Triage principles in Multiple Casualty Situations Involving Children - The Israeli Experience

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Key Words: Disaster medicine, Triage, Emergency Medicine, Trauma, International-cooperation, Disaster-planning-organization- administration, Relief work, Emergency Medical Services.

Abbreviations: ED - emergency department.

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INTRODUCTION

Triage is the medical screening of patients according to their need for treatment and the resources available. It applies to mass casualty situations, when conventional standards of medical care cannot be delivered to all victims (1). The goal is to optimize care for the maximum number of salvageable patients. Patients who will do well with minimum care are distinguished from those who will die despite maximal care. Attention is addressed to those who will benefit most from optimal care and rapid surgical intervention. Effective triage at the scene and within the medical institution is often a major determinant of outcome. In adults, priority for treatment is based on rapid assessment of level of consciousness and vital signs (2,3). In children, triage poses a greater challenge, as measurements of vital signs, particularly of blood pressure, are difficult to obtain and cooperation is limited. Although children may account for 10 to 100% of victims in mass casualty events and disasters (4), most of the triage studies to date have focused on the adult population.

The aim of the present paper is to review the basic principles of triage in mass casualty events, and in particular, to describe our experience in situations where children were involved. The approach described is based on the experience gained by the Israeli Medical Relief Teams both within the country (during the latest wave of suicide terrorism) and in disaster events abroad (in Armenia, Argentina, Mexico, Kenya, Honduras, Turkey, and El Salvador) (5).

TRIAGE – DEFINITIONS

In **multiple casualty** situations (6), the number of patients and the severity of their injuries do not exceed the ability of the facility to render care, and patients with life-threatening problems or multiple-system injuries are treated first. In **mass casualty** situations, the number of patients and the severity of their injuries exceed the capability of the facility and staff, and patients sustaining major injuries who have the greatest chance of survival with the least expenditure of time, equipment, supplies, and personnel are managed first. **Disasters** are characterized by a sudden disproportion between hostile elements of any kind and the survival resources that are available to counterbalance them in the shortest period of time (7). Disasters destroy organized community support mechanisms and result in an overwhelming number of casualties (8).

GENERAL TRIAGE TECHNIQUES

All accepted methods of triage are based on the principles of the Simple Triage and Rapid Treatment (START) Plan (9), and all are subject to under- and over-triage (7). An undertriage rate of 5% is considered acceptable (10); anything higher may lead to unnecessary morbidity and mortality in severely injured but potentially salvageable patients. An overtriage rate of about 50% is acceptable (11), to minimize the number of patients who are undertriaged.

Practically, patients are categorized into one of three groups: 1) immediate care; 2) delayed care; and 3) unsalvageable. Numbers, colors or symbols may be used to denote the different triage categories. For example, red (priority 1) tags are attached to patients

allocated to the immediate-care group, yellow tags (priority 2) to the delayed-care group, and black tags to unsalvageable patients. In Israel, we have added the blue tag to identify children and a gray one to identify patients with a combined injury (induced, for example, by chemical and conventional weapons). Some teams prefer a site-based categorization. No matter what the method, the signs need to be appropriate and clear.

In general, ambulatory patients are automatically triaged for delayed care. For others, categorization is based on vital signs. A quick look will determine if the patient can verbally respond and if the airway is open. Otherwise, the physician performs a simple chin lift or jaw thrust maneuver, or attempts removal of oral debris. If there is no respiration after the airway is opened, the patient is declared dead. After respiration, the pulse and capillary refill are checked, and if there is no peripheral pulse or capillary refill is delayed, the patient is triaged for immediate care. If a good peripheral pulse exists and capillary refill is normal, the patient is triaged for urgent care. Any ongoing bleeding should be stopped.

SPECIAL CONSIDERATIONS IN CHILDREN

Children have unique physiologic and anatomic characteristics and differ from adults in several ways.

1. Mechanisms of injury

Head injury. Head injuries account for approximately 60% of all MCE and disaster injuries in the pediatric population. This high rate can be explained by the large and heavy heads of

children relative to their bodies. Furthermore, in states of unconsciousness, children's upper airways tend to get obstructed by their relatively large, flaccid tongue or kinked because of the large head flexion induced by the short occiput.

