An Australian mass casualty incident triage system for the future based on mistakes of the past: The Homebush Triage Standard

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Introduction

The combined effects of an aging 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 a MCI within Australia. A 'disaster' is said to have occurred when normal community and organisational arrangements are overwhelmed by an event and extraordinary responses need to be instituted (Emergency Management Australia 1995).

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 (Rutherford 1989). Casualty triage is the most important medical function during a mass casualty incident (MCI) and accurate triage a major determinant of an individual's survival (Rutherford 1989; Waeckerle 1991; Fryberg *et al* 1988).

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. These are 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.

Historical perspectives 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. The wounded were then evacuated and treated according to rank including the removal of dead nobles taking priority over wounded common soldiers (Hamby 1967).

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 (Richardson 1974). In 1792 Larrey personally lead 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 (Leroy-Dupré 1862).

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 (Dible 1970). In spite of Larrey's pioneering example, during the American Civil War in 1862, three thousand wounded Union soldiers were left virtually unattended and untreated for three days after the second battle of Bull Run (Adams 1952).

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 hemorrhage, 'To a serious bleeding everything must of necessity at once give way, and the vessel be secured'. Dr Wilson advocated the treatment of those with fatal injuries be restricted to 'a stimulus, an opiate, a proper easy position' (Wilson 1846).

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 (Welch 1947). In the Korean War the application of a four tiered triage system, (immediate, delayed, minimal and expectant) lead to a striking improvement in casualty survival (Hughes 1976). 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 to the 4.7% observed during World War Two (Kennedy *et al* 1996).

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 (Kennedy et al 1996). In civilian practice, the triage process attempts to achieve the greatest good for the greatest number of patients (Emergency Management Australia 1995; Rutherford 1989; Waeckerle 1991; Fryberg *et al* 1988; Burkle 1984). Traditional individual doctor-patient relationships are overridden by a collective medical responsibility to the group of casualties (Waeckerle 1991; Burkle 1984; Llewellyn 1992).

In general there is no role for cardiopulmonary resuscitation during an MCI (Emergency Management Australia 1995) except in cases of lightening strikes involving multiple individuals. Here medical efforts should be directed at those victims in cardio-respiratory arrest, since the majority of other victims will make a good recovery (Myers et al 1977). 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 (Kirk *et al* 1994).

The success of the triage process as a means of minimising 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 concentrated on those critically ill casualties with a reasonable probability of survival (Emergency Management Australia 1995, Waeckerle 1991, Kennedy et al 1996, Burkle 1984).

Injury	High evacuation and treatment priority	Low evacuation and treatment priority
Penetrating abdominal wounds	Individuals who can access definitive surgical treatment within 6 hours of injury	Survival after 12 hours without operative care
Major vascular injury in an extremity	Individuals who can achieve vessel reconstruction within 10 hours of injury	If vessel reconstruction cannot be achieved within 10 hours 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 hours without neurosurgical care with appropriate fluids, wound care and antibiotics

Table 1: triage considerations for single practitioners in isolated locations

Problems with MCI Triage

During an MCI, triage is approximately 70% accurate (Burkle 1984) with a tendency to under estimate injury severity. 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 (Kennedy *et al* 1996; Hughes 1976; Wardrope *et al* 1991) adds to the emotional stress upon the individual attempting to perform casualty screening assessments in a hostile environment during an MCI (Spengler 1995).

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 (Beecher 1946) and neuropsychiatric reactions amongst surviving casualties (Burkle 1996).

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 (Moyasenko 1984; Coupland *et al* 1992).

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 (Caro *et al* 1973). In addition, large numbers of casualties may be transported directly to the hospital from the incident scene by EMS (Anderson *et al* 1977) or they may simply overwhelm established EMS field triage & treatment posts, and then move en masse to the nearest hospital (Maningas *et al* 1997).

