educational and service programs for the essential emergency physicians, intensive care nurses, paramedics, and laboratory support personnel required on the trauma team.

Trauma incidence and patient distribution within an EMS regional system show that 85% of patients can be managed at the local level, 10% need further care in standard and intensive care settings, and 5% need special total advanced care only available in the designated trauma centers, and that these figures might be reversed for spinal cord and burn injury, with 85% requiring immediate special and total care in specialized centers (8). The source for this information primarily reported motor vehicular trauma victims with multiple serious injuries.

Each regional EMS system, through planning, implementation of a basic life support system (BLS), and expansion to an advanced life support system (ALS), has addressed and developed a trauma care system. The community that wishes to establish specialized trauma services should decide what level of trauma services it can support. An analysis of the community or regional status with respect to each clinical category of trauma, burns, and spinal cord injuries and the 15 EMSS components is an appropriate place to begin. If this analysis shows some of the components to be weak or nonexistent, one should then ask how these weaknesses and gaps in

the EMS system would affect the proposed trauma service. Consideration should also be given to the possible effect of the proposed trauma services on the inadequacies of the existing EMS system. Developing a trauma service in an area will usually stimulate the EMS personnel, the surgical leadership, and the health planners to better establish the need for and configuration of these services.

Civilian trauma centers have previously been developed only in larger metropolitan hospitals where extensive medical and surgical resources are available. 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 centers in the region, up to 50% (9) of the vehicular trauma deaths can be prevented if adequate resuscitation, transportation, and proper surgery are performed within the region's organized trauma service centers.

It is therefore apparent that a graded-echelon trauma care system is necessary in all EMS regions across the country. This would provide immediate care at the scene, safe and efficient transportation of critical patients to designated trauma service centers, appropriate definitive surgery, critical care management, and rehabilitation.

REGIONAL EMS SYSTEMS MODELS

Because there are real differences between urban and rural regions, the following systems' models have been conceptualized and are outlined as follows:

Urban/Suburban—Model (X)

Rural/Metropolitan—Model (Y)

Wilderness/Metropolitan—Model (Y')

Of key importance in these regional models are the facilities' orientations and patient flow patterns or *systems configuration*, the *facilities categorization* and *responsibility designation*, and patient tracking through

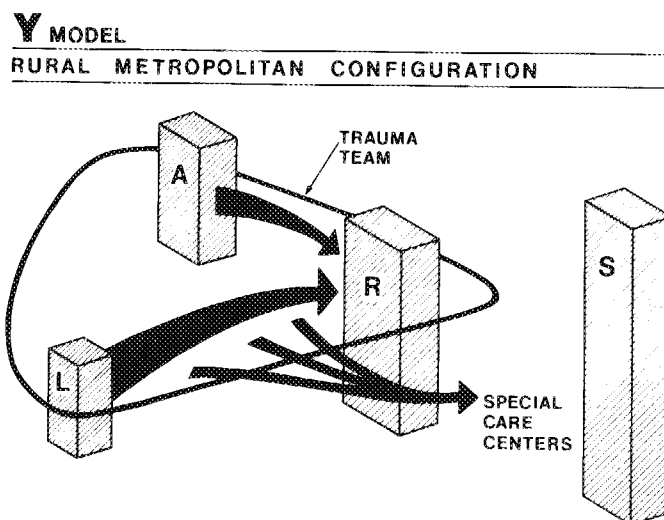


Fig. 3

the transportation and facilities components of the system, or "systems operational design."

Rural-metropolitan Regional (Y) Model System. Schematically shown is a (Y) model regional trauma/EMS system with a triangular boundary defining the regional geography (Fig. 3). The broad base of the triangle to the left of Figure 3 indicates the large patient population of trauma, most of which (85%) can be effectively treated in the local (L) and areawide (A) trauma centers as depicted by their relative sizes within the triangle. Some critical patients, less than 10% from the local center (L), and less than 5% from the areawide center (A), would need to be transported to the much larger and more capable regional center (R) at the apex of the triangle as shown.

In many rural-metropolitan (Y) model regions, while internally capable for the vast majority of the major trauma generated in their respective regions, some highly critical patients or unique cases would need to be sent out of the region for certain burn, spinal cord injury, or hyperbaric oxygen treatment.