Skeletal injury. Children have more pliant and flexible bones than adults and are therefore subject to fewer bone fractures. However, internal organ injuries in the absence of fractures of the overlying bones, in the chest or upper abdomen for example, are not uncommon (12).

Thermoregulation. The less mature thermoregulatory mechanism in children and higher surface area-to-mass ratio compared to adults make heat loss and hypothermia more common in the pediatric population, particularly during exposure to extreme conditions, such as cold weather, decontamination with cold water during biochemical events, or when undressed at triage.

Blood loss. As children have relatively small amounts of blood (80 ml/kg), what may seem to be minor bleeding may in effect represent a significant volume loss and severe shock. Their cardiovascular system is generally free of chronic disabling conditions, therefore, children may tolerate hypovolemic stress better than adults.

Emotional trauma. In addition to physical injuries, emotional trauma, caused for example by separation from the parents, is an important factor in pediatric care.

2. Prognosis

Children tolerate multiple organ injuries better than adults (12), and prognosis usually depends on the severity of the head injury, if present (13). Children have a better prognosis for most, if not all, disaster-related conditions.

3. Triage

The patient's ability to walk is an important criterion in the initial decision-making process. In nonambulatory patients, triage is based on the radial pulse and the motor component of the Glasgow Coma Scale (8). However, infants are unable to walk, and older children are usually strapped to a stretcher by the time they get to the emergency department. Furthermore, communication with children in the preverbal stage may be difficult, and older children may be terrified and refuse to cooperate.

TRIAGE IN THE PEDIATRIC ED

In general, the principles of triage are the same for children and adults, though the priority of children over adults within the same categories is controversial. The Save the Children Fund in 1923 and UNICEF in 1990 declared that children must receive relief first, but this recommendation is not universally accepted (14).

Several researchers introduced assessment tools to aid clinicians in the triage process, such as the Pediatric Trauma Score (with the Eichelberger modification) (13) and the algorithm proposed by Mackway-Jones et al. (4). Both of these, however, have been found to have some major limitations (15):

1. Young infants cannot walk and are therefore immediately categorized as priority 2 at least.

2. There is no airway-opening maneuver.

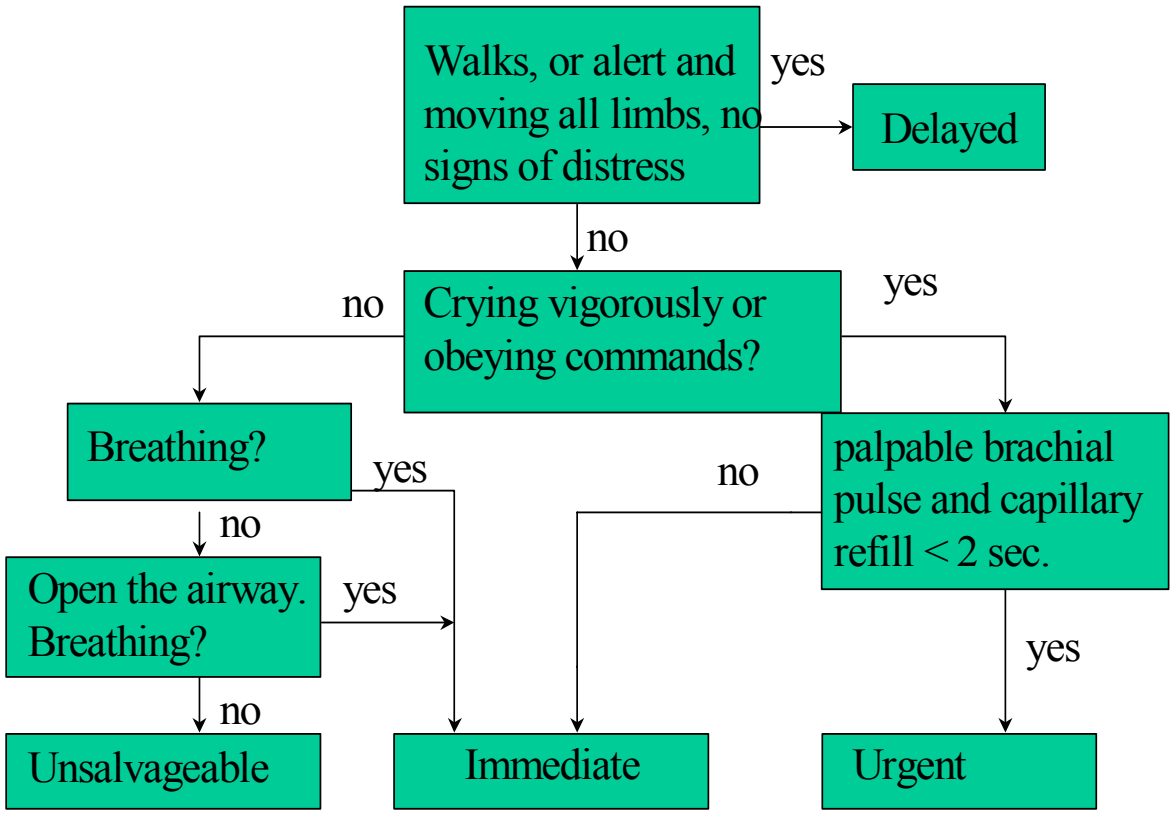
3. The methods require blood pressure measurement which is difficult to perform and time-consuming in children in crises.