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 (Myers *et al* 1977; Wardrope *et al* 1991; Buerk *et al* 1982). During an MCI hospitals have to integrate casualty triage with the triage of normal daily emergency presentations (De Lorenzo *et al* 1996). In addition, there may be an increase in normal daily emergency presentations from ischaemic heart disease or exacerbation's of airways disease in response to the occurrence of an incident (Duclos *et al* 1990; Leor *et al* 1996).

Special triage situations can arise when hospital resources are either damaged (Schultz *et al* 1996) or have to be abandoned (De Lorenzo *et al* 1996, Smith *et al* 1996) during an incident. Staffing shortages can suddenly arise as health care workers spontaneously evacuate their families in anticipation of a hazard (Smith et al 1981) or cannot reach hospitals due to disruption of transport links. Hospital triage decisions may also have to take into account those outpatients normally dependent on domicillary medical services who may have to be admitted should an incident temporarily prevent these services from being delivered.

Operational difficulties with MCI triage

Over the years a variety of different triage systems (Burkle 1984; Coupland *et al* 1992; Caro *et al* 1973; Hodgetts *et al* 1995; Lumley *et al* 1996; Mac Mahon 1985; Miller 1971; Baskett *et al* 1988) along with differing triage tag designs to document casualty triage status (Coupland *et al*1992; Finch *et al* 1982; Hodgetts *et al* 1995; Lumley *et al* 1996; MacHahon 1985; Baskett *et al* 1988) have been developed. 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 different systems 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 (Barton *et al* 1991; Malone 1990).

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 (Pepe *et al* 1991; Rutherford 1973; Vayer *et al* 1986). 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 (Burkle 1984; Mitchell 1986). Accordingly, a triage system must have 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 standardisation of disaster responses within Australia (Senate Standing Committee on Industry, Science, Technology, Transport, Communications and Infrastructure 1994). A national MCI triage system will mean, in the event of an MCI, both

Note

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

Classification	Priority	Priority code	Colour	Colour number[1]
Immediate	Top	A (Alpha)	Red (Homebush Red)	R 22
Urgent	High	B (Bravo)	Yellow (Homebush Gold)	Y 26
NOT Urgent	Low	C (Charlie)	Green (Homebush Green)	G 27
Dying	Terminal Care only	D (Delta)	White	N 14
Dead	Not Applicable	E (Echo)	Black	N 61

Table 2: The Homebush triage taxonomy

hospitals and ambulance services are already using familiar common terminology which will allow effective and efficient communications under stressful circumstances.

A triage system must rapidly screen both children as well as adults (Kennedy *et al* 1996; Klein *et al* 1991), be cost effective, and operable in adverse conditions if they are going to be relevant to single practitioners in isolated areas. The dead and human body parts should be clearly and individually labeled as soon as possible to avoid time being wasted reconfirming death (Rutherford 1989; Burkle 1984) and to prevent the dead being transported to an active treatment area (Faxon 1948).

A simple triage taxonomy with four active treatment levels has been previously used in MCI situations (Hughes 1976; Ammons *et al* 1988; Gans *et al* 1996; Williams *et al* 1974). Increasing the number of categories has not improved the system (Gans *et al* 1996). The Homebush triage taxonomy *(table 2)* uses these triage priorities as a common core for both prehospital and hospital emergency department operations. Simple mechanisms can expand the four core active treatment groups if required for emergency department quality assurance purposes.

Using standard colors[1] 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. This will facilitate the integration of military medical services in the event they were deployed to assist the civilian response of a large-scale MCI within a State. A single common triage system reduces the problems that military personnel would also face trying to interface with different civilian medical services especially with a large number of medical evacuations across State borders, where different systems of MCI triage are used.

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 (Parke *et al* 1992). 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 (Waeckerle 1991; Llewellyn 1992).

A specific triage category for dying patients provides clear management directions for those patients assessed as being beyond help either at the incident site (Fryberg 1988), the casualty collection point or emergency department (Rutherford 1989; Williams *et al* 1974; Sharpe 1985; Artuson 1981; Das 1983; Seletz 1990) or on the operating table (Burkle *et al* 1994). 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) (Benson *et al* 1996) attempt to apply the principles of evidence based medicine to disaster triage. START triage has been used successfully at several MCIs within the United States. These include the 1995 Oklahoma City Bombing, the 1992 Bombing of the New York World Trade Center, Hurricane Andrew, and the 1989 Northridge earthquake (Personal communication Dr Carl Schultz).

