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Disaster Triage: START, then SAVE—A New Method of Dynamic Triage for Victims of a Catastrophic Earthquake

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Abbreviations:
BSA = body surface area
DMAC = disaster medical-aid center
GCS = Glasgow Coma Scale
GOS = Glasgow Outcome Scale
MDR = medical disaster response
MESS = mangled extremity severity score
SAVE = Secondary Assessment of Victim Endpoint
START = simple triage and rapid treatment

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Abstract

Triage of mass casualties in situations in which patients must remain on-scene for prolonged periods of time, such as after a catastrophic earthquake, differs from traditional triage. Often there are multiple scenes (sectors), and the infrastructure is damaged. Available medical resources are limited, and the time to definitive care is uncertain. Early evacuation is not possible, and local initial responders cannot expect significant outside assistance for at least 49–72 hours. Current triage systems are based either on a shorter time to definitive care or on a longer time to initial triage.

The Medical Disaster Response (MDR) project deals with the scenario in which specially trained, local health-care providers evaluate patients immediately after the event, but cannot evacuate patients to definitive care. For this type of scenario, a dynamic triage methodology was developed that permits the triage process to evolve over hours or even days, thereby maximizing patient survival and resulting in a more efficient use of resources. This MDR system incorporates a modified version of "Simple Triage and Rapid Treatment" (START) that substitutes radial pulse for capillary refill, coupled with a system of secondary triage termed, "Secondary Assessment of Victim Endpoint" (SAVE).

The SAVE triage was developed to direct limited resources to the subgroup of patients expected to benefit most from their use. The SAVE assesses survivability of patients with various injuries and, on the basis of trauma statistics, uses this information to describe the relationship between expected benefits and resources consumed. Because early transport to an intact medical system is unavailable, this information guides treatment priorities in the field to a level beyond the scope of the START methodology.

Pre-existing disease and age are factored into the triage decisions. An elderly patient with burns to 70% of body surface area is unsalvageable under austere field conditions and would require the use of significant medical resources—both personnel and equipment—and would be triaged to an "expectant area." Conversely, a young adult with a Glasgow Coma Scale score of 12 who requires only airway maintenance would use few resources and would have a reasonable chance for survival with the interventions available in the field, and would be triaged to a "treatment" area.

The START and SAVE triage techniques are used in situations in which triage is dynamic, occurs over many hours to days, and only limited, austere, field, advanced life support equipment is readily available. The MDR-SAVE methodology is the first systematic attempt to use triage as a tool to maximize patient benefit in the immediate aftermath of a catastrophic disaster. **Prehospital and Disaster Medicine 1996;11(2): 117–124.**

Introduction

There is no single correct way to perform the task of triage. There are various degrees of disasters, and it is unlikely that one can apply all of the same techniques to events that differ markedly. Triage during a widespread, catastrophic disaster differs from triage performed in routine prehospital and hospital settings: the number of victims is increased and the availability of medical resources is limited severely or even absent. Patients may remain at the scene for a protracted period of time and must be reassessed frequently. In addition, the triage process is decentralized, occurring at multiple sites or compartments simultaneously throughout the disaster zone. Rather than a single scene or localized disaster, this situation can be thought of as a "compartmentalized" disaster. To address these concerns, the Secondary Assessment of Victim Endpoint (SAVE) triage system was created as part of the overall Medical Disaster

Response (MDR) training curriculum.[1,3] This triage system is designed to identify patients who most likely will benefit from the care available under austere field conditions. When combined with the Simple Triage and Rapid Treatment (START) protocol,[4] the SAVE triage can be used in any major disaster in which patients experience a prolonged delay in accessing definitive care.

The SAVE triage would be useful in a catastrophic earthquake. In this setting, hospitals may be rendered nonfunctional. Even if these medical centers survive, disruption of the community's infrastructure, particularly communications and transportation, can make them inaccessible to victims.

