Preface

Since the first edition of this book in 1988 and following editions in 1992, 1998, 2004 and 2009, emergency medicine has — fortunately — continued to advance. In this edition much new information, many new approaches and extensive refinements of existing clinical management have been incorporated. Again, current and respected practising clinicians have been chosen as authors for their clinical expertise and experience, so that they can compact their knowledge into the pocket-sized format. As healthcare resources continue to be stretched, the first hours of a patient’s illness or initial contact with healthcare providers, outside and inside a hospital, are even more critical to the outcome. It is also very pertinent given the challenge of re-engineering patient flow, e.g. the ‘4-hour rule’, which is coupled to funding. The aim of this book is to help with this initial contact.

Any suggestions for improving this will be very much appreciated: please send them to gfulde@stvincents.com.au.

Acknowledgements

Once again I am very grateful to the busy clinician authors for their excellent contributions. Also, the support and stimulation from many doctors, nurses, students and other professionals who use this book and have helped with ideas are greatly appreciated.

How do I adequately thank my wife, Lesley, for her unfailing encouragement and support?

Brigette Veen and Rory Banwell typed, collated, chased up details and much more; I most sincerely thank them.

Also, to all the fabulous staff of the emergency department who are so great to work with — not only are the patients lucky to have such people care for them, but also the way they support and care for each other is wonderful.

Disclaimer:
Every effort has been made to ensure that all the information contained in this book is correct and accurate. However, the publisher, editor and authors accept no responsibility for the clinical decisions, management or dosages given. The final responsibility rests with the treating doctor.

Gordian Fulde
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1 Cardiorespiratory arrest algorithms

During CPR
Airway adjuncts (LMA / ETT)
Oxygen
Waveform capnography
Plan actions before interrupting compressions
(e.g. charge manual defibrillator)

Plan actions before interrupting compressions

Drugs
Shockable
* Adrenaline 1 mg after 2nd shock
* Adrenaline 1 mg immediately (then every 2nd loop)
* Amiodarone 300 mg after 3rd shock
* Non Shockable
* Adrenaline 1 mg immediately

Consider and Correct
Hypoxia
Hypovolaemia
Hyper / hypokalaemia / metabolic disorders
Hypothermia / hyperthermia
Tension pneumothorax
Tamponade
Toxins
Thrombosis (pulmonary / coronary)

Post Resuscitation Care
Re-evaluate ABCDE
12 lead ECG
Treat precipitating causes
Re-evaluate oxygenation and ventilation
Temperature control (cool)

Figure 1.1 Adult cardiorespiratory arrest algorithm
Figure 1.2 Paediatric cardiorespiratory arrest algorithm
Figure 1.3 Neonatal cardiorespiratory arrest algorithm

2 Cardiac arrest drugs
The following tables have been adapted from the Australian Resuscitation Council Guidelines.

### Drugs routinely used in ADULT cardiac arrest

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<td>1 mg IV repeat every 2nd loop during CPR</td>
<td>VF/VT</td>
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<td>Asystole/PEA</td>
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<tr>
<td>Amiodarone</td>
<td>300 mg IV</td>
<td>VF/VT</td>
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<tr>
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<td>Additional dose of 150 mg IV can be</td>
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<td></td>
<td>considered that may then be followed by</td>
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<td></td>
<td>infusion of 15 mg/kg over 24 h</td>
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### Other drugs to consider in ADULT cardiac arrest

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<th>Dose</th>
<th>Indications</th>
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<td>5–10 mL IV of 10% calcium chloride</td>
<td>Hyperkalaemia</td>
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<td>Hypercalcaemia</td>
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<td>OD of calcium channel blockers</td>
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<td>Magnesium</td>
<td>5 mmol IV can be repeated once, then followed</td>
<td>Torsades de pointes</td>
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<td>with infusion (20 mmol over 4 h)</td>
<td>Cardiac arrest associated with digoxin toxicity</td>
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<td>VF/VT refractory to defibrillation and adrenaline</td>
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<td>Hypokalaemia</td>
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<td>Hypomagnesaemia</td>
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<td>Potassium</td>
<td>5 mmol IV</td>
<td>Persistent VF due to hypokalaemia</td>
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<td>Lignocaine</td>
<td>1 mg/kg IV</td>
<td>VF/VT where amiodarone cannot be used</td>
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<td>1 mmol/kg</td>
<td>Hyperkalaemia</td>
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<td>bicarbonate</td>
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<td>Treatment of documented metabolic acidosis</td>
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<td></td>
<td>Tricyclic antidepressant OD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prolonged arrest (&gt; 15 min)</td>
</tr>
</tbody>
</table>

### Drugs able to be given via endotracheal tube (ETT)
- Lignocaine
- Adrenaline
- Atropine
- Naloxone

Dilution with 0.9% may give better absorption.
*If unable to gain intravenous access, consider intraosseous (IO) access.*
# Drugs routinely used in PAEDIATRIC cardiac arrest

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose and route of administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenaline</td>
<td>10 microg/kg IV/IO = 0.1 mL/kg of 1:10,000 (max single dose = 1 mg) 100 microg/kg via ETT</td>
</tr>
<tr>
<td>Amiodarone</td>
<td>5 mg/kg IV/IO over 3–5 min</td>
</tr>
<tr>
<td>Defibrillation</td>
<td>4 joules/kg</td>
</tr>
</tbody>
</table>

## Other drugs to consider in PAEDIATRIC cardiac arrest

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose and route of administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td>20 microg/kg IV/IO (max 600 microg) 30 microg/kg via ETT</td>
</tr>
<tr>
<td>Calcium chloride 10%</td>
<td>0.2 mL/kg IV/IO</td>
</tr>
<tr>
<td>Calcium gluconate 10%</td>
<td>0.7 mL/kg IV/IO</td>
</tr>
<tr>
<td>Glucose (dextrose)</td>
<td>0.25 g/kg IV/IO = 0.5 mL/kg of 50% dextrose (via CVC only) = 2.5 mL/kg of 10% dextrose IV/IO</td>
</tr>
<tr>
<td>Lignocaine</td>
<td>1 mg/kg IV</td>
</tr>
<tr>
<td>Magnesium sulfate 50% (= 2 mmol/L)</td>
<td>0.1–0.2 mmol/kg IV/IO bolus 0.3 mmol/kg infusion over 4 h</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.03–0.07 mmol/kg IV/IO slow injection</td>
</tr>
<tr>
<td>Sodium bicarbonate (8.4%)</td>
<td>0.5–1 mmol/kg IV/IO</td>
</tr>
</tbody>
</table>
Chapter 22
Mass-casualty incidents, chemical, biological and radiological hazard contingencies
Iromi Samarasinghe and Jeff Wassertheil

Aims and objectives
Incidents involving mass casualties are infrequent. However, they have the potential to overwhelm usual health resources with very little notice. It is therefore important that contingencies are developed, tested and ready for immediate implementation. Such contingencies outline the responsibilities for overall medical control, coordination and effective casualty management in major emergencies and disaster situations. They include the procedures for triage, first aid and resuscitation, some of which require modification when resource availability needs to be rationed.

Response plans must provide a framework for coordination of transporting injured or incident-affected individuals to appropriate treatment sites. Plans must incorporate procedures to enable the presence of medical, nursing and first-aid personnel, as well as other welfare personnel and psychological carers, to provide care at the scene of a mass-casualty incident (MCI).

At a hospital level, plans need to be developed, implemented, rehearsed and evaluated. This enables hospitals that are often full to manage a large number of patients in excess of usual workloads or capacities and, in certain circumstances, victims with special or specific management needs.

Incorporation of public health resources and interventions is integral to provide guidance and procedures where hygiene, sanitation, communicable disease or biological hazards potentially exist. Contingencies must provide an interface for concurrent activation of recovery plans. Access to appropriate and timely psychological support for victims and care providers is included in both early and ongoing recovery phases. The overall objective is to mitigate disasters by participation in event planning and medical and emergency service activation and training.
This chapter focuses on the health service response to an MCI, as it is not within the scope of this book to describe other emergency services frameworks.

**Phases of a disaster**
The phases of disaster management are prevention, preparedness, response and recovery.

**PREVENTION**
The prevention phase concentrates on strategies that minimise the severity of an incident. It aims to cushion the severity, reduce the effects, minimise adversity and contain the impact of a disaster. Prevention strategies also include incorporation of lessons learned from previous experiences. Legislation ensures plans are in readiness for such eventualities.

**PREPAREDNESS**
Effort in optimal preparedness promotes effective and optimal resource allocation and consumption. This phase occurs with an expectation that the plan will at some time need to be activated. Preparedness occurs from within and external to the health service.

Planning includes providers from both within and stakeholders from outside the health service that would be expected to respond in accordance with emergency management contingency plans. Local community stakeholders—such as the police, ambulance and the fire department—as well as public health and recovery agencies should be included in health service planning committees. Likewise, health service representation should be included in local council, shire or regional planning committees.

