Aust. N.Z. J. Surg. (1999) **69**, 603–608

ORIGINAL ARTICLE

AN AUSTRALIAN MASS CASUALTY INCIDENT TRIAGE SYSTEM FOR THE FUTURE BASED UPON TRIAGE MISTAKES OF THE PAST: THE HOMEBUSH TRIAGE STANDARD

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Background: The purpose of this study was to create a system of mass casualty incident triage that provides a common language platform for both ambulance and hospital personnel based upon standard daily operating procedures for both groups.
Methods: An annotated literature review was conducted.
Results: The Homebush Triage Standard taxonomy consists of five categories: immediate, urgent, not urgent, dying and dead, which are given the phonetic alphabet designations of Alpha, Bravo, Charlie, Delta and Echo, respectively, to facilitate radio voice communications. Colours are assigned to each category: red (Homebush Red), yellow (Homebush Gold), green (Homebush Green), white and black comply with Standards Australia AS-2700 1996 Colour Standard for General Purposes, to ensure triage materials have consistent production standards. Numbers are reserved to either quantify or stratify individuals within a particular triage category. The Homebush Triage Standard methodology is based on START (Simple Triage Assessment and Rapid Transport) and SAVE (Secondary Assessment of Victim Endpoint) and documents triage priority using geographic triage with triage flags, instead of triage tags.
Conclusion: The Homebush Triage Standard provides a basis for both seamless patient reassessment at all points along the casualty evacuation chain and the audit of the medical response to mass casualty incidents. It allows hospital and ambulance staff to keep working using familiar routines and removes fundamental barriers to good communication during a time of crisis.

Key words: disaster planning, disaster triage, emergency department triage, emergency medical services, mass casualty incident.

INTRODUCTION

The combined effects of an ageing population, the trend towards day and minimally invasive surgery, plus the increasing cost pressures upon hospitals have significant implications upon the availability of health resources during a mass casualty incident (MCI). There are no universal definitions of what constitutes either a disaster or an MCI within Australia. A 'disaster' is said to have occurred when normal community and organizational arrangements are overwhelmed by an event and extraordinary responses need to be instituted.[1]

When available medical resources are overwhelmed by casualties, transport and treatment priorities need to be assigned to individuals to ensure limited medical resources are used efficiently. The term *triage* was transposed from French into the English language during the First World War to describe the process of sorting casualties for treatment priority by the American Army Medical Corps.[2] Casualty triage is the most important medical function during an MCI and accurate triage a major determinant of an individual's survival.[2–4]

This study reviews the evolution of triage and factors that can potentially interfere with the triage process and compromise the medical response to an MCI. This information is then used to synthesize a triage system to provide a common platform so that patient priorities at the incident site can be interfaced with those arising within receiving hospitals.

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Accepted for publication 1 April 1999.

HISTORICAL PERSPECTIVES OF MCI TRIAGE

The advent of gunpowder and the development of the rifle forced infantry into linear battle formations. As battlefields became larger it became increasingly more difficult to locate wounded soldiers who were left where they fell until the end of battle. After the completion of battle, wounded were evacuated and treated according to rank, which included the removal of dead nobles taking priority over wounded common soldiers.[5]

Dominique Jean Larrey, Surgeon General to Napoleon's Army of the Rhine, introduced a major revolution in combat casualty care. Larrey's philosophy was to rescue casualties during battle with a dedicated corps using purpose-built wagons, the *ambulance volantes*, and rapidly transport them to a central collection point. Here the most seriously wounded would be operated on, without regard to rank or distinction, by either the Surgeon-in-Chief or a competent surgeon under his direction.[6] In 1792 Larrey personally led his *ambulance volantes* to treat wounded French soldiers in the field and transport them from the front line during the battle against the Austrian Army near Königsberg.[7]

In 1807 at the Battle of Eylau against the Russian Army, Baron Larrey, now Surgeon-in-Chief to Napoleon's Grand Army, gave treatment based on medical need but with priority to the wounded of Napoleon's Imperial Guard over other wounded French soldiers.[8] In spite of Larrey's pioneering example, during the American Civil War in 1862 approximately 3000 wounded Union soldiers were left virtually unattended and untreated for 3 days after the second battle of Bull Run.[9]

In 1846 British Naval surgeon Dr John Wilson described the principles of MCI triage. Dr Wilson classified combat injuries into slight, serious and fatal and described a system of treatment

priority directed towards the control of life threatening haemorrhage: 'To a serious bleeding everything must of necessity at once give way, and the vessel be secured'.[10] Dr Wilson advocated that the treatment of those with fatal injuries be restricted to 'a stimulus, an opiate, a proper easy position'.[10]