Assumptions

The SAVE methodology assumes the following: 1) previously trained, local providers assess patients immediately after the event; 2) available resources are limited; and 3) the time needed for evacuation to a center capable of providing definitive care is prolonged. The condition of patients who otherwise would recover may deteriorate because of this delay. Previous triage experience is derived from situations in which definitive care is immediately available—so that triage need occur only at one point in time (e.g., a plane crash)—or in which initial triage occurs one or more days after the primary event (e.g., the Armenia earthquake). The SAVE methodology is provided for use by health-care providers within the disaster zone who can begin caring for patients immediately but may not be able to transport patients to a definitive care facility for days. It is immediate and dynamic, rather than delayed and static. Although there are many elements in common with other triage systems, rapid transport to a functional medical center within the "golden hour" is impossible.

The SAVE triage assumptions suggest that patients should be classified into one of three categories: 1) those who will die regardless of how much care they receive; 2) those who will survive whether or not they receive care, or 3) those who will benefit significantly from austere field interventions. Only this latter group of patients who are expected to improve will receive more than basic care and comfort measures.

The SAVE concept was designed to separate patients into the above three categories so that resources can be distributed appropriately. The decision to place patients into a particular category is based on field outcome expectations derived from existing survival and morbidity statistics.

Framework

Estimating Delay to Definitive Care

As a disaster evolves, information is gathered in an effort to estimate the anticipated delay until patients can be evacuated to a higher level of care. This is important because the longer that health-care providers must treat patients in isolation, the more frugal they must become in the use of supplies and in the selection of patients to treat.

Overview of Patient Sorting

In a disaster, use of a modified START system is appropriate when the patient initially is encountered by a health-care provider.[4] This may be at the site where the injury occurred or in the triage area of the disaster medical aid center (DMAC). According to the MDR project definition, a DMAC is a predesignated site within the community, such as a school or fire station where advanced life-support supplies have been prepositioned.[1,3,5] The only difference between the standard and the modified START is that a palpable radial pulse replaces capillary refill as the tool used to estimate volume status (Figure 1). The usefulness of capillary refill in predicting hypovolemia has been questioned.[6,7] Although not scientifically proven, the presence of radial pulse may be easier to measure under austere conditions; hence its use is recommended in the SAVE triage system.

Once assessed with START, the patient is sorted into one of the following four categories: *green* (walking wounded); *red* (immediate); *yellow* (delayed); or *black* (deceased). A triage tag such as the California Fire Chiefs' Association tag can be used if available.

There are several disadvantages to the use of triage tags. First, they may be unavailable at the time of need. Second, they may be unreadable because of darkness or inclement weather. Third, as portions of the tags are torn off, the tags can show that a patient's condition deteriorates but not that it improves. With appropriate interventions, some patients should be able to be moved to less critical triage categories. Finally, there is not sufficient space on such tags for the amount of information needed during a prolonged patient stay in the field. Thus, triage tags are best for situations in which patients can be transported immediately to a definitive care facility. An alternative to the use of tags under catastrophic disaster conditions is to sort patients into physically different areas corresponding to their degree of injury or illness.

After initial assessment with START, patients are reassessed with the use of the SAVE methodology. Patients receive secondary assessments in order of priority according to START. That is, Red patients will receive secondary triage before Yellow patients, then Greens, and finally Blacks. This secondary triage defines which persons will be treated and in what order. Note that the only treatment that occurs during START is opening an airway or controlling bleeding with direct pressure on obvious external hemorrhage. Patients need to undergo SAVE triage to determine the appropriateness of further, more advanced interventions.

The SAVE triage is designed to answer two key questions: 1) What is the victim's prognosis if minimal treatment is provided? 2) What is the victim's prognosis with treatment using the resources available at the DMAC? Patients are triaged to a treatment area under two conditions: 1) Morbidity or mortality may be reduced with treatment, given the estimated time until there is access to definitive care; 2) Treatment will not consume an inordinate amount of the limited resources and personnel available.