In some advanced (Y) models, a trauma response team of paraprofessionals, nurses, and surgeons (residents and fellows) respond to lower level trauma centers and community hospitals to assist in the initial resuscitation and stabilization of trauma victims and to maintain patient care during transport to the regional center. The best operational model for this trauma response team has been provided by the neonatologist.

The facility capabilities (functions and potentials) as well as the responsibilities for the various levels of trauma service center for a (Y) model are shown in Table I (10-12).

In the "systems operational design model" for the transportation and facility interrelationship of a (Y) model trauma region (Fig. 4) there is an initiating trauma incident and initial transport (1) to the local primary care facility or trauma center where the patient resuscitation can be provided and measured. The critical trauma victim must then be transferred by a secondary transport mechanism (2) from a local (L) or areawide (A) center to the tertiary regional care trauma center (R) where definitive care can be provided and survival output measured. After this is a more leisurely, but no less defined, movement (3) to a rehabilitation facility where long-term care can be provided and analyzed.

TABLE I Y model system

Local Trauma Center: Resuscitation and initial care, within its capabilities (minimal).
Areawide Trauma Center: Resuscitation and initial care as well as standard operative care management, within its capabilities (intermediate).
Regional Trauma Center: Resuscitation and initial, standard operative, and intensive care management specialized care. Education and investigation for all trauma problems and professionals with the region, within its capabilities (optimal).

Wilderness-metropolitan Regional Model (Y') System. A schematic display of a (Y') regional trauma/EMS system with the available local trauma centers (L) so depicted in their relative location and size in the triangle is shown in Figure 5. A substantial number of patients needing further care would need to be retransported to the regional center (R) for advanced total care outside of this geographic region. Most wilderness-metropolitan (Y') model regions are internally incapable of handling much of the trauma generated in their respective regions, and will need to send some moderately severe cases and certainly all of the critical patients and/or special cases out of the region for progressive care.

The facility capabilities for the local trauma service centers are basically those of local trauma centers where resuscitation and initial care within its capabilities is possible. The regional centers are outside of the (Y) region and usually at some distance in an (X) or sometimes a (Y) region.

The "systems operational design" for the transportation and facility interrelationship for a (Y') model trauma region is structured similarly to the (Y) model. The critical trauma victim must then be retransported during a secondary transport (2) phase over long distances from the local (L) centers to a tertiary regional care trauma or specialty care center (R) where definitive care and survival output can be provided and measured. A variety of transportation devices must be incorporated in these regional systems (helicopters, fixed wing planes, etc.).

Of the 49,500 vehicular deaths reported in 1977, approximately one third (17,700) occurred in urban areas and 31,800 in rural settings. It is interesting to note that in the urban area, one third of the victims (6,000), were pedestrians. In the rural area, however, there were only ten percent or 2,800 pedestrians involved in vehicular deaths (1).

Urban-suburban Regional Model (X) System. In the Urban-suburban Model (X) there is only a need for a selected number of Regional, Special, and Areawide trauma centers so depicted in Figure 6, shown with their relative location and size within the triangle. Some patients, less than 10%, should bypass the community hospitals and go directly to regional areawide centers, and another 5% will need to be selectively transported to (primarily and secondarily) the regional and specialty care centers (R) at the apex of the triangle. The urban-suburban (X) model region is almost always internally capable of handling all of the major trauma and unique cases generated in the respective regions.

Since some very special conditions require highly sophisticated services (e.g., reimplantation, hyperbaric treatments, etc.) some patients will require transfer from the region. Certainly a goal would be to have at least one center of excellence designated for the major traumatic conditions (e.g., adult and pediatric multiple trauma burns, and spinal cord injuries) in each urban (X) region of the country. Specific critical trauma patient categories

Y MODEL

RURAL METROPOLITAN "SYSTEMS OPERATION DESIGN"