In the Second World War the procedure of patient triage was regarded as the biggest single factor contributing to survival following abdominal wounds in the US Army.[11] In the Korean War the application of a four-tiered triage system (i.e. immediate, delayed, minimal and expectant) led to a striking improvement in casualty survival.[12] The combination of triage, advanced resuscitation and rapid helicopter evacuation of casualties in the Vietnam War contributed to reducing mortality rates down to 1%, compared with the 4.7% observed during the Second World War.[13]

GOALS OF MCI TRIAGE

The primary objective of military triage was to identify those wounded soldiers who could be treated rapidly and returned to the battlefield.[13] In civilian practice, the triage process attempts to achieve the greatest good for the greatest number of patients.[1–4,14] Traditional individual doctor–patient relationships are overridden by a collective medical responsibility to the group of casualties.[3,14,15]

In general there is no role for cardiopulmonary resuscitation during an MCI except in cases of lightning strikes involving multiple individuals.[1] Here medical efforts should be directed at those victims in cardiorespiratory arrest since the majority of other victims will make a good recovery.[16] Normal triage priorities may be reversed for casualties involved in highly toxic hazardous material exposures where decontamination and treatment priority should be directed at the uninjured and even asymptomatic patients.[17]

The success of the triage process as a means of minimizing preventable deaths during an MCI depends upon being able to rapidly identify those casualties at the extremes of care. Medical resources are diverted from those who will either die or recover irrespective of the medical care they receive and concentrate on those critically ill casualties with a reasonable probability of survival.[1,3,13,14]

PROBLEMS WITH MCI TRIAGE

During an MCI, triage is approximately 70% accurate but with a tendency to underestimate injury severity.[14] This underscores the need for triage to be viewed as a process of repeated casualty reassessments until the patient receives definitive care. The difficulties in making rapid value judgements based upon relative percentage survival probabilities[3,12,18] adds to the emotional stress upon the individual attempting to perform casualty screening assessments in a hostile environment during an MCI.[19]

Triage accuracy is also adversely affected by other factors including the physiological ability of the young to compensate for hypovolaemia, altered perceptions of pain in high stress situations[20] and neuropsychiatric reactions among surviving casualties.[21]

MCI TRIAGE CONSIDERATIONS FOR SINGLE PRACTITIONERS IN ISOLATED LOCATIONS

The limited resources and long transportation times dramatically reduce the threshold of what constitutes an MCI in isolated locations and creates unique ethical and practical difficulties in managing incidents. Collective experience from the Korean and Vietnam wars provides some triage guidance in delayed management of penetrating trauma (Table 1).[22,23]

MCI TRIAGE CONSIDERATIONS FOR HOSPITALS

Hospitals must have triage systems to cope with potential incidents in close proximity to their facility where a large number of casualties can present without warning before an emergency medical system (EMS) response has been initiated.[24] In addition, large numbers of casualties may be transported directly to the hospital from the incident scene by EMS vehicles[25] or they may simply overwhelm established EMS field triage and treatment posts, and then move *en masse* to the nearest hospital.[26]

The hospital triage process has to be fluid as well as continuous and capable of dealing with incidents where the major casualties are medical rather than surgical.[16,18,27] During an MCI hospitals have to integrate casualty triage with the triage of normal daily emergency presentations.[28] In addition there may be an increase in normal daily emergency presentations from ischaemic heart disease or exacerbations of airways disease in response to the occurrence of an incident.[29,30]

Special triage situations can arise when hospital resources are either damaged[31] or have to be abandoned during an incident.[28,32] Staffing shortages can suddenly arise as healthcare workers spontaneously evacuate their families in anticipation of a hazard or cannot reach hospitals due to disruption of transport links.[32] Hospital triage decisions may also have to take into account those outpatients normally dependent on domiciliary medical services who may have to be admitted should an incident temporarily prevent these services from being delivered.

Table 1. Triage criteria for penetrating trauma when patient evacuation will be inherently delayed.

Injury	High evacuation and treatment priority	Low evacuation and treatment priority
Penetrating abdominal wounds	Individuals who can access definitive surgical treatment within 6 h of injury.	Survival after 12 h without operative care.
Major vascular injury in an extremity	Individuals who can achieve vessel reconstruction within 10 h of injury.	If vessel reconstruction cannot be achieved within 10 h direct ligation of the vessel will result in limb loss in 50% of cases.
Penetrating head injuries	Unstable patients with evolving neurological signs.	Individuals who are stable, conscious with either no deficit or moderate paresis or hemianopia can survive for 36 h without neurosurgical care with appropriate fluids, wound care and antibiotics.