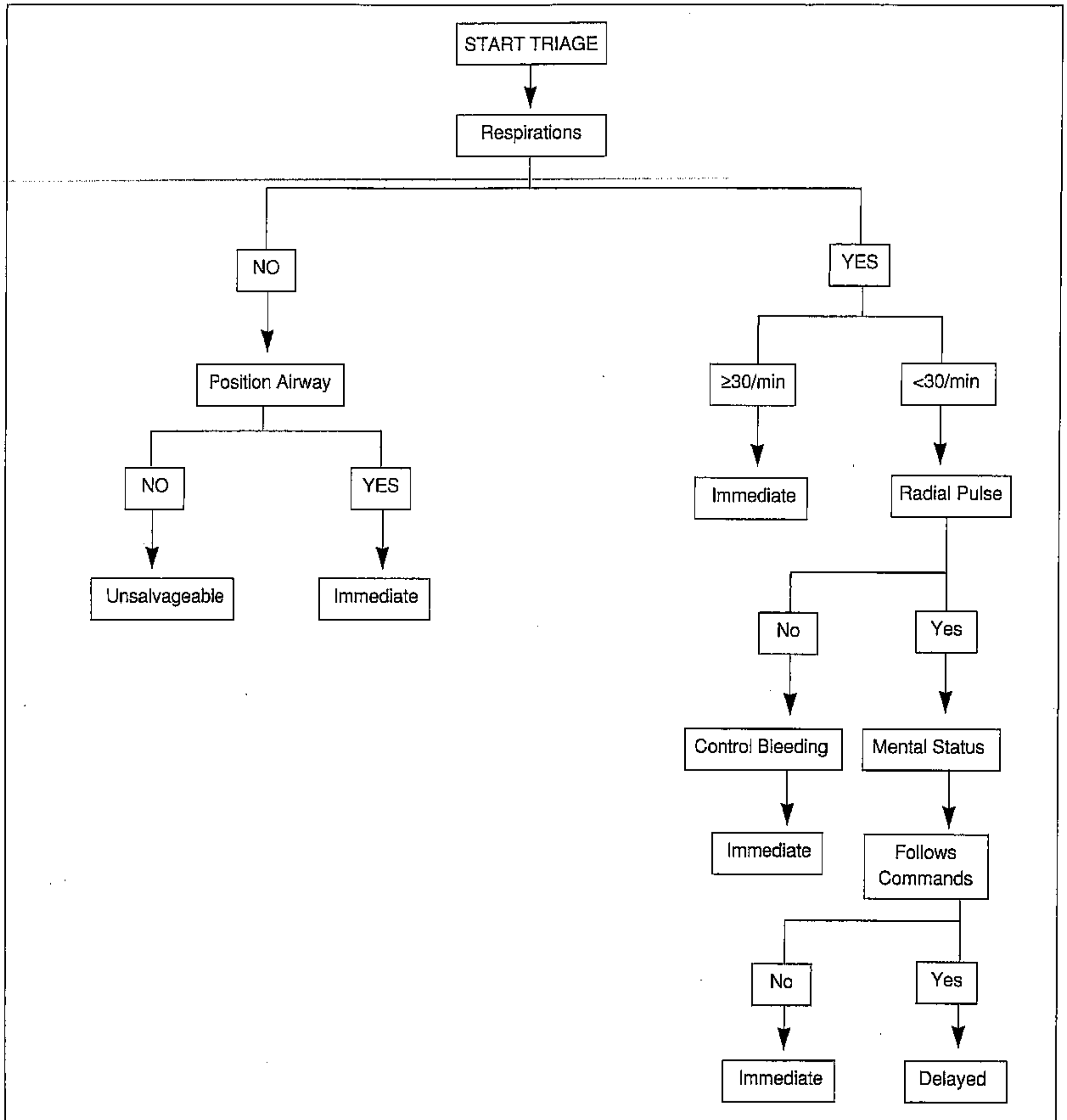

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Figure 1—Medical disaster response modified simple triage and rapid treatment (START)

Some patients should not be triaged to the treatment area. Patients expected to die despite interventions available at the DMAC or those who will deplete available supplies completely if resuscitated and stabilized should be triaged to an observation/holding area, but should be reassessed and moved to the treatment area if they improve. These patients should not receive resources beyond those necessary to provide comfort care and continued monitoring.

The second group of patients who would not be assigned to the treatment area consists of those with stable or minor injuries for whom a delay in the delivery of care would do no harm. They, too, would be triaged to an observation area and receive basic care and periodic reassessment.