4. The methods do not account for differences in physiological parameters with age.

In consequence, on the basis of our broad experience, we have formulated a new algorithm for pediatric triage in mass casualty events (Fig. 1) which has several advantages over the earlier ones: It eliminates time-consuming vital signs measurements; takes into account the level of consciousness in children too young to walk; and uses four priority categories instead of three: 1- immediate care/shock room; 2 - urgent care/emergency department; 3 - delayed care; and 4 - unsalvageable. In view of the lack of objective measurements for triaging children, our algorithm emphasizes the need for clinician experience in pediatrics and trauma care for the quick and accurate assessment of respiratory, circulatory and central nervous system function in this age group. The most important decision of triage is rapidly identifying patients in category 1. As noted in the work of Hirshberg et al. (8), and supported by our own experience, of the patients in the immediate-care group, it is particularly important to identify critically injured children who require treatment in shock rooms, and of those in the delayed-care group, it is important to identify children with anxiety and acute emotional stress who need to see a social worker or mental health professional. A finding of bradycardia is an indication for the shock room, and of

tachycardia, for the immediate-care group. Children with bleeding are assigned to the immediate-care group as well.

Figure 1: Authors Algorithm for Mass Casualty Pediatric Triage



Differences between conventional triage systems and mass casualty triage formulated by us are summarized in Tables 1 and 2.

Table 1: Main Differences Between Conventional Triage systems and the Mass Casualty Triage Formulated by Authors

Parameter	Conventional Triage	Mass Casualty Triage (Used by Authors)
Triage site	Inside emergency department	Outside emergency department
Triage professional	Nurses	Senior physician
Assessment technique	Clinical + physiological measurements	Clinical
Measurement of vital signs	Required	Not performed
Extent of resuscitation	Maximal care for every patient	Unsalvageable category implemented
Decision to transfer	Performed after initial care	From triage, according to patient condition and availability of local resources

Table 2: Routine Medical Practices Unaltered Between Conventional Triage Systems and Mass Casualty Triage Formulated by Authors

Parameter	Conventional and Mass Casualty Triage
Extent of Care	Immediate attention to airway, breathing and circulatory emergencies in a potential viable patient
Pain Management	Appropriate management of pain
Patient Assessment	Systematic, though abbreviated in mass casualty event
Reassessment	Frequent reassessment for changes in status

PREPARATIONS FOR TRIAGE

Total hospital preparedness to cope with mass casualty events and disasters requires intensive, multidisciplinary efforts (16), and the details are beyond the scope of this manuscript. Regarding triage, the following preparations are necessary.

Triage and treatment sites

Triage site: Ideally the triage site is located outside the emergency department (ED), between the area for ambulance unloading and the entrance to the ED. At the triage site, patients are categorized to one of the four designated sites. Mistriaged patients may be provided care at the wrong site or transferred to the correct one.