The START triage scheme

Walking → YES → Not urgent → Triage Priority Charlie (Homebush Green)
↓
NO → Breathing with airway maneuvers → NO → DEAD. Triage Echo (Black)
↓
YES → Obeys 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)

Table 3: The Simple Triage And Rapid Treatment (START) Triage scheme (modified). Combining START with the Homebush triage taxonomy allows a simple triage decision tree to be developed. Reprinted with the permission of Prehospital and Disaster Medicine.

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

- anyone who does not breathe with simple airway maneuvers is dead
- anyone who can walk is assigned a not urgent triage priority
- anyone who cannot walk but can obey commands, with both a radial pulse being present and a respiratory rate less than 30 breaths per minute, is assigned an urgent triage priority
- anyone else has an immediate triage priority

SAVE guidelines look at a number of parameters (table 4) which are designed to answer two key triage questions at a major incident site (Benson *et al* 1996):

- What is the victim's prognosis if minimal treatment is provided?
- What is the victim's prognosis with the treatment resources available at the area medical center?

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

SAVE Guidelines
• Mangled Extremity Severity Score (MESS) (Johansen et al 1990) 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 healthcare workers with minor injuries who with simple treatment may be able to assist in the medical response

Table 4: Secondary Assessment of Victim Endpoint (SAVE) Guidelines

Paediatric triage

The basic principles of triage remain the same for children as they are for adults (Holbrook 1991). The START methodology will tend to overtriage children. This is acceptable given the higher probability of children surviving head injury (Luerssen *et al* 1988) and multiorgan system failure compared with adults (Wilkinson *et al* 1986), along with the fact that most blunt abdominal trauma is managed conservatively in children compared with adults (Powell *et al* 1987). The initial Glasgow Coma Score following head injury in children does not reliably predict outcome unless there is associated hypoxia and hypotension present (Lieh-Lai *et al* 1992).

Triage documentation

Triaging patients into geographic areas has been raised as an alternative to the use of triage tags (Rutherford 1989; Vayer *et al* 1986; Vukmir *et al* 1991; Kerns *et al* 1990). Geographic triage provides a major time saving in triage documentation especially when there is a large influx of patients. (Waeckerle 1991; Kennedy *et al* 1996; Vayer *et al* 1986; Angus *et al* 1993). 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 (Anderson 1995).

Triage is generally carried out once the casualties have been taken to a casualty collection point (Burkle 1984; Vayer *et al* 1986; Orr *et al* 1983). 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 (Vukmir *et al* 1991) that can assist single practitioners with limited site resources to triage casualties efficiently.

The casualty profile following an MCI typically has 6 to 25% of patients requiring medical or surgical treatment within 12 hours to prevent loss of life or severe morbidity (Anderson 1995; Sklar 1987). 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 a large scale MCI (Rutherford 1989; Waeckerle 1991; Angus *et al* 1993). In 1974 a Turkish DC10 crashed into a forest at Ermenoville, France killing 345 persons. Nearly 20,000 fragments of human tissue were produced from the impact with the remains of 188 victims subsequently positively identified (Personal communication Mr. Peter J. Stuart).

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 communications.

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Acknowledgement

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

Declaration

This paper has been prepared without any funding from any organization or institution. The original manuscript was exclusively submitted to the Australian and New Zealand Journal of Surgery as an original work by the authors who retain the copyright over the manuscript.

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EMA Safer Communities Awards

EMA
Safer Communities Awards

From flood recovery processes to innovations in firefighting, the entries in this year's Emergency Management Australia (EMA) Safer Communities Awards have shown excellence in many areas of emergency management.

More than 75 entries were received from across Australia. They were submitted by State Government, Local Government, private sector and volunteer organisations, and covered both pre and post-disaster emergency management.