As highlighted under prevention, the recommendations from previous operational debriefings, adverse incidents or experience are woven into response plans.

Preparedness of medical services involves training and accreditation processes for each facility to work in conjunction with other agencies. Exercises to coordinate resources within and across agencies are aimed at improving the preparation phase.

**RESPONSE**
This involves the activation of a pre-determined and well-rehearsed emergency plan to respond to multicasualty external disasters resulting in the rapid mobilisation of personnel and other resources to manage the surge of patients.
RECOVERY
Recovery contingencies are implemented and provide for the short- and long-term recovery of the community (victims and helpers) affected by the disaster. This includes the health service staff and the repair and reinstatement of physical resources, consumables and services. A coordinated approach is required to rebuild the infrastructure and economic, social and emotional needs of the affected community.

Administrative and legislative mandates
A national legislative framework for emergency management provides for counter-disaster planning for response to and recovery from emergency situations that take place throughout Australia, and provides a blueprint for state or territory response plans.

MANAGEMENT STRUCTURE
National
At the Commonwealth level, Emergency Medicine Australia (EMA) is responsible for guidance and support of disaster-management procedures within each of the states and territories.

- EMA will fund any nationally coordinated response, especially any international deployments. A national response is triggered when an affected state is overwhelmed by a disaster and asks for assistance; when there is a political interest in the response involving international aspects, media or border regions; or when there is a terrorist threat and the National Counter Terrorism Committee is required to respond.
- The Commonwealth can also engage defence forces if a civilian disaster requires defence assistance. This commonly involves transportation, whether in the form of trucks for carrying equipment or aircraft for transporting casualties back to Australian shores. Highly trained medical teams may also be available if not engaged in areas of conflict.
- The Commonwealth can provide expertise in emergency management and assistance with political and media management.
- The Commonwealth can coordinate state assets such as aeromedical capability and medical teams. Although these medical teams are state-based and are designed for intrastate deployment, in the event that a state is overwhelmed other medical teams can be coordinated for interstate deployment.
• In addition, the Commonwealth can coordinate any foreign offers of help.
• COMDISPLAN has been established to coordinate the provision of Australian government assistance in the form of physical assets by funding the interstate deployment of medical teams and resources to the state in crisis.
• AUSTRALIANMAPLAN allows the Commonwealth to become involved in a local incident if it is of national significance.
• OSMASSCASPLAN is a national overseas MCI response plan to deal with repatriation of Australian citizens, victims and nationals of other countries involved in an MCI in a foreign land.
• AUSASSISTPLAN involves Commonwealth funding, through the Department of Foreign Affairs and Trade (DFAT), for an MCI response in a foreign land. It differs from AusAid, which involves financial support from DFAT provided to a developing nation affected by a disaster.

State

Separate state emergency response plans, designed to provide long-term assistance to people and communities, are activated during the response phase of an incident to provide early commitment of resources. The principal role of the state Health Department is to deal with matters associated with the general health of the community and to provide health and medical services required as a result of a major emergency or disaster. Specific specialty plans for events such as shore retrieval, major burns management and terrorism and CBR (chemical, biological and radiation) incidents have been developed in order to harness a coordinated and cooperative multi-city response.

Very broadly, these state legislative frameworks provide for:
• disaster planning and response coordination of activities throughout the state to be enacted by the chief commissioner for police or nominated deputies
• roles and responsibilities of emergency services and support organisations for various types of emergencies or disasters
• the state Health Department to coordinate agencies involved in providing recovery actions in communities following major incidents and disasters.

The state Health Department ensures coordination of:
• provision of hospital and medical services
• provision of transport and hospitalisation for the injured or sick
- supply of medical and first-aid teams
- setting up of medical centres and casualty-clearing stations
- provision of disease control and other scientific and pathological services required
- health and scientific survey teams
- public health information, advice and warnings, to control and support agencies and for release to the affected communities.

The state Health Department has direct responsibilities as the control agency for:
- infectious disease outbreaks
- contaminated foodstuffs and water
- CBR substance releases.

It is also the support agency for all incidents, and provides advice to all combat and support agencies and to the general public in hazardous material, chemical, biological, radiological and nuclear incidents.

Accordingly, under these arrangements, the police and the various state or territory emergency service organisations develop the non-medical component of the state disaster emergency management plans. Under the various state emergency response arrangements, the Health Departments have statutory responsibility to provide the necessary planning and response required to deal with matters associated with the general health of the community and to provide medical and hospital services required as a result of a major emergency or disaster.

Individual local health districts will develop detailed plans specific to that local area. Local Emergency Management Committees, which include key stakeholders, ensure that the local community will be prepared and able to commit local resources.

An ‘all hazards’ approach to disaster planning ensures that contingencies are in place to respond to a variety of incidents involving a large number of victims. For instance, a disaster plan should be able to respond to a natural disaster such as a cyclone with some forewarning or a man-made disaster such as a terrorist attack which is a sudden-impact disaster without preparation time.

An ‘all agencies’ approach to disaster response helps to build a resilient community where all key stakeholders are prepared, trained and capable of responding to an MCI situation.

Medical response plans and agencies
A medical response plan (HEALTHPLAN) is a support plan for the state DISPLAN. It provides for a clinical-care organisational framework that outlines the roles and responsibilities of the various participating
medical and healthcare responders, and provides the necessary integrated procedures for altering and mobilising medical and healthcare personnel, for establishing on-site medical control and for definitive treatment of casualties. The concept is that all arrangements and procedures made within the medical response can be applied from the smallest to the largest incident with a build-up of medical coordination and medical and health resources as necessary, following the general pattern of normal daily operational procedures wherever possible. This extends to contingency planning and has a presence at major events where potential public threat is perceived to exist.

The state DISPLAN is further divided into District and Local Emergency Response Committees, to ensure that an integrated effective response can be provided in times of emergency.

EMERGENCY SERVICE ORGANISATIONS
Also referred to as Combat Agencies, and include:
- police
- fire brigade
- rural fire service
- ambulance service
- state emergency service
- volunteer rescue associations.

EMERGENCY OPERATION CENTRES (EOCs)
EOCs will be activated when a major incident is declared and a coordinated support effort is required to assist with on-site medical care and transport of injured victims to appropriate hospitals for further treatment. For longer-term recovery assistance, EOCs are essential to coordinate the physical, medical, mental health and public health issues of victims and to assist with ongoing needs of communities. EOCs have representatives from all essential emergency service organisations. EOCs are activated at all levels of government, including receiving hospitals.

HEALTH SERVICE COMMAND AND CONTROL
This is determined by the state DISPLAN and is coordinated by the state HSFAC (Health Services Functional Area Coordinator) who controls the mobilisation of all healthcare personnel and resources to any emergency when the plan is activated. This includes:
- the mobilisation of resources to the incident site, and initiation of triage and treatment
establishing 24-hour operational communications to initiate and instigate the necessary mobilisation of site medical commanders, medical response teams and notify casualty receiving hospitals in major emergencies
• the initial setting up of a casualty clearing station by the first ambulance team for triage and treatment on-site until a joint medical command post is established
• coordination of first aid with the ambulance service until the establishment of adequate medical response teams on-site
• coordination with Ambulance Command for transportation of casualties to appropriate hospitals
• coordination with HazMat and fire services for assistance with on-site decontamination of people exposed to toxic or microbiological hazards
• deploying the expertise of public health officers in emergencies where public health is threatened; all work within the framework of the Health Department public health sector for preventing and controlling outbreaks of communicable diseases, and for the preservation of acceptable standards for safe drinking water and foodstuffs.

HEALTH SERVICES FUNCTIONAL AREA COORDINATOR (HSFAC)
This senior medical advisor manages the internal administrative functions of the medical response plan and is responsible for activating a disaster response. All health personnel involved must be appropriately trained in emergency management and understand the command and control structure of disaster response. In some states the HSFAC is referred to as the Chief Health Officer.

Although specific contingencies and structures vary throughout Australia, the senior medical advisor generally manages the EOC when activated in support of the medical response system. The HSFAC also assists with the distribution of mass casualties to hospitals and, in times of major emergencies, will provide briefings via the Health Department to the appropriate minister and the media. The HSFAC is also responsible for coordinating resources by liaising with other agencies.

Pre-hospital medical coordination and disaster scene control
Although titles, role delineations, responsibilities, definitions and plans may vary among the states, the following principles are generic.
The descriptions below outline the events and actions that are required for proficient on-site disaster medicine management.

**SITE MEDICAL CONTROL**
The disaster-site medical procedures in place for establishing early medical control for the proper triage, treatment and transportation of casualties are initially provided by officers of the first responding ambulance vehicle. These officers carry out the roles of Casualty Collecting Officer (for assessment of numbers and types of casualties, to carry out a reconnaissance of the area and select an area suitable to set up a casualty collecting post, to report findings to Ambulance Control and to commence triage of casualties) and Transport Control Officer (to establish suitable access and turn-around for ambulance vehicles and to report this information to Ambulance Command for further incoming response vehicles).