Unexpected improvement is possible if stressed medical care providers overestimate the severity of a person's condition or the time until possible evacuation of the victim. If the condition of a patient in the observation area stabilizes, or if an evacuation opportunity develops, a victim who was once triaged as too sick to help may become salvageable. Under these circumstances, this person must be moved to the treatment area. Triage is a dynamic process and periodic patient reassessment is mandatory.

Patients sent to the treatment area are treated in a prioritized manner according to the severity of their con-

1. Skeletal/soft-tissue injury	
Low energy (stabsimple fracture; civilian gunshot wound)	1
Medium energy (open/multiple fractures, dislocation)	2
High energy (CRUSH, shotgun, military gunshot wound)	3
Very high energy—as above plus gross contamination or soft-tissue avulsion	4
2. Limb ischemia	
Pulse reduced or absent but normal perfusion	1
Pulseless; paresthesia; reduced capillary refill	2
Cool, paralyzed, insensate, numb	3
(Score doubled for ischemia longer than 6 hours.)	
3. Shock	
Systolic blood pressure maintained above 90 mmHg	0
Transient hypotension	1
Persistent hypotension	2
4. Age (years)	
<30	0
30 through 50	1
>50	2

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Figure 2—Mangled Extremity Severity Score (MESS)

Used with permission: Johansen et al: Objective criteria accurately predict amputation following lower extremity trauma. J Trauma; *30:568–573*

Eye opening	
Opens eyes spontaneously	4
Opens eyes to voice	3
Opens eyes to pain	2
No eye opening	1
Best motor response	
Obeys commands	6
Localizes to pain	5
Withdraws to pain	4
Abnormal flexor response	3
Abnormal extensor response	2
No movement	1
Best verbal response	
Appropriate and oriented	5
Confused conversation	4
Inappropriate words	3
Incomprehensible sounds	2
No sounds	1

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Figure 3—Glasgow Coma Scale scoring

ditions, availability of supplies, and common sense. For example, three victims arrive requiring chest tubes, but only two tubes remain. Two patients need only one tube each. The third person requires bilateral chest tubes. The principle of SAVE triage dictates that aggressive interventions be withheld from the victim with bilateral chest wounds to help the other two.

Patients initially triaged to the treatment area may fail to respond and may be retriaged to the observation area. Time and resources should not continue to be expended on a battle that has been lost.

During the triage process, persons who would benefit most from early transport should be marked as first out, in case an unexpected evacuation opportunity presents. These would be victims with medical problems readily treatable at a hospital, but untreatable and fatal in the field. Patients requiring surgery for intra-abdominal hemorrhage are an example.

SAVE Guidelines

Crush Injury of the Extremities

Crush injuries are a common problem in earthquakes and other disasters. Appropriate but simple interventions can prevent death and disability in these patients.[8,9] Therefore, persons with such injuries who are otherwise viable should be triaged to the treatment area.

Such patients are challenging particularly because, in standard practice, crush wounds are rare and physicians may lack experience in recognition and management of the disease process. Therefore, physicians may require assistance in deciding which limbs to attempt to salvage and which to amputate. To guide this difficult choice, the mangled extremity severity score (MESS) can be used (Figure 2).[10,11] The patient is evaluated for age and signs of shock, while the injured extremity is examined for degree of tissue disruption and circulatory compromise. On the basis of the findings, a score is calculated. Patients with scores ≥7 have an increased probability of limb loss despite aggressive care, and amputation should be considered. Victims with scores of <7 have a better prognosis, and limb salvage should be considered, including the performance of a fasciotomy if indicated. Physician training in the performance of amputations and fasciotomies under austere conditions is available.[12,13]

It is important to understand that the MESS concept was developed with the assumption that immediate access to tertiary care would be available. This assumption is invalid under catastrophic disaster conditions. Therefore, the concept cannot be applied blindly. For example, the doubling of the limb ischemia score, which occurs after six hours probably should be done earlier to reflect the more austere medical environment. Nonetheless, the MESS can serve as a useful reference point to aid decision making in a chaotic situation.

Head Injury

Neurologic assessment of head-injured patients for the purpose of triage can be simplified if an efficient and goal-directed neurologic examination is performed. An essential component of this examination is determining the Glasgow Coma Scale (GCS) score (Figure 3).