OPERATIONAL DIFFICULTIES WITH MCI TRIAGE

Over the years a variety of different triage systems,[14,23,33–39] along with differing triage tag designs to document casualty triage status, have been developed.[23,34–39] The crash of a Boeing 737–400 in 1989 at Kegworth in the United Kingdom occurred on the boundary of three different counties whose respective ambulance services used a different system of MCI triage. This incident highlights the avoidable confusion that can arise when responding personnel attempt to use different triage systems and triage tags during an incident.[40,41]

Experience has shown that the key operational principle for an efficient disaster response is to ensure staff work as near as practical to their normal daily routines.[42–44] Planning must be based upon what people are likely to do in the stress of an MCI and procedures should be kept simple and practical.[14,45] Accordingly, a triage system must have a simple structure and be based on normal daily operating procedures that can also be applied during an MCI.

THE HOMEBUSH TRIAGE TAXONOMY

There are clear benefits from the standardization of disaster responses within Australia.[46] A national MCI triage system will mean that in the event of an MCI, both hospitals and ambulance services are already using familiar common terminology which will allow effective and efficient communications under stressful circumstances.

Table 2. The Homebush triage taxonomy

Classification	Priority	Priority code	Colour	Colour number*
Immediate	Top	A (Alpha)	Red (Homebush Red)	R22
Urgent	High	B (Bravo)	Yellow (Homebush Gold)	Y26
Not urgent	Low	C (Charlie)	Green (Homebush Green)	G27
Dying	Terminal care only	D (Delta)	White	N14
Dead	Not applicable	E (Echo)	Black	N61

*Standards Australia AS-2700 1996 Colour Standard for General Purposes.

A triage system must rapidly screen both children as well as adults, be cost effective, and operable in adverse conditions if it is going to be relevant to single practitioners in isolated areas.[13,47] The dead and human body parts should be clearly and individually labelled as soon as possible to avoid time being wasted reconfirming death[2,14] and to prevent the dead being transported to an active treatment area.[48]

A simple triage taxonomy with four active treatment levels has been previously used in MCI situations.[12,49–51] Increasing the number of categories has not improved the system.[50] The Homebush triage taxonomy uses these triage priorities as a common core for both prehospital and hospital emergency department operations (Table 2). Simple mechanisms can expand the four core active treatment groups if required for emergency department quality assurance purposes.

Using standard colours (i.e Standards Australia AS-2700 1996 Colour Standard for General Purposes) means there will be consistent production standards for triage materials. Providing a common triage language for all healthcare responders eliminates potential communication problems associated with using different terminology. The use of phonetic triage priority codes instead of numerical codes takes into account the problems with radio voice transmission. Numbers are reserved to either stratify patient priorities within a particular triage category, or to quantify the number of casualties within a particular triage category.

In an overwhelming situation there will be patients for whom the difficult decision not to treat must be made.[52] However the decision on what constitutes a non-survivable injury is a balance between the magnitude of the incident, an individual casualty's relative probability of survival, and the capacity of available medical resources at different points in the casualty evacuation chain.[3,15]

A specific triage category for dying patients provides clear management directions for those patients assessed as being beyond help either at the incident site,[53] the casualty collection point, the emergency department[2,51,54–57] or on the operating table.[58] The introduction of this classification into daily emergency department operations identifies those patients with advance medical treatment directives and directs appropriate care to patients with terminal chronic illnesses.

HOMEBUSH TRIAGE METHODOLOGY

The Simple Triage and Rapid Treatment (START) and Secondary Assessment of Victim Endpoint (SAVE) attempt to

Table 3. The Simple Triage and Rapid Treatment (START) Triage Scheme (modified)

Walking → Yes → Not urgent → Triage Priority Charlie (Homebush Green)
↓
No → Breathing with airway manoeuvres → No → Dead. Triage Echo (Black)
↓
Yes → Obey command → No → Immediate. Triage Priority Alpha (Homebush Red)
↓
Yes → Radial pulse present → No → Immediate. Triage Priority Alpha (Homebush Red)
↓
Yes → Respiratory rate > 30 → Yes → Immediate. Triage Priority Alpha (Homebush Red)
↓
No → Urgent. Triage Priority Bravo (Homebush Yellow)

Reprinted with the permission of Prehospital and Disaster Medicine. Combining START with the Homebush triage taxonomy allows a simple triage decision tree to be developed.