As an ambulance commander arrives on-site, further assessments will be made and an Incident Command Centre established. All incoming medical responders report to the command post where tasks within the casualty clearing station (CCS) are allocated. Further medical assistance required on-site is requested through the chain of command via the site medical commander to avoid convergence and duplication of resources. A typical communication structure is outlined in Figure 22.1.

The medical services provided on-site will be limited initially, and will use the principle of doing as little as possible, as simply as possible, as quickly as possible and to as many as possible.

Life-saving procedures, such as airway management, immediate decompression of tension pneumothorax, arrest of haemorrhage, fracture stabilisation and relief of pain where necessary, may be the limit of medical assistance where medical resources are few. Effective triage prioritisation of casualties by a Triage Officer, usually an ambulance officer from the first responding team, is essential to determine number and type of casualty in the MCI. Early, accurate communication to the Incident Command Centre and further up the chain of command to the HSFAC will enable effective delivery of personnel and resources to the scene.

**SITE MEDICAL COMMANDER**
The site medical commander (SMC) directs medical aspects of treatment in the casualty clearing station. The medical commander coordinates medical teams on-site and is the top of the chain of command.
for medical response—all requests for resupply, resources and personnel pass through this officer. The medical commander determines the need for specialist teams, which include mental health and public health officers depending on the particular incident. As the SMC oversees several medical response teams, he/she does not get involved in medical care of individual patients.

The SMC is responsible for on-site medical coordination of all medical and health resources required, and for the command of all healthcare responders. The SMC is responsible for:

- in conjunction with the ambulance commander, establishing an effective medical controlled area (casualty clearing station) and effecting liaison with the police coordinator and other emergency services
- providing a frequent and accurate manifest to HSFAC and EOC detailing numbers and triage priorities of MCI victims following assessment of the casualty status
- assessing the on-site conditions with the ambulance commander and, if necessary, initiating the setting up of a second casualty

**Figure 22.1** Linkage between emergency services organisations
DEOCON, LEOCON and SEOCON are the District, Local and State Emergency Operations Controllers, respectively
clearing station or designating area where transport of injured persons from the scene may safely incur significant delays

• assessing the requirement for relief of or for further medical teams at the scene, for further first-aid support and whether psychological services may be needed.

The SMC is usually located in the Ambulance Command Centre. The SMC’s role is to:

• initiate and arrange distribution of casualties to appropriate hospital facilities, in conjunction with an ambulance commander—the concept is to distribute casualties to as many hospitals as practicable to avoid facility overload
• alert and mobilise medical teams and other medical and healthcare responders to the disaster scene
• liaise and request activation of Health Department emergency operation centres at state and national level if necessary, and provide situation reports at frequent intervals to EOC and to request further assistance
• instigate stand-down of the various medical and health responders as appropriate after consultation with the on-site ambulance commander and other emergency service authorities.

CASUALTY CLEARING STATION
This is initially established by the ambulance service and eventually managed by the medical response teams deployed to the scene. The primary requirement is that the casualty clearing station must be located in a safe place. When establishing a casualty clearing station, it should be a safe distance away from the ‘hot zone’, as sheltered as possible and of an adequate size to safely manage casualties delivered from the scene. It serves as a point for secondary triage by the medical response teams and for provision of essential treatments to safely package the casualties for transport to hospital for definitive care.

DISASTER MEDICAL RESPONSE TEAMS
Each team consists of 2 senior doctors and 4 resuscitation nurses, deployed from designated hospitals as determined by the state HSFAC. In Australia, all team members must be appropriately trained and accredited to work in the pre-hospital environment. All team members are registered on arrival at the site and need to be in appropriate pre-hospital uniforms, including regulation hats and footwear. Each team deployed to the incident site carries regulation disaster packs containing essential equipment.
These teams provide treatment to injured victims based on disaster triage priorities (SMART triage, discussed below). Working in austere conditions with minimal resources, these teams provide essential treatment to allow safe passage of critically injured victims to hospitals for definitive care.

Disaster medical response teams have a critical role in minimising surge impact on hospitals by stabilising and sorting victims to allow them to be transported to hospitals outside the immediate network. Those not needing hospital or ED management can be referred to community-based resources either acutely or subacutely, in keeping with regional or municipal plans.

**Triage**
Triage generally implies direction of clinical resources to the most seriously ill or injured by a trieur or triage officer, in order to get the right casualty to the right place at the right time. In a mass-casualty situation, demand may be in excess of resource availability. It is neither ethical nor practical to classify clearly non-salvageable victims as top priorities.

**TRIAGE SIEVE AND SORT**
The triaging system in an MCI must be quick, simple, safe and reproducible. Triage performed by emergency personnel at the disaster site must be a ‘quick look’ and is referred to as *triage sieve*; this is followed
by a more detailed reassessment in the treatment area of the casualty clearing station, referred to as triage sort. This process enables pre-hospital personnel to prioritise medical care and transport victims to definitive care in hospital in an organised and rational way.

Triage is a dynamic process that is repeated at each reassessment to ensure refinement of urgency stratification and to respond appropriately to the ongoing evolution of a casualty’s injury complex and consequent physiology.

**Sieve**

This initial casualty assessment is based on the findings of a primary survey.

- If casualties are ambulant, they are initially regarded as walking wounded and are directed or escorted to a separate area of the casualty clearing station. These casualties are given a **priority 3** and will await delayed treatment and transport.
- If casualties are not ambulant, a triaging primary survey is performed. This looks at the airway, respiratory rate and

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Table 22.1 **Triage priorities and criteria for MCI victims**

<table>
<thead>
<tr>
<th>Priority</th>
<th>Colour</th>
<th>Description</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Red</td>
<td>Immediate</td>
<td>Severely injured Immediate resuscitation, life-saving procedures and transportation required</td>
</tr>
<tr>
<td>2</td>
<td>Yellow</td>
<td>Urgent</td>
<td>Significant injuries Intervention required within 4–6 hours</td>
</tr>
<tr>
<td>3</td>
<td>Green</td>
<td>Delayed</td>
<td>Casualty ambulant—‘walking wounded’ Has less-serious injuries, can await delayed treatment Uninjured psychologically-disturbed victims are included in this category</td>
</tr>
<tr>
<td>4</td>
<td>Blue</td>
<td>Expectant</td>
<td>Injuries so severe will require extensive medical care which will compromise the treatment of large numbers of other casualties</td>
</tr>
<tr>
<td></td>
<td>Black</td>
<td>Deceased</td>
<td>Medical officer is required to certify death on triage card Body becomes the responsibility of police/coroner’s office Body not to be moved without police in attendance. Then body is stored in mortuary on/near incident site</td>
</tr>
</tbody>
</table>
capillary refill time. If there is haemodynamic instability (see Figure 22.3), the casualty will be given a priority 1 triage category to be moved to the casualty clearing station for commencement of immediate life-saving interventions.

- Non-ambulant casualties who are stable on primary ABC survey are given a priority 2. These second-priority patients may have significant injuries, but at the time of initial triage there is no evidence of airway compromise and they have normal respiratory and perfusion status assessments. These constitute most of the injuries that are time-critical on a pattern of blast injury. The implication of being stratified as a priority 2 patient is that treatment should be provided in a hospital within 4–6 hours.

- The operation of priority 4 assignment is declared by the incident commander if the number of critically ill casualties far outweighs the resources available to treat at the scene or to transport to definitive care in hospitals. In normal circumstances these patients would be given a priority 1 for immediate intervention to treat life-threatening injuries, but in the resource-poor and austere conditions of an MCI the aim is to do the best for the most, and it may be deemed inappropriate to direct several personnel and much resources to provide treatment at the scene for a single victim in an MCI of great magnitude.

Figure 22.3 Triage sieve protocol
Treatment at the scene is limited to the institution of simple life-saving primary survey manoeuvres. These are:

- airway clearance by manual or other available methods
- decompression of a tension pneumothorax by needle thoracostomy
- control of external haemorrhage by compression bandage or splinting open-limb fractures
- appropriate positioning of unconscious patients or patients with head, chest, abdominal, pelvic or spinal injuries.

**SMART tags**

Standardised triage tags—SMART tags—are currently used across NSW Health and most other states and territories. These nationally accepted triage tags are waterproof, carry personal details of the victim, allow documentation of injuries, allow serial assessment of the Triage Revised Trauma Score (TRTS; see below) and can be used to document treatment instituted at the scene.

Priority 1 patients based on triage sieve assessment will be tagged with the red side of the SMART tag showing. These patients require immediate medical attention and are moved to the casualty clearing station as first priority, to commence treatment and transport to definitive care.