Incorporating the score into the triage process is attractive for two reasons: 1) Most important, it is useful in estimating the potential for neurologic recovery of patients with head trauma.[14,16] 2) Health-care providers are familiar with it and, therefore, are more likely to use it.

As a group, patients with a GCS score of 8 at the time of presentation have a 90% overall probability of achieving a final outcome characterized as good to severely disabled by the Glasgow Outcome Scale (GOS), with less than a 10% chance of progressing to a vegetative state or death.[16] The National Institute of Neurological Disorders and Stroke assessed outcomes in patients with severe closed head injury by individual GCS score. A score of 3 indicated an 80% probability that the patient would remain in a vegetative state or die. A score of 8 decreased the probability of this result to 16%.[15] Although scores of 6–7 were associated with a progressively worsening prognosis, patients with these scores still had at least a 50% probability of surviving with an outcome defined by GOS as good or moderate disability.

A word of caution is needed. These outcomes were derived after treatment at tertiary-care hospitals with unlimited resources available. In addition, the GCS scores were determined after initial resuscitation. Under disaster conditions, neither of these situations apply. Therefore, it is likely that field interventions would produce worse results. Pending further data, prudence dictates that initial resuscitation of head-injured patients be restricted to those with GCS scores of 8 or better unless resources are plentiful. Adults who do not qualify for treatment because of low GCS scores should be triaged to the observation/holding area by SAVE.

The studies discussed above involved mostly adults. Children appear to have higher recovery rates for a given GCS score. Lieh-Lai et al came to the conclusion that a low GCS score in the absence of hypoxic injury does not predict outcome accurately. In fact, children with scores of 3–5 can recover independent function.[17] In this setting, it is emotionally and logically sound to treat head injuries in children aggressively and triage them to the treatment area.

Treatment of head-injured patients consists mostly of airway protection and head elevation when possible. However, a decompensating patient with a unilateral fixed and dilated pupil may be a candidate for burr holes if the appropriate tools and skills are available at the treatment area.

Chest Trauma

Physical examination and measurement of vital signs are the main guides to triage and treatment in victims with chest trauma. Patients with normal vital signs and a normal cardiopulmonary examination can be placed in the observation area without intravenous lines or chest tubes if they are otherwise stable. Patients with a suspected pneumothorax who are tolerating it well, with normal vital signs and good skin color, should be monitored in the treatment area. Some pneumothoraces resolve without treatment, but patients also can develop complications rapidly. If a patient's condition deteriorates in the treatment area, a Heimlich valve or chest tube can be placed quickly. Periodic re-evaluation is paramount.

Victims with abnormal vital signs or skin color should be triaged to the treatment area, where appropriate interventions may be instituted. This may include the use of intravenous lines, oxygen, if available, Heimlich valves, chest tubes, analgesia, closure of open pneumothorax, or other indicated procedures. A field thoracotomy is not likely to be beneficial.

Abdominal Trauma

Limited diagnostic and treatment options make most patients with abdominal trauma difficult to triage. An adult victim with significant abdominal injury should be triaged to the treatment area and receive a 4 ml/kg fluid challenge with hypertonic saline.[18] If the patient remains in shock, a saline lock should be left in place and the patient moved to the observation area. If the person responds, additional intravenous fluid may be given and continued care in the treatment area is appropriate.

An argument can be made for limiting fluid resuscitation for hypotensive trauma victims in the disaster setting. If the source of hemorrhage remains uncontrolled, there is evidence that aggressive fluid resuscitation until a normal blood pressure results potentially could result in increased bleeding, a coagulopathy, and decreased likelihood of survival.[19] In the case of penetrating trauma, it has been suggested that, until surgery is available, fluid should be titrated carefully to produce mild hypotension in hopes of stabilizing hemostatic clots.[20] Although intriguing, there is minimal evidence that this strategy is effective in humans.

Children with abdominal injuries should be treated aggressively. Studies show that even with significant intra-abdominal injuries, many will survive with nonoperative care.[21] Saladino et al studied isolated liver and spleen injuries in children.[22] Neither the initial clinical findings nor the pediatric trauma score reliably predicted the presence of liver or spleen injuries in children with focal abdominal injuries. In addition, 82% (63/77) of the documented liver and/or spleen injuries were managed successfully without surgery. Of the 14 children who underwent surgical intervention, two required no operative repair. With such a high survival rate, it is prudent for all children in the absence of other fatal injuries, such as severe head injuries, to receive initial resuscitation.