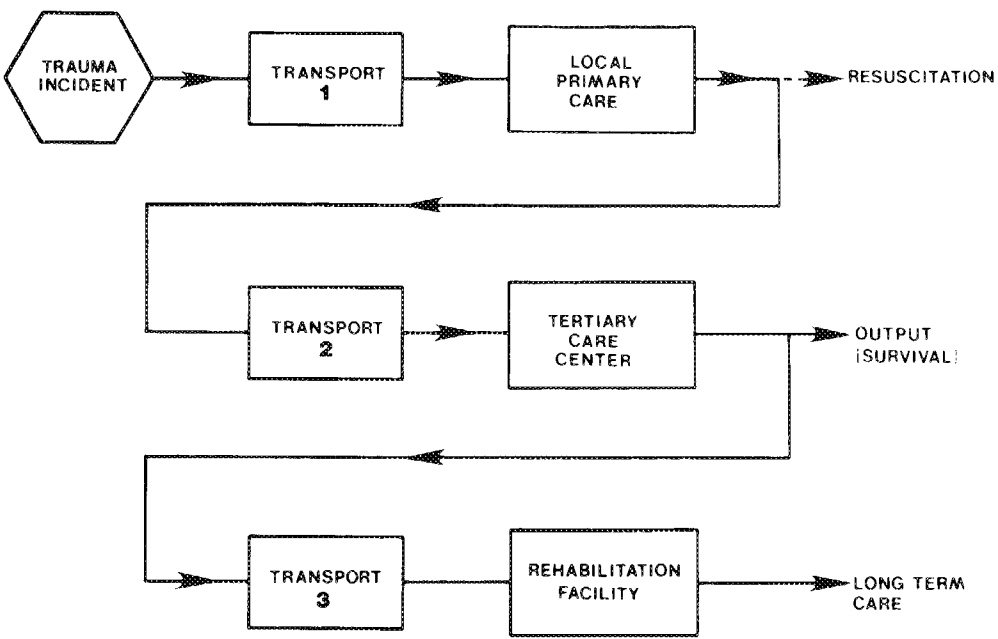


FIG. 4

Y' MODEL

WILDERNESS - METROPOLITAN CONFIGURATION

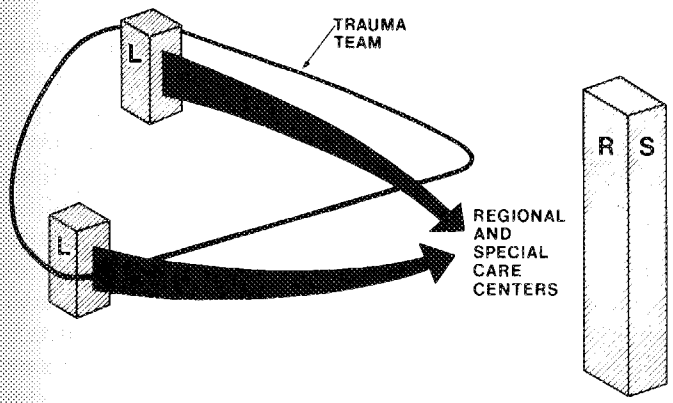


FIG. 5

X MODEL

URBAN - SUBURBAN CONFIGURATION

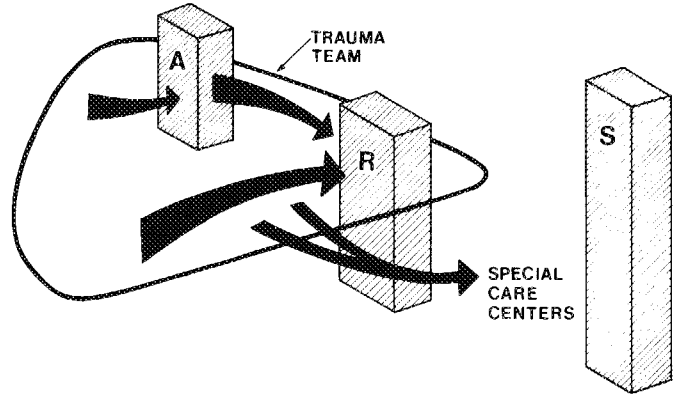


FIG. 6

need to be identified for transportation immediately to advanced care centers by mobile ALS paramedic units under medical control and according to the regional triage protocols. Certainly those patients in shock, with ventilatory problems, changing neurologic signs, and major tissue damage can be identified in the field and appropriately selected for direct admission to the best care facility according to previously established triage plans. Because of the facility capabilities in the urban-suburban region, there is no justification for local trauma centers.