Priority 2 patients will have the yellow side of the SMART tag showing. The walking wounded, priority 3 patients, have the green side showing. If the casualty’s triage priority changes, the SMART tag is easily changed to reflect this.

Those casualties that die at the scene have a separate black ‘Deceased’ SMART tag attached to them.

If use of priority 4 is declared at the MCI, the top left-hand corner of the red triage tag is folded over to show a blue patch. These casualties are critically ill and will require significant resources to treat.

In the event of an MCI involving a CBR agent, an alternative SMART tag is available which can be included in the plastic bag along with the standard triage tag.

Casualties must be re-triaged on the basis of response to simple first aid, injury pattern and likely prognosis. If critically injured or ill patients are unresponsive to these measures and unlikely to survive, they become second-priority casualties. This is sometimes known as reverse triage. In current MCI parlance, this is the priority 4/Blue/Expectant category. The incident commander must declare the operation of this triage category at the commencement of the emergency response, based on casualty numbers and availability of resources.
In this case the SMART tag’s red priority 1 side will have the blue triangle folded down in the top left-hand corner. A doctor, preferably of 3 or more years’ experience, or a senior nurse may be allocated to the care of extremely severely injured patients with a low probability of survival—the expectant category. Intensive efforts to resuscitate these patients may jeopardise the survival of large numbers of other casualties because of an excessive drain on resources. Supportive and palliative care only should be given until resources are available to commence more-vigorous resuscitation, if appropriate.

**Sort**
This triage method is the more formal risk stratification that identifies time-critical patients and assists in scheduling optimal allocation of available resources. It is commonly used by emergency medical personnel on admission of patients to casualty clearing stations or field hospitals.

This method of triage is based on the Revised Trauma Score (RTS) and is consistent with the Australasian Triage Scale and triage practices taught in emergency management of severe trauma (EMST), emergency life support (ELS), advanced paediatric life support (APLS) and major incident medical management and support (MIMMS) courses. It is a repeated process that is dependent on traditional ongoing patient observation.

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*Figure 22.4* Triage cards—SMART tags (above) and CBR tags (below)
Sort is generally implemented in the field utilising the RTS in order to rank physiological embarrassment and allocating an ordinal score. This assists with re-prioritisation or risk-stratification of casualties. Scores of 1–10 are associated with the Immediate (priority 1) category. A score of 11 identifies an Urgent (priority 2) patient. A score of 12 or higher identifies casualties that can wait for Delayed (priority 3) management (Figure 22.5).

Further refinement of triage can be assisted by attention to pattern of injuries or mechanism of injuries. However, in a trauma-related MCI, a considerable number of patients may be classified as time-critical on mechanism of injury alone (Table 22.2). Close observation of this latter group is necessary. Although these patients are of lesser priority owing to normal physiological parameters or the absence of an identified pattern of injury, they are victims of major trauma, have sustained major forces and are at risk of significant and occult internal injury.

**TRIAGE REVISED TRAUMA SCORE (TRTS)**

<table>
<thead>
<tr>
<th>SYSTOLIC BP</th>
<th>CODED VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 89</td>
<td>4</td>
</tr>
<tr>
<td>76–89</td>
<td>3</td>
</tr>
<tr>
<td>50–75</td>
<td>2</td>
</tr>
<tr>
<td>1–49</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESPIRATORY RATE</th>
<th>CODED VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–29</td>
<td>4</td>
</tr>
<tr>
<td>&gt; 29</td>
<td>3</td>
</tr>
<tr>
<td>6–9</td>
<td>2</td>
</tr>
<tr>
<td>1–5</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GLASGOW COMA SCORE</th>
<th>CODED VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>13–15</td>
<td>4</td>
</tr>
<tr>
<td>9–12</td>
<td>3</td>
</tr>
<tr>
<td>6–8</td>
<td>2</td>
</tr>
<tr>
<td>4–5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**Figure 22.5** Triage Revised Trauma Score system to sort casualty priority
**Table 22.2  Features suggestive of severe trauma or time-critical casualties**

<table>
<thead>
<tr>
<th>Pattern of injury</th>
<th>All penetrating injuries—head/neck/chest/abdomen/pelvis/axilla/groin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blunt injuries—</td>
</tr>
<tr>
<td></td>
<td>• Patients with a significant injury to a single region: head/neck/chest/abdomen/axilla/groin</td>
</tr>
<tr>
<td></td>
<td>• Patients with injuries involving 2 or more of the above body regions</td>
</tr>
<tr>
<td></td>
<td>Specific injuries—</td>
</tr>
<tr>
<td></td>
<td>• Limb amputations/limb-threatening injuries</td>
</tr>
<tr>
<td></td>
<td>• Suspected spinal cord injury</td>
</tr>
<tr>
<td></td>
<td>• Burns &gt; 20% of body surface area or suspected respiratory tract involvement</td>
</tr>
<tr>
<td></td>
<td>• Crush injuries where pressure is maintained for &gt; 1 hour</td>
</tr>
<tr>
<td></td>
<td>• Major compound fracture or open dislocation</td>
</tr>
<tr>
<td></td>
<td>• Fracture to 2 or more proximal long bones</td>
</tr>
<tr>
<td></td>
<td>• Fractured pelvis</td>
</tr>
<tr>
<td>Mechanism of injury</td>
<td>Car occupants involved in high-speed motor vehicle crash, e.g. impact speed &gt; 60 km/h with major vehicle damage</td>
</tr>
<tr>
<td></td>
<td>Pedestrians or cyclists hit by vehicles travelling at &gt; 30 km/h</td>
</tr>
<tr>
<td></td>
<td>Patients ejected from a vehicle</td>
</tr>
<tr>
<td></td>
<td>Patients in a car that has rolled over</td>
</tr>
<tr>
<td></td>
<td>Patients in a motor vehicle crash where there is a death of another or same vehicle occupant</td>
</tr>
<tr>
<td></td>
<td>Patients who have fallen from a height &gt; 3 metres</td>
</tr>
<tr>
<td></td>
<td>Patients hit by an object that has fallen from &gt; 3 metres</td>
</tr>
<tr>
<td></td>
<td>Motorcyclists, cyclists</td>
</tr>
<tr>
<td></td>
<td>Explosion victims</td>
</tr>
<tr>
<td></td>
<td>Patients who are trapped and likely to remain so for &gt; 30 minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age and concurrent medical problems</th>
<th>Age &gt; 55 years or &lt; 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pregnancy</td>
</tr>
<tr>
<td></td>
<td>Significant underlying medical condition</td>
</tr>
</tbody>
</table>

**Triage officers**

It is preferable for the triage role to be undertaken by a senior doctor experienced and accredited in the sort and sieve methods of disaster triage.

**FIRST-AID SERVICES**

First-aid services can be provided by several different organisations. The common ones are St John Ambulance Australia and the Australian...
Red Cross. These may be complemented by other first-aid providers such as the Australian Ski Patrol Association, the Royal Life Saving Society or Surf Life Saving Australia, depending on the circumstances. First-aid agencies are often activated by the ambulance service.

The principal role of first-aid organisations is to assist with minor injuries where the setting up of separate treatment centres is necessary to cope with walking wounded. First-aid teams generally work under the direction of a site medical commander or ambulance commander in casualty collecting stations or in field hospitals.

**Communication**

Good communication is essential to the effective functioning and coordination of an MCI operation. Breakdown in communication has been cited as one of the commonest failures of major-incident management. Various methods of communication are used in MCI management, including land-lines, mobile phones, megaphones and television broadcasts, but appropriate training in radio voice procedures is essential for those working in an MCI.

There are several advantages of radio communication through a specific network for the MCI, especially in remote areas and when mobile networks are jammed. All members of a medical response team are trained in NATO radio voice procedures, including use of standardised phrases (Table 22.3), phonetic alphabet (Table 22.4), clarity, brevity and accuracy.

**Code Brown: hospital external disaster or emergency response plan**

All public hospitals are required to have external disaster plans to cope with mass casualties directed to hospital facilities for treatment. In keeping with national standards for colour-coding emergency response plans, an external emergency, which includes disasters and MCIs, is referred to as a Code Brown.

Public hospitals are required to develop, implement and test contingencies for the reception of mass casualties. This is a requirement both of legislature and of the Australian Council on Healthcare Standards. During a health emergency, hospitals will have to convert quickly from their standard care capacity to surge capacity. This is achieved through re-prioritisation of healthcare needs to provide essential services to mass casualties. This would include cancellation of elective surgeries, early discharge of hospitalised patients and diversion of patients with minor complaints to alternative healthcare
Some private hospitals participate in counter-disaster planning activities, especially if they are affiliated with or in close proximity to a large general hospital. Their external emergency response plans work side-by-side with the main receiving hospital, and a memorandum of understanding exists between the hospital management and the local health district or state HSFAC. They may be required to provide sheltered accommodation for casualties from an MCI or ongoing care of admitted patients being decanted from a local public hospital for it to receive casualties.