Peritoneal lavage has no role in the field unless the capability to perform a laparotomy is immediately available. Otherwise, this is an unnecessary waste of precious fluids. As ultrasound examination equipment becomes more compact and transportable, it may play a role in the future evaluation of blunt abdominal trauma under disaster conditions.

Victims with urologic trauma also should be triaged to the treatment area where catheterization (urethral or suprapubic) and fluid resuscitation can be instituted as indicated. The possible existence of an occult crush injury should be considered when one is evaluating patients for urologic trauma on the basis of blood in the urine, because myoglobinuria also will cause the dipstick to read positive for blood.

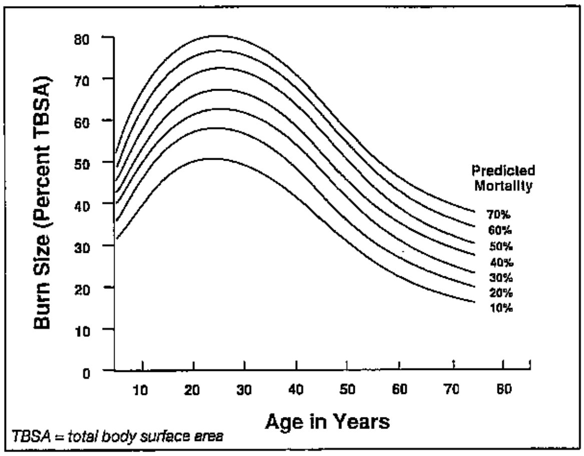

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Figure 4—Burn size and patient age as predictors of mortality.
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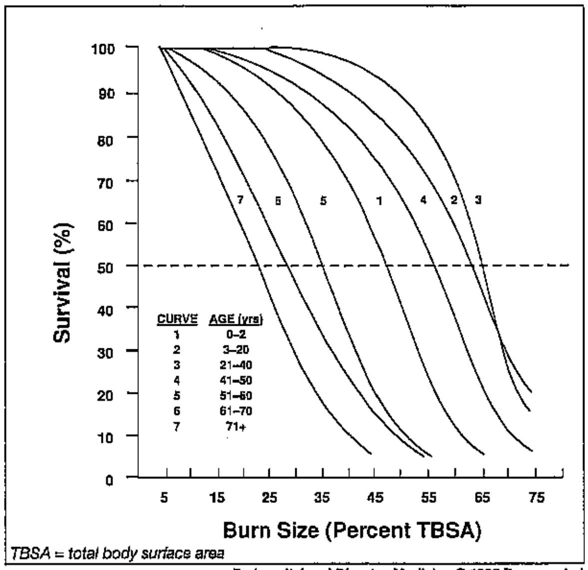

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Figure 5—Patient survival and burn size according to patient age.
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Spinal Trauma

Victims with spinal trauma generally should be triaged to the treatment area. Spinal immobilization may prevent cord injury or protect against further trauma to a partially damaged cord. In addition, high-dose steroids may be beneficial.[23]

Burns

Resuscitation of burn patients is resource intensive. Therefore, a burn victim's survival potential must be evaluated carefully, and only those patients with a reasonable prognosis under austere conditions should receive treatment. Current burn survival statistics can offer guidance in making this assessment. Unfortunately, these are derived from patients admitted to inpatient burn units. Field treatment of burn patients will not be as efficacious, and, hence, survival rates will be lower. Nonetheless, the existing statistics serve as a reference point until more accurate information becomes available.

Age and percentage of body surface area (BSA) burned are the most reliable information available under field conditions and provide the best basis for triage decisions. Other factors, such as the presence of inhalation injury, also may be important in estimating burn mortality. Considering these factors in a mass-casualty situation, a reasonable compromise would be to treat only those patients with at least a 50% probability of survival.