The "systems operational design" for the transporta-

tion and facility interrelationship is shown in Figure 7. The initial transport is to the tertiary areawide and regional trauma centers where the best possible definitive care can be provided and outcome measured. The critical trauma victim who is taken first to a non-trauma center and then retransported must be considered a systems failure.

The EMS systems component implementation (e.g., transportation, communications, training, etc.) as well as the overall systems management and coordination will vary considerably among the (Y), (Y'), and (X) regional models. There will also be some variation between

X MODEL

URBAN - SUBURBAN "SYSTEMS OPERATION DESIGN"

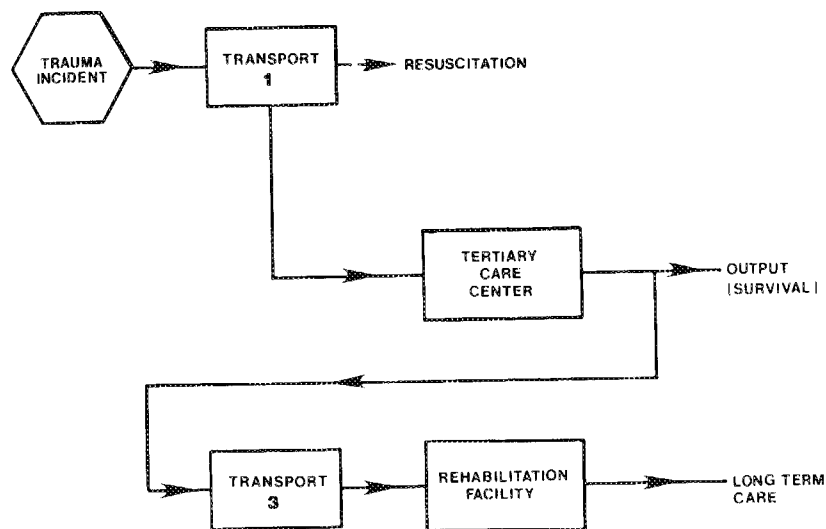


FIG. 7

models of similar types because of certain geographic and social effects. There are, however, some considerable parallels between regions of the same type models. A national experience now exists with replication of models in developing EMS regional programs across the country in similar geographic areas.

TRAUMA SERVICE CENTER ORGANIZATION AND OPERATIONS

The experience and lessons learned in organization and operation of trauma units in the early pioneering civilian programs have been invaluable in subsequent organizational and therapeutic endeavors across the country (13-18). Of paramount importance throughout has been the concept of the "trauma team" approach in patient care, teaching, and, research.

Ancillary benefits, in addition to vastly improved patient care, include the efficiency with which comprehensive practical training programs for various echelons of health professionals can be carried out. Utilizing trained, experienced individuals with numerous skills, both formal seminars and informal bedside teaching sessions can be conducted without unnecessary duplication or needless overlap of effort. These can be presented at frequent intervals, with systematic coverage of all important aspects of acute and rehabilitative trauma care. The opportunity to participate in and benefit from such programs has proved an attractive feature of trauma programs and has markedly enhanced recruitment of talented and dedicated individuals in the broad area of trauma care, including registered and practical nurses, inhalation therapists, laboratory technicians, nursing assistants, and, of course, interns, residents, and staff phy-

sicians interested in trauma and emergency medical services.

Several important principles have been involved in this approach (3). These include:

- 1) immediate identification of the injured patient and provision for transport to the trauma care area
- 2) triage of all hospitalized trauma victims in a single location by a single team of experienced surgeons
- 3) resuscitation and comprehensive initial evaluation in a single fully staffed and equipped area of the trauma unit
- 4) utilization of a team approach to the individual patient with the general surgeon or orthopedist functioning as a team coordinator, as a rule
- 5) upgrading the level of training of the trauma team coordinator to that of a senior experienced surgeon
- 6) establishment of an integral intensive care area dedicated to the needs of the critically injured patient
- 7) specially trained nurses and other health professionals developed to staff the unit, with continuing education courses for these personnel
- 8) consolidation of all related hospital resources for the injured patient in this central location
- 9) necessary supporting laboratory services available in the unit itself
- 10) establishment of a priority system in the hospital's X-ray department and blood bank, in which trauma patients are given appropriately high priority at any time of the day or night.