Immediate-care site: The ED is reserved for patients in the immediate-care and urgent-care categories. Patients in the immediate-care category who require treatment in the shock room are isolated. In a general facility, a separate area in the ED should be designated and equipped for children.

Delayed-care site: An area outside the ED but in close proximity to it should be reserved for delayed-care patients. A large waiting room, outpatient clinic, or hallway not normally used for patient care may be used. Again, a separate area is set-aside for children. Carts with appropriate equipment for this level of care should be prepared in advance and brought to the site at the time of the event. Equipment preparation should take into account cases of undertriage of immediate-care patients. The path from the triage site to the delayed-care site should not cut through the ED.

Patient registration is done at the bedside.

Patient Flow

Patient flow must be in one direction only. Easy-to-read signs and arrows directing staff and ambulatory patients to the appropriate treatment site should be prepared in advance and hung at the time of the event. Walkie-talkies or other means of communication among

personnel and among the different treatment sites should be stocked and provided as necessary.

Manpower

The triage site should ideally be staffed by two experienced physicians, one with expertise in emergency medicine and the other with expertise in pediatrics, pediatric emergency medicine, or critical care. The physicians should be assisted by one nurse each for tagging patients and delivering care. In addition, auxiliary personnel are needed to carry stretchers; security guards should also be placed. At least one physician and nurse should be available for each patient admitted to the immediate-care site. All medical staff assigned to triage must be specially trained in the necessary techniques.

The Karnei Shomron Event as an Example

On February 16, 2002, at 20:00 hours, a suicide bomber exploded himself at the entrance to the local "Burger Ranch" (fast food restaurant) in Karnei Shomron. Over 24 men, women and children were injured. Victims were treated on scene and evacuated by our national EMS system, Magen David Adom, to 4 different hospitals in order to avoid overwhelming of a single facility. Of the 24 victims, 14 were brought to the combined (adult & pediatric) treatment site of the Beilinson Medical Center (Level 1, trauma center, general hospital) and the Schneider Children's Medical Center of Israel (pediatric tertiary care facility). Of them 10 were children and adolescents aged 1 - 18 years, 4 were adults. ED triage decisions of these victims, including time of arrival, type of injury, triage category and outcome are listed in tables 3 and 4, and schematically shown in figure 2. Some of the typical injuries are shown in figure 3.

Table 3: Karnei Shomron MCI Event - February 16, 2002

Pt. #	Time of Arrival	Age/ years	Type of Injuries	Category	Out.
1	20:25	14	Burns, inh. injury	Immediate	S
2	20:32	23	Burns, breast, pelvis(P)	Immediate	S
3	20:39	25	Head, eye, ankle (P,N)	Immediate-SR	S
4	20:45	16	Head & all body(P,N), mandible(O,F), foot (P)	Unsalvageable	D
5	20:46	20	Base of skull & arm (F)	Immediate-SR	S
6	20:49	14	Abdomen (P), arm(F)	Immediate-SR	S
7	20:50	10	Foot & hand (P,N)	Delayed	S
8	20:52	1	Open brain injury	Unsalvageable	D

(P)=penetrating injury; (N)= nail; (F)=fracture; (O)=open; SR=shock Room; Out.=outcome;S=survivor; D=Dead

Table 4: Karnei Shomron MCI Event - February 16, 2002 (cont.)

Pt. #	Time of Arrival	Age/ years	Type of Injuries	Category	Out.
9	20:54	40	Facial bruises	Delayed	S
10	20:58	20	Face, neck, thyroid (P)	Immediate	S
11	21:00	18	Groin (P)	Delayed	S
12	21:08	14	Heart, back, pelvis (P,N) Facial burns, inh. Inj.	Unsalvageable	D
13	21:38	45	Burns, abdomen (P,N)	Immediate	S
14	21:40	15	Back (P,N)	Delayed	S
15	22:19	14	Acute stress disorder	Delayed	S
16	22:38	16	Head, back (P,N)	Unsalvageable	S