Survival potential for any burn victim is greatest between the ages of 15 and 30 years, and declines during extremes of age.[24] Merrell examined the correlation between the percentage of BSA burned and survival rates in various age groups (Figure 4). The 50% mortality rate curve includes a 50% burn in an infant, a 65% to 70% burn in a young adult, and a 35% burn in a 60-year-old person (Figure 5).[24] Manktelow demonstrated the additional risk from inhalation injury.[25] Any person over 60 years of age with an inhalation injury has a >50% probability of dying, regardless of the BSA burned. Therefore, these patients generally should be triaged to the observation area.

Effect of Pre-existing Disease and Multiple Injuries

An injury or illness in an otherwise healthy patient may not have the same sequelae as a similar medical problem in a person with renal disease, heart disease, malignancy, or diabetes.[26] Milzman and his associates studied mortality rates in trauma patients with pre-existing disease and found mortality rates nearly three times higher than for those patients who were otherwise healthy. The highest mortality rates were in those patients with renal disease (37%), cardiac disease (18%), malignancy (20%), and two or more pre-existing diseases.[26] In comparison, persons without these problems had mortality rates of only 3%. These statistics may overestimate the effects of the additional health problems, because patients with pre-existing disease were on average 19 years older than were their healthier peers. However, after the statistics were controlled for age, victims with multiple pre-existing problems still had a significantly worse prognosis.

In addition to the effects of pre-existing disease, multiple injuries should be considered to be synergistic. The prognosis for an individual patient with multiple injuries is worse than can be deduced from the simple sum of the survival probabilities for each injury.

The existence of multiple injuries and pre-existing disease must be taken into account when one is making triage decisions in patients with thermal injuries. Patients at extremes of age also have a worse prognosis.

Nontraumatic Emergencies

Fortunately, the treatment of many nontraumatic emergencies can be accomplished with field interventions