Table 22.3  NATO radio voice procedures

<table>
<thead>
<tr>
<th>Word/phrase</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>THIS IS</td>
<td>When calling, say the call sign that you want followed by your call sign. For example: ALPHA THIS IS BRAVO.</td>
</tr>
<tr>
<td>OVER</td>
<td>I have finished speaking and it is your turn to reply.</td>
</tr>
<tr>
<td>OUT</td>
<td>I have finished talking to you.</td>
</tr>
<tr>
<td>RADIO CHECK</td>
<td>Can you hear me? If you can, then how well? Ideally it will be LOUD and CLEAR. If it isn’t then describe it, such as WEAK BUT READABLE, etc.</td>
</tr>
<tr>
<td>OK/ROGER</td>
<td>Use either word to show that you have received and understood the message. Note: ‘COPY THAT’ is just another, non-standard way of saying OK or ROGER but can be confusing if you really want them to copy it!</td>
</tr>
<tr>
<td>MESSAGE</td>
<td>I have a message for you—are you ready to receive it?</td>
</tr>
<tr>
<td>SEND</td>
<td>I am ready to receive your message.</td>
</tr>
<tr>
<td>MORE TO FOLLOW</td>
<td>The message isn’t finished—but have you got it all so far?</td>
</tr>
<tr>
<td>SAY AGAIN</td>
<td>This can be SAY AGAIN ALL BEFORE or ALL AFTER or NUMBER or anything else that you didn’t get down.</td>
</tr>
<tr>
<td>ACKNOWLEDGE</td>
<td>Please tell me that you have received the message. If you have, then respond as ROGER (or OK)—you do not have to read it all back.</td>
</tr>
<tr>
<td>WAIT</td>
<td>Give me 10 seconds to find a pencil or whatever.</td>
</tr>
<tr>
<td>WAIT OUT</td>
<td>I’ll get back to you.</td>
</tr>
<tr>
<td>I SPELL</td>
<td>Say the word followed by I SPELL, then spell the word phonetically. If there is more than one word then say FIRST WORD—say the word—I SPELL … etc.</td>
</tr>
</tbody>
</table>
Such plans may also include procedures for providing a trained and equipped medical team for casualty treatment at a disaster site. The provision of such medical teams may reduce the ED’s effectiveness. The state HSFAC will give consideration to replacing or providing a team from another facility if the responding hospital is to continue to be a major casualty-receiving hospital. Some base hospitals in rural regions also have the capability to provide such teams, with smaller hospitals having a reduced capability.

Certain first-aid organisations such as St John Ambulance are also able to provide medical teams on request through the state HSFAC to the Commissioner of St John’s Ambulance Australia. The Royal Flying Doctor Service (RFDS) of Australia has the capacity to provide medical teams for deployment to an MCI site within or outside its normal area of operation. The coordination of these resources is

### Table 22.4  **NATO alphabet and numbers for radio communication in an MCI situation**

<table>
<thead>
<tr>
<th>Letter</th>
<th>Word</th>
<th>Letter</th>
<th>Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Alpha</td>
<td>T</td>
<td>Tango</td>
</tr>
<tr>
<td>B</td>
<td>Bravo</td>
<td>U</td>
<td>Uniform</td>
</tr>
<tr>
<td>C</td>
<td>Charlie</td>
<td>V</td>
<td>Victor</td>
</tr>
<tr>
<td>D</td>
<td>Delta</td>
<td>W</td>
<td>Whisky</td>
</tr>
<tr>
<td>E</td>
<td>Echo</td>
<td>X</td>
<td>X-ray</td>
</tr>
<tr>
<td>F</td>
<td>Foxtrot</td>
<td>Y</td>
<td>Yankee</td>
</tr>
<tr>
<td>G</td>
<td>Golf</td>
<td>Z</td>
<td>Zulu</td>
</tr>
<tr>
<td>H</td>
<td>Hotel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>India</td>
<td>1</td>
<td>Wun</td>
</tr>
<tr>
<td>J</td>
<td>Juliet</td>
<td>2</td>
<td>Too</td>
</tr>
<tr>
<td>K</td>
<td>Kilo</td>
<td>3</td>
<td>Th-ree</td>
</tr>
<tr>
<td>L</td>
<td>Lima</td>
<td>4</td>
<td>For-wer</td>
</tr>
<tr>
<td>M</td>
<td>Mike</td>
<td>5</td>
<td>Fi-yiv</td>
</tr>
<tr>
<td>N</td>
<td>November</td>
<td>6</td>
<td>Six</td>
</tr>
<tr>
<td>O</td>
<td>Oscar</td>
<td>7</td>
<td>Sev-en</td>
</tr>
<tr>
<td>P</td>
<td>Papa</td>
<td>8</td>
<td>Ate</td>
</tr>
<tr>
<td>Q</td>
<td>Quebec</td>
<td>9</td>
<td>Niner</td>
</tr>
<tr>
<td>R</td>
<td>Romeo</td>
<td>0</td>
<td>Zero</td>
</tr>
<tr>
<td>S</td>
<td>Sierra</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*From the Advanced Life Support Group Australia (MIMMS), September 2003; updated November 2007.*
through the state HSFAC and the Chief Medical Controller of RFDS as well as the Director of the Aero Medical Retrieval Service.

**PLANNING, EXERCISES AND REVIEW OF PLANS**
All participating agencies integral to a medical DISPLAN response have subplans to ensure that effective response is available when required. Integrated medical response planning with other emergency services takes place at all levels, addressing various hazards that exist. The exercising and testing of plans takes place at frequent intervals and as necessary following planning reviews.

**HEALTHCARE FACILITY EMERGENCY MANAGEMENT PLANS**
The role of a healthcare facility in responding to external incidents will depend on the size and scope of healthcare services usually offered. Healthcare facilities that offer acute, subacute, long-term care and community outreach health care have a greater capacity to manage demand and overflows. The Code Brown plan of such large facilities will include arrangements for the reception of large numbers of casualties and will include designated treatment areas, security arrangements and the control of vehicular and pedestrian traffic to facilitate ambulance turnaround. Smaller hospitals can contribute by providing care to patients or casualties not requiring intensive resources or by assisting in decanting convalescing patients from other acute services, thus freeing resources to receive disaster victims.

**Stages of response**
In general, the phases of an external disaster emergency management plan are alert, standby, activation (declared or action), stand down and recovery.

**Alert—a disaster situation is possible**
- Begin preparations
- Develop contingency for potential escalation in required response

**Standby—a disaster situation is probable**
- Complete preparations
- Ensure readiness to receive casualties

**Prepare to receive—a disaster situation exists**
- Prepare to receive casualties

**Stand down—a disaster situation is contained**
- Cancellation of response
- Replacement of equipment
- All personnel resume normal duties
STAGES OF THE EXTERNAL EMERGENCY RESPONSE PLAN

Alert
A possible disaster may be advised by one of the emergency services, a media enquiry or a member of the public. Sometimes the alert is raised when ambulant victims present for treatment prior to any other notification. A chemical or biological exposure may be suspected when several patients present with similar symptoms or clinical syndromes over a short time.

All notifications or alerts should be validated. Each healthcare facility should have an incident response team (IRT) which can assess the situation and validate the alert. The IRT may be notified by the emergency department in the event of several casualties presenting to the ED, or by the area HSFAC. The IRT should consist of at least the hospital’s disaster coordinator and incident commander. When the alert has been validated, the hospital incident commander, or similarly authorised person, will activate the external emergency response (EER) plan.

Occasionally, emergency services may need to be alerted by the health service after a number of patients have presented with a clinical syndrome suggestive of an exposure. Food poisoning and chemical exposures are examples of the latter.

Standby
Standby advises the health service of the presence of an external incident that may impact on hospital resources and services. During this phase, designated officers assess resources. Current staffing levels, any imminent shift changes and any extra staff that would be required in such a situation are noted. Bed availability is estimated.

An emergency operations centre (EOC) is established in the designated area. It is equipped with computers providing data relating to the Code Brown, and with adequate phone lines, radio communications and fax machines. The EOC is staffed by the hospital incident commander and the disaster coordinator as well as media relations officers and other essential executive officers. It becomes responsible for the management of all aspects of the external disaster as it affects the hospital. In addition to overseeing clinical operations in a Code Brown situation, the EOC manages planning, logistics and finance duties.

Staff must access action cards or documents and become familiar with their roles during the various stages of an EER. Staff not covered by specific action cards continue normal duties.
The operations chief will determine which staff are to be called in for duty and at what stage in the EER this should occur. If a protracted response is anticipated, staff may be required to come in several hours later. Notification is dependent on the nature of the incident. For example, for a Code Brown involving a chemical hazard it may be decided not to advise the senior surgical staff. In addition, the time of day may determine extent of notification within the healthcare facility. For example, an MCI occurring out of hours would be limited to the ED, ICU and operating theatres and might not include areas such as ambulatory care and other outpatient facilities which would not be staffed out of hours.