The innovation and leadership exhibited in the entries demonstrated real achievement in helping communities prepare for, as well as recover from, disasters such as flooding, cyclones or bushfires.

Following the selection of 26 winners at a State and Territory level, the judging panel chose the following eight National winners, with five commendations made to other entries. The winners were presented with their Awards at a ceremony hosted by the Minister for Defence, Mr John Moore MP, at Parliament House, Canberra, on 28 June 2000.

Department of Human Services, Gippsland (VIC)

Post-disaster category
Federal/State Government Stream

For its pro-active response in resourcing, implementing and monitoring the immediate welfare and recovery activities following the severe flooding of the East Gippsland Shire in 1998.

Wollongong City Council (NSW)

Post-disaster category
Local Government Stream

For the work of their geo-technical team which had the task of assessing landslide risks following flash flooding in the area. The team's knowledge and expertise saved valuable resources by evacuating only those who absolutely had to be evacuated.

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Australian Red Cross (NSW)

Post-disaster category
Volunteer Organisation Stream

For the work of the NSW State Enquiry Centre which acts as the humanitarian interface between people affected by a disaster. The centre also helps friends and families of those affected by a disaster.

Richard Bryant Post-traumatic Stress Disorder Unit, University of New South Wales (NSW)

Post-disaster category
Private Sector Organisation Stream

For his unit's work in developing the Acute Stress Disorder Scale (ASDS), the world's first scientifically derived instrument to identify individuals at risk of developing post-traumatic stress disorder.

NSW Fire Brigades (NSW)

Pre-disaster category
Federal/State Government Stream

For its Static Water Supply Program, which identifies static water resources such as backyard swimming pools in high-risk bushfire areas. Identification plates are placed outside the resident's property so that the water resource can be easily found during a fire.

Shire of Augusta, Margaret River (WA)

Pre-disaster category
Local Government Stream

For the development of a new memorandum of understanding which now means that emergency management procedures for Margaret River, Augusta, and surrounding towns are addressed at a local level.

New Norfolk Fire Brigade (TAS)

Pre-disaster Category
Volunteer Organisation Stream (joint winner)

For its Home Fire Safety Audit program which involves inspecting the homes of sick, aged or frail people in New Norfolk to ensure they are fitted with appropriate safety measures in the event of a fire.

Australian Red Cross (NSW)

Pre-disaster category
Volunteer Organisation Stream (joint winner)

For the development of its Team Leader handbook which, by containing step-by-step guides, forms, policies, practical exercises and background information, aims to better equip and support Team Leaders for the task of leading a Personal Support Team.

Commendations

Melbourne Water (VIC)

Pre-disaster category
Federal/State Government Stream

For work in improving community knowledge about urban flood risks, as well as promoting appropriate building development, following significant drainage work in the greater Melbourne area.

Albany Coastal Safety Committee (WA)

Pre-disaster category
Federal/State Government Stream

For its *Fish Safe, Be Coast Safe* public education program, designed to raise awareness about safety along the south coast of Western Australia.

NSW Fire Brigades and ACT Fire Brigade (NSW)

Pre-disaster category
Federal/State Government Stream

For the production of a CD-ROM which aims to train rescuers and volunteers in the principles of Urban Search and Rescue.

Gold Coast City Council (QLD)

Pre-disaster category
Local Government Stream

For its Nerang River flood mitigation project which aims to reduce the magnitude of river flooding, raise community awareness, as well as address land use controls.

Success Management International Learning Enterprises (NT)

Pre-disaster category
Private Sector Organisation Stream

For its four major hazard mitigation projects: the Public Cyclone Shelter Study: Greater Darwin region (1998); the Public Cyclone Shelter Study: Coastal Communities of the Northern Territory (1999); the Katherine District Flood Disaster Study (1998) and the Lifelines Northern Territory Study (1999).

The National judging panel commented that the task of picking the winners from the exceptional standard of entries was particularly difficult.

For more information on the EMA Safer Communities Awards visit the EMA website at www.ema.gov.au