Financial Impact of Specialized Trauma Services

The financial impact of trauma services on sponsoring institutions and other hospitals throughout the region has been discussed by Tufel and Trunkey. They estimated that an optimal level I trauma center as prescribed

by the American College of Surgeons or by the Health Services Agency would cost \$3,679,440 and \$2,692,709, respectively. These centers would by necessity be limited to university teaching center hospitals. A similar cost estimate for a community hospital trauma program with an essential first response team of an emergency physician, surgeon, and anesthesiologist inhouse would be \$1,682,336 (19).

It is estimated that a major trauma center should treat at least 1,000 critically injured patients a year to remain clinically and cost effective (12). A planning guide for estimating patient demand is that 5% of motor vehicular accidents (MVA) with personal injury will need the services of a trauma center (8, 19).

Centralizing emergency care of the critically ill and injured on a regional basis can decrease death and disability by providing appropriate resources for many life-threatening conditions. Regionalization allows other hospitals to avoid unnecessary duplication of services. This results in more effective use of health care dollars and decreases their "risk" of a sophisticated advance care response posture and liability by not having these same regional responsibilities. An ever-increasing awareness of the cost of medical care, especially for the most critical cases, places great demands on the professional and logistic resources of a community and cannot be adequately supported in many hospitals in a region.

The principal clinical and economic issues of: 1) truly available surgical manpower, 2) team development and skill maintenance, and 3) overall cost of care of the critically injured must be integrated into any conceptualization and formalization of a regional trauma program.

Trauma Systems Management. A trauma system is a complex arrangement of essential personnel and facilities, the coordination and management of which requires an EMS lead agency to provide the necessary focus and central direction of trauma system planning, implementation, operations, monitoring, and evaluation (8). This EMS lead agency must be within the public health authority and represent the interests of all trauma patients and providers. It must assume the responsibility for all trauma patients both in the public and private sector within the region. All innovations create conflict, and no single provider or special interest group can adequately conceptualize and maintain an objective perception, or coordinate an unbiased trauma system, for a region. Through various means and under the direction of a credible traumatologist, a physician knowledgeable about trauma care and systems development, uniform programs, guidelines, and collaborative protocols for patient response and care for the region must be established. This lead agency's traumatologist (20), working with colleagues at various levels within the system, jointly identifies problems, develops practical solutions, and deploys operational protocols for the prehospital, inter-hospital and trauma center care, and rehabilitation

from the initial planning to implementation and evaluation of the system.

A regional trauma/EMS system is a first attempt to conceptualize and implement an operational model for a regional management entity within the health care delivery system. This is accomplished through the consensus of intelligence built into the system and is, therefore, able to deal with aspects of prevention, primary and tertiary care, and other interrelated issues appropriately, as defined by the system description and operations protocols. The system is constructed and operated by individuals who collaborate within an interrelating communication network. The traditional bureaucratic system of strict unit responsibility and line authority dating from the time of the Industrial Revolution and having the goal of high efficiency for specific tasks from an assembly line operation will not work in a complex regional trauma system.

Systems management is basically working with people and through people in order to make effective the work of this complex arrangement of individuals, institutions, and interests toward a common goal. This management style necessitates new and technical conceptual and human communicative skills. An interdependent region-wide trauma team, working in concert, at different phases of the trauma system, must collaborate and cooperate, and follow some uniform approaches if critical patient care is to be effectively provided through the system at different locations by different team members.

Because of rotating responsibilities, the element of fatigue, etc., in trauma teams working within a care unit or the entire system, it is essential to have standard uniform operational protocols for initial patient identification, field treatment, transportation care, distribution, and triage to appropriate centers as well as in-hospital critical care for shock, surgery, and early rehabilitation, and followup care in regional trauma systems. Critical trauma patient care, therefore, demands a "protocol approach" for many of the systems operations, as well as treatments given to patients as they progress through various providers and phases of care. These same protocols should be utilized during both training and daily operations and form the basis for evaluation, and provide a legal standard of care (21).