**Activation (Prepare to receive)**

**Access to hospital beds**
The following are principles to guide creation of bed capacity. It is desirable to accommodate all the disaster victims in one area or receiving ward. The following groups of patients are considered for discharge or transfer to less-acute facilities:

- electives with non-life-threatening conditions
- patients for routine investigation
- stable postnatal patients
- stable patients undergoing long-term treatment
- stable postoperative patients
- patients able to be accommodated by a ‘hospital in the home’ program.

**Emergency department response**

**Aim**
The aim of the ED is to rapidly assess and stabilise patients and then clear them from the department as soon as possible. If the external disaster is limited with no possibility of further casualties, a full patient assessment could be completed in the ED in keeping with usual practices. Most priority 1 casualties would require emergency operative management of open wounds and fractured limbs, and as such have no place in the ED on arrival from the scene. Other priority 1 casualties with blunt trauma would require ICU admission and the hospital’s Code Brown plan should allow for direct or rapid admission of such patients to its ICU.

**Call-in and notifications**
Key clinical staff, clinical departments and management staff placed on standby are advised of the escalation. Clinical staff are initially summoned to the ED and prepared to receive casualties.
Triage officers
An appropriately trained senior medical officer would be allocated to perform secondary or tertiary triage on arriving casualties. The triage officer should be assisted by a clerical officer to document details on arrival. The triage officer should be in close communication with the ED team leader regarding numbers and acuity of casualties arriving from the scene. This is usually done via hand-held radio, as other modalities of communication can be unreliable in an MCI. There may be a need for more than one triage officer if the influx of casualties is high.

Resuscitation team leader
This role is allocated to an appropriately trained senior medical officer who may need to manage all the resuscitation rooms simultaneously. All available clinical support is directed to the critically ill casualties arriving from the scene. Close communication with both the surgical team leader and the ICU is essential for the safe and rapid disposition of these casualties.

Acute care team leader
A senior medical officer with appropriate training will oversee the care of patients with triage priority 2. Many of these patients may have significant occult injuries and may ideally need to be managed in resuscitation areas. Thorough clinical assessment and close monitoring is essential to avoid missing significant occult injuries.

Consulting space access
ED clinical staff should endeavour to discharge patients by expediting treatment, disposition, completion of clinical procedures and return of investigation results. Where possible, patients able to be managed in different environments, such as in general practice, could be directed to those services.

There is also an ongoing obligation to continue triage of non-disaster patients. It may be elected to simply use the Australasian Triage Scale with reverse triage of expectant cases designated as urgent.

Clinical records
Previously compiled standard clinical records containing medication charts, pathology and medical imaging request forms should be utilised for all MCI victims. Each MCI victim should be allocated an MCI medical record number for ease of tracking. The SMART triage tags should be retained within the clinical records.
Clinical zones
In order to coordinate clinical care, and depending on the size of the department and the anticipated workload, the ED can be divided into different zones with separate teams of clinical staff. Other clinical areas, such as outpatients, could be set up as satellite EDs to manage overflow ambulatory care patients.

Medical staff
During the standby stage of a Code Brown response, the emergency team leader should brief all medical and nursing staff on the expectations during the ensuing hours. It is preferable for ED doctors to be allocated to work in specific zones. Their roles should be clearly defined in their action cards. They should be appropriately dressed in personal protective equipment (PPE) and wear tabards showing their designation.

Additional medical officers may be requested through the EOC. It is imperative that staff follow their chain of command for all requests.

In trauma incidents, a surgeon should remain in the ED for immediate referrals and assessments. That surgeon is responsible for prioritising patients for theatre.

An anaesthetist will assist with urgent airway intervention, referrals and preoperative assessments as required.

Junior medical staff may be utilised to manage ambulatory patients in designated satellite areas. Similarly, medical and nursing students may be utilised appropriately in clinical areas.

Nursing staff
ED nursing staff roles generally parallel those of the medical staff, as treating teams are allocated to specific areas. Their role focuses on the nursing aspects of patient care and the management of the designated ED zones or other designated areas. Nurses receive and assess patients and assist with the examination and treatment of patients.

Senior nursing staff allocate nurses and clerical support staff to the designated areas and assist the triage officer in resource allocation.

Other
A particular focus is the availability of extra equipment, sterile stock and medications. All requests for re-supply must be escalated through the team leader to ensure that requests are not duplicated nor missed in the potentially chaotic working environment associated with a Code Brown response.
The detailed management of in-hospital responses and executive management issues are beyond the scope of this chapter.

**Stand down**

The cessation of the EER and return to usual operations is initiated by the hospital incident commander via the EOC. The response may conclude on advice from the disaster site or the area HSFAC. However, the response plan may require ongoing activation until pressure on the health service or hospital resources has subsided and normal activities can be resumed.

The stand-down mechanism may be total or progressive. Progressive stand-down can be initiated when certain areas are no longer required to function under response plan conditions.

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**Box 22.1 Hospital-wide services necessary for external disaster plan**

<table>
<thead>
<tr>
<th>Departments and services contributing to Code Brown external disaster responses:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Executive management</td>
</tr>
<tr>
<td>• Emergency department</td>
</tr>
<tr>
<td>• Intensive care unit and high-dependency unit</td>
</tr>
<tr>
<td>• Operating theatres and recovery units</td>
</tr>
<tr>
<td>• Receiving and non-receiving wards</td>
</tr>
<tr>
<td>• Outpatients department for managing ambulatory victims with minor injuries or psychological complaints</td>
</tr>
<tr>
<td>• Medical imaging</td>
</tr>
<tr>
<td>• Laboratory services</td>
</tr>
<tr>
<td>• Pharmacy services</td>
</tr>
<tr>
<td>• Supply and materials department</td>
</tr>
<tr>
<td>• Central sterilising supply department</td>
</tr>
<tr>
<td>• Environmental services</td>
</tr>
<tr>
<td>• Wardspersons and porters</td>
</tr>
<tr>
<td>• Linen and waste services</td>
</tr>
<tr>
<td>• Food services</td>
</tr>
<tr>
<td>• Engineering and facilities department</td>
</tr>
<tr>
<td>• Security</td>
</tr>
<tr>
<td>• Traffic control</td>
</tr>
<tr>
<td>• Mortuary services</td>
</tr>
<tr>
<td>• Social work department for management of worried-well victims and families of disaster victims</td>
</tr>
<tr>
<td>• Community relations and media management</td>
</tr>
<tr>
<td>• Volunteers</td>
</tr>
</tbody>
</table>
Debriefing
There are two types of debriefing: operational debriefing and psychological debriefing. The latter has two components: immediate debriefing is a defusing of staff; formal counselling is offered for ongoing symptoms.

Operational debrief
A formal operational debrief, involving key participants and heads of departments, should be conducted within 1 week. This debriefing examines the incident and the organisational response. Reports are prepared for the external disaster committee. Recommendations in this report will form the basis of revisions to the healthcare facility’s EER plan.

Defusing
Defusing is the immediate attention to the psychological needs of staff. This provides staff with an opportunity to express their feelings and thoughts about the episode.

Counselling
Counselling aims to assist staff with long-term distress suffered as a consequence of the disaster response. These services are generally provided by employee assistance programs or may be accessed through the various Health Departments.

Chemical, biological and radiological hazards
The approach to chemical, biological and radiological (CBR) exposures is similar in principle to multicasualty trauma incidents whether exposed victims are single casualties, several or within the context of mass casualties. The prime difference is the need to prevent contamination and/or infection of rescuers, healthcare providers and the community. The approach aims to provide optimum care while maintaining safety for other patients and staff. A second broad aim is to effectively decontaminate patients prior to entering the ED. It focuses on a sequence of actions and interventions that admits decontaminated casualties to EDs. A further aim is the expedient identification of causal agents that may enable specific treatment.

Acute recovery incorporates the restoration of areas used for decontamination to usual functions. It includes management of contaminated items for cleaning and inspection by hazard management or public health agencies. Where applicable, non-disposable medical equipment is cleaned and returned to regular use. Some
contingency plans include specific equipment kits reserved for use in CBR incidents.

In the field, the sequence begins with identification of casualties and proceeds to isolation, decontamination, triage, treatment and transport to hospital. ED contingences are similar. However, treatment may need to commence before or concurrently with decontamination. The main risk for hospitals is the arrival of contaminated or infected individuals prior to recognition or advice of a CBR incident, with consequent contamination of the ED and, potentially, the whole healthcare facility.

FEATURES OF CBR AND NUCLEAR HAZARDS
CBR and nuclear substances potentially cause harm to human health. Incidents involving these substances often generate vapours, fumes, dusts and mists. Hazardous wastes can pollute waste streams, causing a threat to public health, safety or to the environment. They can also be invisible.