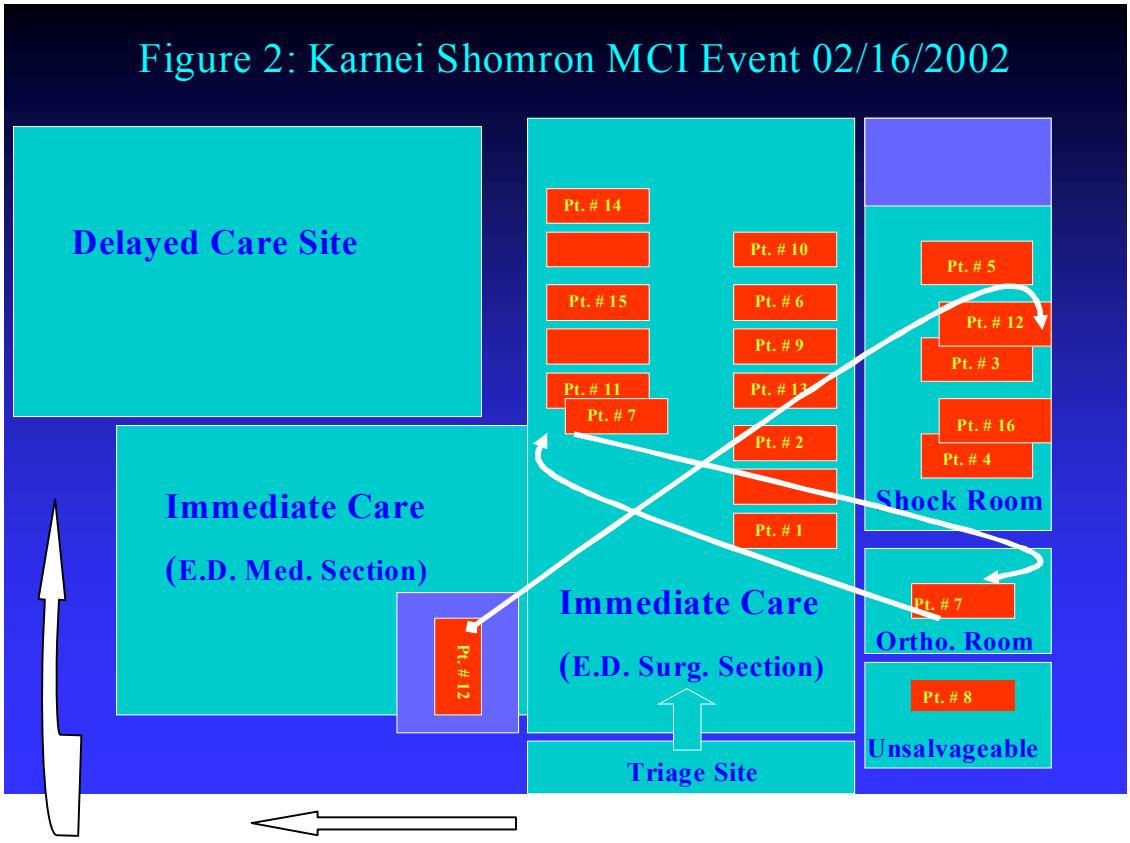
(P)=penetrating injury; (N)= nail; (F)=fracture; (O)=open; SR=shock Room; Out.=outcome;S=survivor; D=Dead

Addendum to tables 3 and 4:

1) Patients suffered from severe blast injuries and from high velocity penetration of nails included in the bomb (fig 3).

2) All unsalvageable patients were evacuated from scene due to available manpower.

3) Only 1 patient was a young child (patient 8); he was declared dead on scene. Of the 10 children involved, 3 were triaged as unsalvageable and died. 1 child who was triaged as unsalvageable on scene, survived (no. 16). He was transported from ED to a neurosurgical procedure. 4 children who were triaged as “Delayed ” on scene, were sent to Immediate care area on ED-triage, 2 of them suffered from shock.