This interrelated, interdependent communication and management network of a regional trauma system utilizes a team approach and must maintain a team-building effort on a wide geographic basis. This approach is now being utilized in industry but has heretofore not occurred within the health care system. It is in early stages even now in developing regional trauma systems. The basic transfer agreements between rural physicians and trauma center surgeons, the development of areawide triage and treatment protocols and regional evaluation studies are the first bonafide examples of interdependent team interaction on a wide geographic basis. This team approach is essential to ensure integrity and competency

as well as to maintain interdependency and the quality of service that must be coordinated throughout a region-wide trauma system. These interactions must occur under very acute and demanding environmental circumstances and ensure that trauma patients will be provided care to the level of the art within the region, and not by a capricious and ineffective fragmented response.

Trauma is a very trying and clinically demanding disease. Other conditions that have less severity, multiplicity, and fewer limitations of time and geographic constraints can possibly be developed on a non-regional, non-system and non-interdependent basis. For the critically injured, this cannot be done.

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 motor vehicle accidents would have been salvageable based on autopsy studies and the utilization of standard techniques (22). 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 (23). 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 (24, 25). 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 EMT's 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 (9). 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 directly or by transfer has occurred. Cowley documented the effectiveness of the statewide helicopter program at the Maryland Institute for Emergency Medical Services, and reports a progressive fall in mortality for patients transported by helicopter to the Shock-Trauma Center from 50% to below 20% for a very seriously injured group (16). A Wisconsin statewide study on the effect of categorization on trauma patient care showed that more appropriate and effective care was provided for the severely injured in most advanced care facilities after categorization (26). West and Trunkey recently 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 (18). Myer has shown the effectiveness in decreased morbidity, length of hospital stay and medical care cost of spinal cord injured "systems" patients treated within the Illinois trauma and spinal cord injury system, as compared to "non-systems" or delayed entry patients (27).

TRAUMA CENTERS OF EXCELLENCE

There is a need for uniform regionwide control measures that can monitor and document the experience of regional trauma programs across the country. Currently at the regional EMS program level, mortality impact and compliance studies in selected CNS trauma tracer patients is ongoing (8). There is the need for a much more in-depth analysis and review, as originally recommended by the 1966 National Research Council call for regional and national trauma registries to develop clinical studies establish mortality and morbidity risks, epidemiologic evaluations, define logistic requirements of trauma centers and systems, and study cost dynamics and effectiveness of various trauma program activities (5).

It appears from a limited number of studies that trauma/EMS systems are having a positive impact on death and disability and some effects on controlling the care costs of the critically injured. The current data are largely anecdotal and localized, and it is unrealistic to assume that programs have always moved in the right direction by clinical instinct or armchair rationale. There exist today great limitations to our knowledge of the trauma problem. An in-depth description of trauma incidence, medical, epidemiologic, demographic, financial and societal dimensions of this disease with a national trauma registry and standardized data base is necessary upon which the impact of developing EMS trauma systems can be evaluated.

The national pandemic of trauma is a \$60 billion cost phenomena of which little is known. EMS project data, information from the National Center for Health Statistics, Accident Facts from the National Safety Council, actuary and cost tables from the insurance industry, and rehabilitation services from both private and government sectors only provide a fragmentary appreciation of the overall problem. Model demonstration trauma centers need to assimilate uniform data, develop strategies for impact studies, and assist in the development of a national trauma registry data base for traumatic injury care, and rehabilitation (28-30).

These centers of excellence would typically reside in a major medical center involved in providing trauma care. They would orient themselves to investigate trauma in surrounding geographic regions. A better understanding of the needs of patients and their access to high resource treatments would result. Lessons learned in consolidating these high-cost services with cost control would be models for other centers of trauma care excellence in the future. Certainly, there is a need for trauma centers of excellence in every major community Model (X) across the nation.