CBR hazards can be infectious, toxic, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive and may cause immediate and/or long-term health effects. Exposure may result in poisoning, irritation, chemical burns, sensitisation, cancer, birth defects or organ disease of the skin, lungs, liver, kidneys and nervous system. The severity of the illness or disease depends on the nature of the substance and the dose absorbed.

Detailed information on all the hazards, their properties, effects and treatments is beyond the scope of this discussion. The following is provided as a broad overview.

MODE OF PRESENTATION
Education of all staff in recognising a contaminated or CBR-hazard-exposed person is necessary in order to minimise the risk of ED exposure and contamination. Self-presentation prior to notification by emergency services agencies is common in chemical incidents. Occasionally, emergency services may be unaware of the incident. In this situation the health service has a system-initiation function. In biological incidents, there is often a trickle followed by an epidemic flood of patients. Radiological incidents may involve burns, the consequences of initial radiation illness or the management of ongoing radioactivity.

An uninformed public, presentations of the worried well and an uncertainty or lack of knowledge by community-based doctors and healthcare providers compound ED impact. It has been estimated that the ratio of worried well to affected victims is 10:1.
CHEMICAL AGENTS

Nerve agents
Nerve agents are organophosphates. They block acetylcholine esterase inhibitors, causing a cholinergic crisis. Examples include Tabun (GA), sarin (GB) and VX.

Blistering agents
These irritate the epithelial surfaces by direct contact. The skin and mucosal surfaces are the target tissues. The mustard agents and lewisite are examples of this group.

Incapacitating agents
This group causes short-term disabling physical and/or mental effects by affecting higher cortical function. The group includes central nervous system depressants, stimulants and hallucinogens. To qualify for membership of this group, agents must be potent, last hours to days, not be potentially lethal at effective doses and have no long-term adverse sequelae. LSD (lysergic acid diethylamide) and 3-quinuclidinyl benzilate (BZ) are examples of incapacitating agents. BZ is an anticholinergic agent.

Blood agents—the cyanides
These agents impair cellular function by uncoupling oxidative phosphorylation.

Pulmonary/choking agents
Choking agents impair the respiratory system by irritating the respiratory tract mucosa and alveolar epithelium. These can produce a spectrum of illness from minor irritation to acute respiratory distress syndrome. Examples include chlorine and phosgene.

BIOLOGICAL HAZARDS
These are varied. Illness is usually of insidious onset. Because early symptoms may be non-specific, especially when patients may be prodromally unwell, early recognition can be difficult. Once the community is aware, workload is increased. Patient load will include those with non-specific symptoms, worried patients with usual clinical features of a non-exposure-related illness and those with unusual symptoms or clinical signs needing diagnostic refinement.

Patients exposed to microbiological agents may be recognised when a number of patients present with unusual similar symptoms or clinical signs. Alternatively an influx of patients with similar symptoms
may present, with diagnostic refinement identifying a common broad illness such as pneumonia with isolation of an unusual causal agent.

Other dilemmas include when to immunise and when to definitively treat. These decisions must be made in conjunction with infectious-disease doctors and public health agencies. Rationalisation of available therapeutic substances is a logistical problem. The principles of managing this issue are no different to those of disaster triage and reverse triage. However, within this context, development of inclusion and exclusion criteria is more relevant.

The impact of the exposure on hospitals is likely to increase the workload of laboratory facilities in initial identification and ongoing examinations for isolation of infective agents or bacterial endotoxins and exotoxins.

**RADIOLOGICAL HAZARDS**

Two broad questions need to be asked when considering radiological exposure. Has the patient been irradiated? Is the patient radioactive? Irradiation alone can cause life-threatening illness. The latter additionally poses a risk to rescuers and ongoing careers.

All forms of ionising radiation can cause illness. Alpha particles generally have poor tissue penetration. They are of significance if ingested, inhaled or have contacted open wounds. Gamma rays penetrate tissues, directly affecting cells. Neutrons cause effects indirectly. Human tissue provides some resistance to beta particles, thus decreasing their impact and causing only tissue damage when they have penetrated cells. Bone marrow and gastrointestinal mucosa are the tissues at most risk. Injuries may be caused by a single radiation exposure, exposure to high levels of fallout and repeated exposures.

Acute radiation syndrome involves four phases: prodrome, latent period, manifest illness and death or recovery.

**Prodrome**

Initial symptoms often appear within 6 hours of exposure. Symptoms include nausea, vomiting, anorexia and general malaise. Treatment is largely symptomatic and supportive. A 48-hour lymphocyte count and chromosomal analysis of lymphocytes for dicentric fragments are predictors of likely bone marrow suppression and haemopoietic syndrome (see Figure 22.6).

**Latent period**

This phase is a variable symptom-free period of hours to weeks.
Manifest illness

In this, definitive radiation illness and its complications become evident. Four clinical syndromes are described: gastrointestinal, haemopoietic, vascular and cerebral.

- The symptoms of the gastrointestinal syndrome are similar to those of the prodrome phase with additional problems of diarrhoea, fever and gastrointestinal haemorrhage. Bowel perforation and septicaemia are complications of severe illness. Treatment is supportive with intravenous fluid resuscitation, dehydration and parenteral nutrition.

- The haemopoietic syndrome is the effect of bone-marrow suppression with increased susceptibility to infection, haemorrhage and occasionally anaemia. Treatment is generally supportive. Platelet transfusion may be necessary for thrombocytopenia-associated haemorrhage or if surgical intervention is required. Sepsis must be energetically treated. Wounds should be closed as soon as possible. Infected or
devitalised tissue should be excised. Early skin grafting of burns prevents opportunistic infection. Other blood products to enhance immunocompetence may be considered as clinically indicated.

- The vascular syndrome is due to vascular bed dilation and capillary leaking. Shock occurs as a result of volume loss and poor vascular resistance, due to stimulation of acute inflammation and release of vasoactive humoral mediators causing peripheral vasodilation.
- The cerebral syndrome comprises nausea, vomiting, cardiovascular instability, confusion, ataxia, seizure and loss of consciousness. There is a high mortality within 24–48 hours.

**Recovery/death**
Death or recovery over several weeks are sequelae of the illness.

**GOALS OF EMERGENCY DEPARTMENT MANAGEMENT OF CBR EXPOSURE**
The ED’s goals are to:

- protect staff from toxic exposure
- rapidly assess and treat immediately life-threatening problems
- decontaminate
- determine the identity of the hazardous materials or chemical agents and provide specific treatment as indicated
- prevent cross-contamination of staff, visitors and other patients
- restore the clinical environment to normal functions following the incident.

**Personal protective equipment (PPE)**
The use of PPE by staff treating contaminated patients is the single most important line of defence against airborne agents. It prevents cross-contamination and provides a physical barrier and respiratory protection.

There are various safety standards of protective equipment. Hospitals generally require safety standard C equipment. The suggested contents of a level C PPE kit are outlined in Box 22.2.

**Isolation areas**
CBR plans must include the availability of an isolation area. In some instances, this may be a physical structure that has been developed in keeping with appropriate standards that have been incorporated into new or renovated facilities. In other circumstances, the isolation area may be makeshift or portable. Decontamination takes place within or immediately adjacent to the isolation area.
Hot zone
The hot zone is an area of contamination. For practical purposes, this is an isolation area for dealing with contaminated casualties. In selecting an appropriate area for the hot zone, consideration needs to be given to wind direction, slope for run-off, access to water and drainage, ability to provide screening for privacy, traffic management and proximity to the ED.

Warm zone
The warm zone is a buffer area between hot and cold zones to minimize cross-contamination.

Cold zone
This is a clean, non-contaminated area.

Decontamination corridor
The decontamination corridor traverses the warm zone. The decontamination process is functionally a one-way sequence and process. Contaminated casualties enter the hot zone, pass through the decontamination process and exit into the cold zone, prior to definitive treatment within the ED.

Contaminated-area and hot-zone issues
Life-saving equipment required in this area will be out of service until decontaminated. All patient clothing and personal belongings are bagged and labelled. All items used and present in the hot zone must be decontaminated before reuse or, in the case of personal belongings, returned to owners. Specialist cleaning may be required.

Decontamination requires the availability of showering facilities. Screening is necessary for patient privacy. The area must be well ventilated. If necessary, ventilation may need to be enhanced using portable industrial exhaust fans.

In makeshift or portable situations, the contaminated hot zone,
the uncontaminated cold zones and the ED should be easily identifiable and taped off to prevent accidental cross-contamination.

Contaminated waste and patient belongings are double-bagged, a red (‘dirty’) label is attached and the bag is placed in a yellow contaminated-waste bin. Extreme care should be taken with patient clothing and valuables. These must be clearly labelled, as they may be the only form of patient identification and may be required for forensic evidence.

Specimens that may cause cross-contamination through the normal means of transport must be transported in a safe manner. This may require specimens to be transported in labelled, sealed containers via a courier.