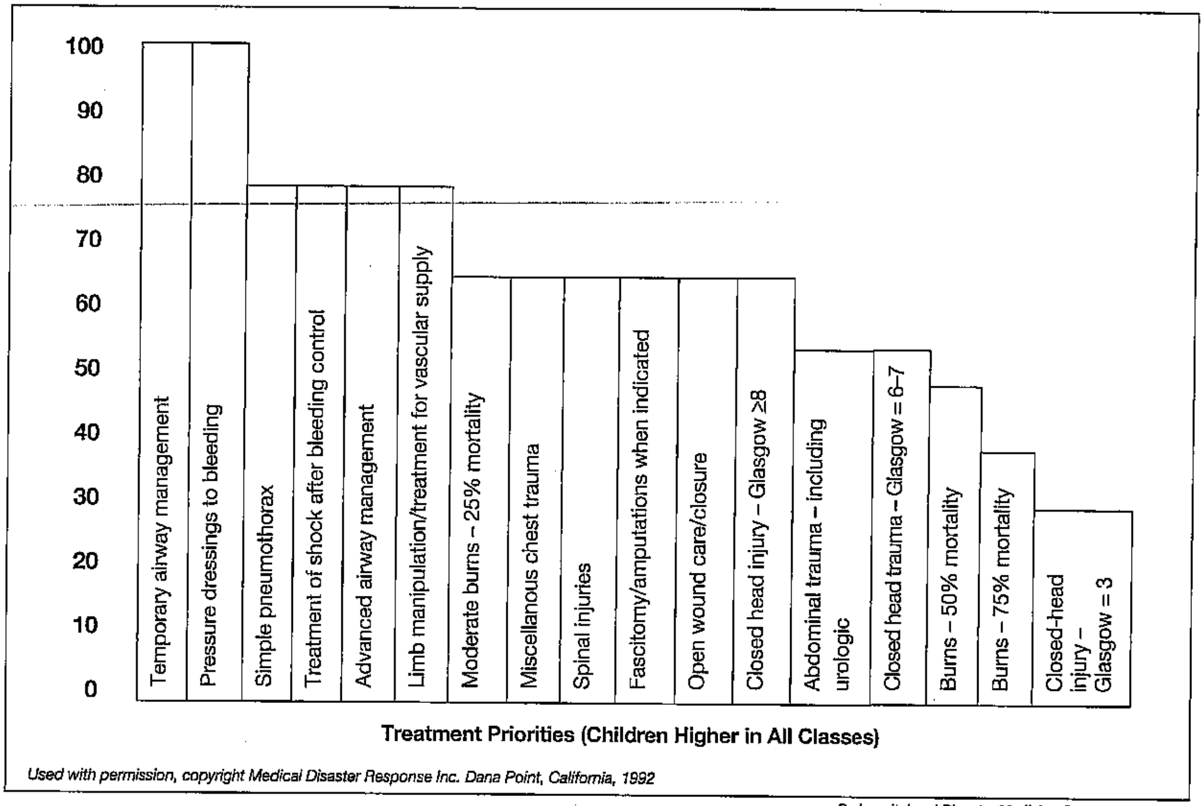

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Figure 6—Patient survival and burn size according to patient age

that do not consume extensive resources. Therefore, patients with such illnesses usually should be triaged to the treatment area. The severity of illness must be determined on a case-by-case basis, but it is reasonable to assume that victims with problems such as asthma and mild cardiac disease will respond to treatment. Other urgent problems, such as otitis media, bladder infections, or gout, frequently resolve spontaneously. Patients with these conditions initially should be triaged to the observation area. They can be treated later, resources permitting.

Special Triage Categories

To maximize personnel resources, victims who normally would be triaged to the observation area can be triaged to the treatment area if they possess special skills valuable to the medical team. This should be done whenever providing care to these persons would result in sufficient recovery to permit their participation in the response. An example would be splinting the forearm fracture of a physician. By increasing the number of functional team members, the effectiveness of the overall response may improve.

Summary of Treatment Area Priorities

Appropriate prioritization of care for patients triaged to the treatment area according to the previous recommendations is depicted in Figure 6. This graph provides estimates of the probability of improving outcome—reducing morbidity and mortality—with treatment of various types of injuries. It combines the expected benefit of rendering care with the cost in resources to achieve that benefit and the probability of survival. Resources required include physicians, nurses, support staff time, and supplies.

An equation describing this relationship is:

$$\text{Value} = \frac{\text{Benefit expected}}{\text{Resources required}} \times \text{Probability of survival}$$

Those patients whose treatment yields the greatest value have the highest priority. If the benefit expected for saving a life were assigned arbitrarily a score of 100, the score for other expected benefits might be:

life = 100 *renal salvage = 75*
limb saved = 50 *infection avoided = 25*

Resources also can be assigned a relative point value. Those that are plentiful and easily replaced will have lower point scores than will those that are in limited supply and difficult to replace. One such arbitrary point scale would be:

1 hour of physician time = 3 *1 liter normal saline = 2*
1 dose of pain medication = 1 *1 wound dressing = 0.5*

As an example, a pressure dressing applied to a bleeding wound will save a life, yet require minimal materials and only a small amount of provider time. When combined with a survival probability approaching 100%, the equation representing the value of treating this patient would be:

$$100/0.5 \times 1 = 200$$

This person would be a first priority patient.

In contrast, a patient with burns of 50% BSA would require significant fluid resuscitation, pain medication, staff time, and extensive dressings. If the patient is elderly and has a survival rate of 50%, requires one hour of physician time, 4 liters of saline, one dose of pain medication, and one dressing change in the first 4 hours, the value equation of treating this person would be calculated as follows:

$$100/(3 + 8 + 1 + 0.5) \times 0.50 = 4$$

This person would have a much lower priority and should be triaged to the observation area.

Obviously, the values here were selected for the purpose of illustrating the triage methodology and were not derived scientifically. The same is true for the treatment priorities assigned to the injuries depicted in Figure 6. Nevertheless, through study of disaster victims and consensus building, real values could be generated for these variables and result in a more accurate estimate of treatment priorities.

Conclusion

The SAVE triage defines a disaster response methodology designed to "do the most good for the most people" in a situation in which health-care providers are available immediately to provide treatment, but time to definitive care is prolonged. It provides a framework to facilitate difficult triage decisions on the basis of estimations of survival probability given limited field resources. Without the existence of a logical secondary triage system, chaotic application of limited resources may result in unnecessarily high morbidity and mortality rates. SAVE will be refined as additional field survival statistics are analyzed. Further research is needed to test the concepts presented in this paper.

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