Table 4. Secondary Assessment of Victim Endpoint (SAVE) guidelines

Mangled Extremity Severity Score (MESS) (64) to assess crush injury to extremities
Glasgow Coma Score less than eight in adults with significant head injury
Abdominal trauma with refractory hypotension
Chest trauma with abnormal vital signs
Spinal trauma
Burns with < 50% probability of survival or adults over 60 years of age with an inhalational injury
Adults with pre-existing diseases
Non-traumatic emergencies
Special triage categories such as health-care workers with minor injuries who with simple treatment may be able to assist in the medical response

apply the principles of evidence based medicine to disaster triage.[33] Simple Triage and Rapid Treatment triage has been used successfully at several MCI within the USA. These include the 1995 Oklahoma City bombing, the 1992 bombing of the New York World Trade Center, Hurricane Andrew, and the 1989 Northridge earthquake (C Schultz, pers. comm.).

The simplicity of START (Table 3) allows it to be performed rapidly as a quick screening tool and can be easily remembered as:

1. Anyone who does not breathe with simple airway manoeuvres is dead.
2. Anyone who can walk is assigned a not urgent triage priority.
3. Anyone who cannot walk but can obey commands, with both a radial pulse being present and a respiratory rate less than 30 b.p.m., is assigned an urgent triage priority.
4. Anyone else has an immediate triage priority. Secondary Assessment of Victim Endpoint guidelines look at a number of parameters (Table 4) which are designed to answer two key triage questions at a major incident site:[33]
5. What is the victim's prognosis if minimal treatment is provided?
6. What is the victim's prognosis with the treatment resources available at the area medical centre?

There has never been a situation to date that has required the implementation of both START and SAVE triage criteria.

PAEDIATRIC TRIAGE

The basic principles of triage remain the same for children as they are for adults.[59] The START methodology will tend to overtriage children. This is acceptable given the higher probability of children surviving head injury[60] and multiorgan system failure compared with adults,[61] along with the fact that most blunt abdominal trauma is managed conservatively in children compared with adults.[62] The initial Glasgow Coma Score following head injury in children does not reliably predict outcome unless there is associated hypoxia and hypotension present.[63]

TRIAGE DOCUMENTATION

Triaging patients into geographic areas has been raised as an alternative to the use of triage tags.[2,44,65,66] Geographic triage provides a major time saving benefit in triage documentation, especially when there is a large influx of patients.[3,13,44,67] In a series of six major air accidents within the USA the largest incident, involving 297 people with 59 critically injured and 124 less severely injured, had the shortest prehospital time using geographic triage instead of triage tags, combined with efficient ground and rotary wing transport systems.[68]

Triage is generally carried out once the casualties have been taken to a casualty collection point.[14,44,69] Triage flags provide the first ambulance on scene at an MCI with the capability to lay the foundation for the site medical response irrespective of the number of casualties. Geographic triage may reflect the normal disposition of trauma patients at an incident and can assist single practitioners with limited site resources to triage casualties efficiently.[65]

The casualty profile following an MCI typically has 6 to 25% of patients requiring medical or surgical treatment within 12 h to prevent loss of life or severe morbidity.[68,70] The bulk of the casualty load consists of patients with non-urgent injuries who have little to gain from immediate medical care. Using expensive triage tags to identify them or label dead bodies is an inappropriate use of resources, especially in large scale MCI.[2,3,67] In 1974 a Turkish DC10 crashed into a forest at Ermenoville, France killing 345 people. Nearly 20 000 fragments of human tissue were produced from the impact with the remains of 188 victims subsequently positively identified (PJ Stuart, pers. comm., 1998).

Triage procedures should avoid unnecessarily complicating the subsequent investigation of the incident. Labelling human remains with numbered chemically resistant tags helps to document the location of human body parts and their relationship to objects, such as motor vehicles, at the scene. This facilitates their systematic removal from the site for subsequent forensic examination and can play an important role in victim identification.

CONCLUSION

Australia has the opportunity to build upon past experience and develop a nationally integrated system of casualty triage. Appropriate preplanning can mitigate some of the problems that complicate the triage process, but those involved in the medical response to an MCI must have a common language and understanding of triage issues to remove existing fundamental barriers to good communication.

ACKNOWLEDGEMENT

The authors would like to acknowledge the assistance of Ms Anne Newton in the formulation of the manuscript.

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