These centers would develop standards and programs for training of professionals, paraprofessionals, and the public in sophisticated as well as simple techniques to better the care of trauma victims at all levels of the system. These centers would also develop programs of public education and prevention—the ultimate goal in trauma control.

Cancer, another major health problem, receives millions of dollars each year for research to find solutions in terms of population screening, medical treatments, rehabilitation, and prevention. There is a magnitude of unknowns in cancer.

In trauma patients, identification, necessary treatments, rehabilitation, and even many aspects of prevention in terms of better systems of care, safety engineering, behavioral modification, and restrictive legislation are known at least in qualitative terms. All these areas still need further in-depth study and analysis, with the overall quantitative potential of specific strategies and actions made in real time operating regional trauma systems. Probably the most important effect of trauma centers of excellence will be the regional trauma program monitoring from which data collection and analysis would provide information for directing national policy and programs for improved trauma care.

SUMMARY

There has been a maturation of thought in regard to the trauma victim over the last twenty years. Not so long ago, serious injury was an "acceptable death."

The improvements in resuscitation and surgical management of the critically injured in the military and inner city trauma units in the 1960's stimulated some initial academic interest in trauma care with biomedical research, clinical studies, and postgraduate surgical trauma training programs.

In the early 1970's, as an outgrowth of our military experience, several pioneer regional systems programs showed the way for better planning, organization, and resource deployment for trauma systems in the civilian community. The experience of the mid- and late 70's has brought an even wider implementation and modeling of trauma care systems with identification of specific patient problems, designation of trauma 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 prospects for developing even better systems of trauma care and control in the 1980's.

Trauma, so managed, can come under control as the natural history of the disease is better understood and as the trauma patient and systems interface points become better identified. Effective prevention will then be feasible with significant reduction in trauma incidence as outgrowths of these prevention programs (e.g., alcohol, violence control), based on studies in operating clinical systems.

Professional and public apathy about the mounting toll from accidents is now being transformed into action programs under strong medical leadership in EMS regions across the country. This is being accomplished by the same methods employed to bring poliomyelitis and other epidemics under control; by identifying the problems, consolidating our efforts, and sharing the problem across all resources. Federal, state, and local governments, and national and local professional and voluntary agencies are now being mobilized in support of programs to better treat and prevent trauma. The American Trauma Society is now providing a national forum where governmental professionals and public support for improved systems care, research, education, and prevention of injury can be focused as a result of the current and many projected initiatives that will result in sound trauma programs. At the national, regional, and local level, control of the trauma epidemic can be accomplished within the next decade. Trauma can be controlled in the 1980's.

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NEW A.C.S. TRAUMA APPOINTMENTS ANNOUNCED

The American College of Surgeons Committee on Trauma recently appointed six new state and local ACS Trauma Committee Chairmen, and one new Region Chief.

The Chairmen will be responsible for the development of activities best suited to improve the care of the injured in their area, in accordance with the practices and policies of the A.C.S. Committee on Trauma.

The appointments are as follows:

- Jay M. Kranz, M.D., F.A.C.S., Seattle, Washington: Chief of Region X in the ACS Regional Committee Organization.
- John B. McGinty, M.D., F.A.C.S., Newton Lower Falls, Massachusetts: Chairman of the ACS Massachusetts Committee on Trauma.
- Richard C. Britton, M.D., F.A.C.S., Portland, Maine: Chairman of the ACS Maine Committee on Trauma.
- Paul E. Collicott, M.D., F.A.C.S., Lincoln, Nebraska: Chairman of the ACS Nebraska Committee on Trauma.
- Martin E. Silverstein, M.D., F.A.C.S., Tucson, Arizona: Chairman of the ACS Arizona Committee on Trauma.
- William M. Stahl, Jr., M.D., F.A.C.S., New York, New York: Chairman of the ACS New York-Brooklyn Committee on Trauma.
- David R. Stewart, M.D., F.A.C.S., Kansas City, Kansas: Chairman of the ACS Kansas Committee on Trauma.

The American College of Surgeons was established in 1913 to raise the standards of surgery and upgrade the care of the surgical patient. The work of the A.C.S. Committee on Trauma has been an important part of the efforts to raise the quality of care of injured patients.