**Decontamination**

Decontamination aims to remove substance and stop ongoing exposure. Decontamination requires the removal of clothing and showering with copious amounts of water. If there is any doubt about contamination, then the person must be decontaminated. This also applies to emergency services personnel.

For safety reasons, only those staff designated as members of the decontamination team and wearing full PPE are permitted to decontaminate patients. If protective respiratory equipment is required, only staff trained in the equipment are to be deployed.

The following points serve as a guide to effective patient decontamination:

1. It is preferred that males and females be segregated.
2. The patient stands on a plastic sheet and removes clothing and personal belongings. These are wrapped in the sheet and placed in a bag. The bag is placed in a second bag. Identification and red ‘contaminated’ labels are attached.
3. Patients proceed to decontamination showers. Copious amounts of water and soap are used. Liquid, flour and disposable wipes and tissues may be required to remove thick liquid before showering.
4. Following decontamination, patients move through the warm zone or corridor to a ‘clean area’ or cold zone. The patient is dried and clothed in a standard examination gown. Once externally decontaminated, the patient has a green ‘external decontamination’ tag or armband applied and is moved to the triage area.
Specific decontamination issues

- A contaminated appendage can be washed without wetting the whole body.
- Skin is washed down for 5 minutes with copious amounts of soap and water.
- Open wounds require gentle scrubbing or irrigation of wound for 5–10 minutes with lukewarm water.
- Eye exposures require irrigation of eyes with sterile normal saline for 15–30 minutes.
- Contaminated facial and nose hair and ear canals are to be gently irrigated, with frequent suctioning to ensure removal of contaminants.

Substance identification

Substance identification is necessary for correct decontamination and for providing medical treatment specific to the substance.

Chemical substances may be identified using:

- HazMat or product advice sheets
- computerised databases, e.g. Poisindex
- dangerous goods guide
- Poisons Information Centre—phone number 13 11 26 (Australia-wide).

A biological agent may have been identified and advised by the state public health agency. If a biological agent is suspected, identification strategies should be planned in conjunction with health service clinical microbiologists or infectious disease doctors. Forewarning of and close liaison with laboratory medicine is required.

Radiation hazard identification may have already been advised by the relevant public health and environment protection agencies. However, local nuclear medicine departments, especially those associated with radiotherapy treatment centres, may initially be of assistance. It is preferable that a radiation physicist assist with on-site assessment of patients and the local environment for radioactive contamination.
**Staff roles**

It is essential that all staff members are familiar with their roles in a chemical, biological or radiation incident/disaster. The roles are similar to those identified for response to traumatically injured mass casualties.

The triage nurse or officer remains ‘clean’, adjacent to the triage station.

The senior doctor in charge remains in the cold zone and allocates medical personnel to specific duties and areas, such as to isolation and decontamination. Doctors allocated to the hot zone must be familiar with the PPE, equipment and procedures for decontamination and treatment. The doctor in charge endeavours to determine substance identification and specific treatment.

The role of the nurse in charge of managing nursing and clerical resources parallels that of the senior doctor. A specific responsibility is to ensure that the decontamination area is screened off for patient privacy, clearly marked, signposted and isolated to prevent cross-contamination.

**Decontamination teams**

A decontamination unit consists of 2 teams, each with a minimum of 3 staff: doctor, nurse and patient services assistant. One team triages using either sieve or sort methods, and where appropriate clinically manages time-critical patients in need of emergency care. The second team concentrates on decontamination procedures.

Colour-coded role-specific action cards outlining team roles should be worn around the neck.

Men with full beards will not be able to obtain an accurate seal from the respirator and thus cannot participate in a medical decontamination team.

**Clean-up and decontamination of hot zone equipment**

Hot zone equipment may be separated into two groups, a chemical/disaster box and supplementary equipment, as outlined in Box 22.3.

Non-disposable hot zone equipment requires cleaning. Specialist cleaning may be necessary. These items should be doubled-bagged and labelled with a red ‘contaminated’ label.

Disposal of consumables, cleaning of equipment and restoration of decontamination areas to normal activities will vary among hospitals depending upon the set-up. Issues include:

- Chemical disposal of any contaminated waste water.
- Cleaning or disposal of contaminated clothing and contaminated disposable protective clothing.
### Box 22.3 Suggested equipment lists for decontamination areas

#### Chemical disaster box equipment
- Personal protective equipment—disposable barrier suit, overshoe, nitrile gloves and respirator with disposable filter and air hose
- CBR procedure manual
- Liquid soap, flour, disposable wipes or tissues
- Clear bags for double-bagging of contaminated clothing and linen/ black pen to write on contents of bag (e.g. linen, patient clothing, disposable equipment)
- Plastic sheet
- Red CONTAMINATED tags and green DECONTAMINATED tags
- Red CONTAMINATED patient labels and green DECONTAMINATED patient labels
- Special specimen-carrying container for contaminated specimens
- Nozzle for hose
- Hazard signs and tape to identify isolation zone

#### Other equipment
- Hoses to connect to external outlets (depending on decontamination zone design)
- Dressing trolley for laying out resuscitation equipment
- Patient trolley(s)
- Portable oxygen and suction
- Transport resuscitation bag—adult and paediatric
- Defibrillator
- Portable BP cuff and sphygmomanometer
- Portable otoscope
- Towels, gowns to use after decontamination shower, warm blankets
- Clean trolleys for decontaminated patients
- Dirty linen skip

- Cleaning of the shower and hot zone areas. Cleaning staff may need access to PPE.
- Cleaning of contaminated equipment.
- ED staff may be able to clean equipment if this can be achieved safely. If not, specialist cleaning may be required.
- Disposable equipment will need to be replaced. This includes PPE equipment such as suits, gloves, overshoe and respirator hoods.
- Government agencies responsible for environment protection are notified if hazardous chemicals have entered the sewers or stormwater drainage system.
- Particulate matter removed from radiation exposure victims may need to be stored in lead-lined bags or sealed containers.
Staff decontamination
Staff should only remove and dispose of PPE and clothing when contaminated ‘dirty’ area clothing and linen has been double-bagged and trolleys and other equipment used in this area have been decontaminated.

Clinical and related wastes
The underlying principles for the treatment and disposal of clinical and related wastes are the health and safety of personnel and the public and the minimisation of overall environmental impact.

Clinical wastes include sharp items and human tissue wastes. Related wastes include cytotoxic, pharmaceutical, chemical and radioactive wastes. Ultimate disposal of wastes will depend on their nature and on national, state or local regulations governing the disposal of hazardous substances.

Wastes need to be segregated according to their category, bagged, packaged or containerised. Segregation practices need to facilitate the ongoing maintenance of safe waste movement and transport.

Plastic bags are used for the collection and storage of clinical and related wastes, other than sharps. They need to be of sufficient strength to safely contain the waste class they are designated to hold. They need to conform to colour coding and marking. If moist sterilisation is to be used for decontamination, bags must be suitable for that purpose. Bags may only be filled to a maximum of two-thirds of their capacity or to a maximum weight of 6 kg. This allows for secure final closure and unlikely tearing of the bag. Bags may only be secured with closure devices not having sharp protuberances such as staples or exposed wire ties.

Rigid-walled containers are used for collection of sharp items. Containers such as mobile garbage bins should be resistant to leakage, impact rupture and corrosion. These containers should be inspected after each use to ascertain that they are clean, intact and without leaks. Any containers should have interiors of smooth impervious construction to contain any spillage and to be able to be readily inspected, cleaned and sanitised. Rigid-walled containers must be appropriately colour-coded and securely closed, but not necessarily locked, during transport.

The key consideration for clinical and related wastes storage is their safe containment in a vermin-proof, clean and tidy area. Storage requirements will be dependent upon the volume and type of clinical and related wastes to be contained and the mode of waste treatment to be employed. Procedures will also be dictated by the logistics of waste treatment methods and the requirements of disposal facilities.
Waste segregation is maintained during the movement and handling of wastes. If waste is mixed or loses identification during movement, it must be treated at the highest level of contamination. Movement of wastes through patient care areas should be avoided. Industrial trolleys should be used to move clinical wastes contained in plastic bags or non-mobile rigid-walled containers.

Chemical exposure register
A chemical exposure register may be managed by the fire brigade or an appropriate HazMat management agency. However, hospital staff may be required to manage this.

All staff, including visiting emergency service personnel, and patients involved in contaminated areas must be listed on the register. The minimum details required in the register include name, hospital record number, designation and injuries sustained. Contact details of involved staff are recorded to ensure timely access if additional follow-up is required.

A tag stating the person has been exposed to a radiation, biological or chemical hazard and the substance involved is attached to the patient in the form of a wrist band. It is worn for a predetermined time, usually 48 hours in the case of a chemical exposure.

Online resources
South Australian Metropolitan Fire Service website
www.mfs.sa.gov.au
Victorian Metropolitan Fire Brigade website
www.mfb.sa.gov.au

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Gordian Fulde