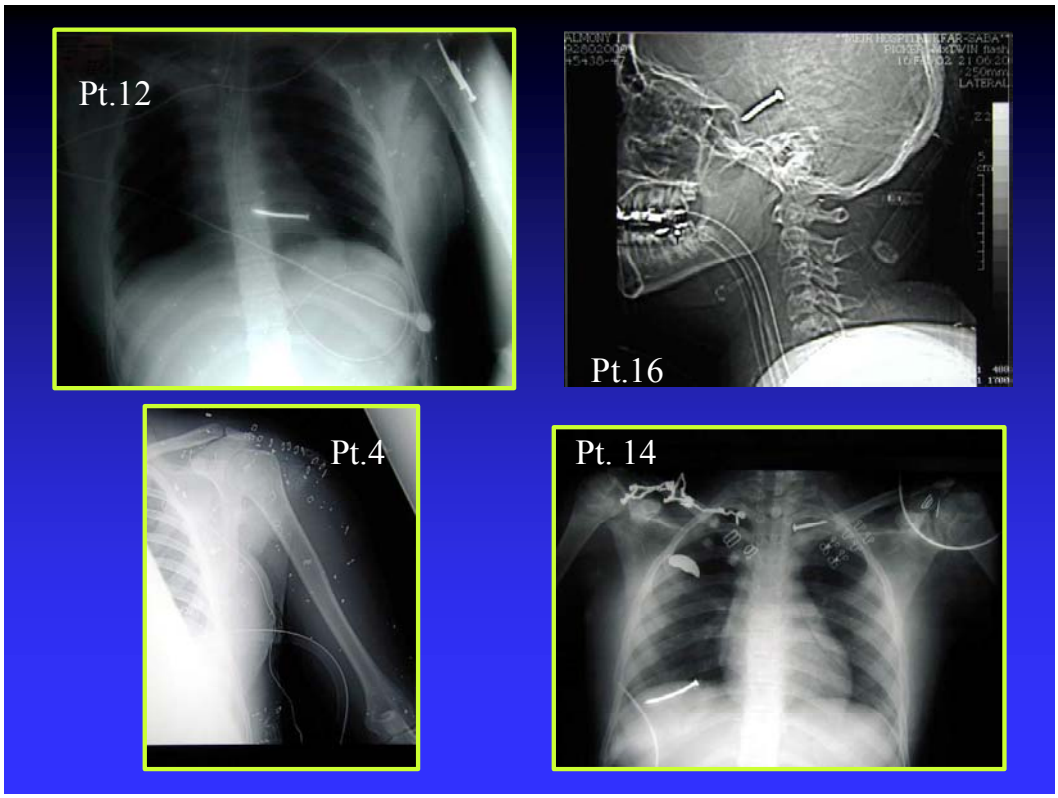
Addendum to figure 2:

1) Three beds only in Shock Room. Time differences allowed more than one pt./bed

2) Some of the patients triaged as immediate care-SR room were eventually treated in immediate care site because of lack of room in SR at a given time

3) Pt. 7 was moved to Ortho. Room for a procedure

Figure 3: Some of the typical penetrating injuries with nails, nuts and shrapnel's of patients from the Karnei Shomron MCI event.



This event represents our triage principles in the setting of suicide bombing attack, based on our previous experience:

1. We are trying to use maximal manpower to evacuate as much patients as possible in order to save time and for allowing ED re-evaluation of field triage.

2. START principles on scene-triage. Our modified algorithm for infant's triage is recommended (this algorithm was not used on scene by the EMS personnel in this event).

3. Triage decisions must take into consideration not only type of injury, but also age. Overall, young children will usually be triaged to a higher category. We cannot provide specific recommendations as to how this parameter should be included in the decision making process.

SUMMARY

The appropriate triage of victims of mass casualty events or disasters will ensure optimal delivery of care and improve outcome. Triaging children poses an important challenge because the clinician's ability to rapidly and accurately assess vital signs, and the patient's cooperation, may be limited. The principles of triage are basically the same for children and adults. To account for certain unique characteristics of children, we proposed an algorithm using four triage categories, which emphasizes the role of senior physicians experienced in trauma care and crisis management. Attention is directed to the age of the patient and for children with emotional distress.

ACKNOWLEDGMNENT

The authors would very much like to thank Dr. Michael Stein, director, and Dina Alboher RN, trauma coordinator, from the Trauma Unit at the Beilinson Medical Center for collecting and providing the information on the Karnei Shomron MCI event presented in this manuscript, and for their ongoing, strong and wonderful collaboration with trauma patients in both institutions.

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