Clinical Guidelines for

Major Incidents and
Mass Casualty Events

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Clinical guidelines for major incidents and mass casualty events

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These guidelines have been created with the occasional trauma team in mind. They have been updated following the numerous major incidents we’ve had to deal with over the last couple of years. They have been developed by experts in the subject areas from both civilian and military practice.

Classification: OFFICIAL

This information can be made available in alternative formats, such as easy read or large print, and may be available in alternative languages, upon request. Please contact National EPRR team on england.eprr@nhs.net.
The clinical guidelines for use in major incidents and mass casualty events has been developed following a period of multiple incidents that have presented a range of challenging clinical scenarios such as blast injury, penetrating injury and the use of chemical agents, unlike those seen in day to day practice.

This guidance is regularly reviewed and re-issued as new developments based on an ever-increasing evidence base and experience emerge.

The intention is that this guidance will be regularly reviewed and re-issued as new developments based on an ever-increasing evidence base and experience emerge.

Organisations should ensure these guidelines are available to staff and that staff are appropriately trained and confident in responding to major incidents.

The challenge now is to ensure that organisations ensure that these guidelines are available to staff and that staff are appropriately trained and confident in responding to major incidents.

Stephen Groves  
National Head of Emergency Preparedness, Resilience and Response

Keith Willett  
National Director for Emergency Planning and Incident Response

As the Surgeon General for the Defence Medical Services, I am delighted to write the foreword to this very important document that provides clinical guidelines for mass casualty incidents in the civilian setting. This work culminates considerable collaboration between NHS Emergency Planning experts and Defence Medical Services personnel in which we have shared knowledge from both the civilian and military sector. This knowledge has been consolidated into one place in order to provide an authoritative reference for anyone who might be involved in the health sector response to a mass casualty incident.

This document is the modern embodiment of the close co-operation between our professions. We have always shared knowledge from the unique environment of military medical practice into the civilian sector to inform our professions how to care for the types of casualties normally seen in conflict. We collaborated together to inform the development of the Emergency Medical Services to respond to Air Raid in the Second World War, this has continued as the NHS developed Major Trauma Centres, and has been evident as we responded to recent terrorist incidents in the U.K. It is very fitting that we publish this document in the year of the 70th anniversary of the creation of the National Health Service.

Martin Bricknell  
Lieutenant General  
Surgeon General United Kingdom
The Clinical Guidelines for use in a Major Incident have been created with the occasional trauma team in mind, for example, for surgeons in a trauma unit who need to treat a deteriorating P2 patient, or a P1 patient who has been conveyed to the trauma unit, during a major incident response.

Current protocols and guidance from pre-hospital care and advanced trauma practices have been blended with expert clinical knowledge, military experience gained over many years of managing blast and ballistic injury, NGO/global trauma doctrine and learning points from recent incidents, and made relevant to UK NHS clinical practice.

Major trauma centres may have their own protocols and guidance already in place for managing multiple severely injured casualties and these guidelines are not intended to replace these. For the occasional trauma team responder, in a trauma unit or local emergency centre, these guidelines should form the basis of clinical emergency preparedness and serve as an aide memoire during a major incident.

It is unusual for an Editor to wish that their work is never used and gathers dust on a shelf someplace, and with regard to a major casualty response, I will always covet this. However, acting as a custodian of knowledge and expertise gained by managing wounded servicemen and victims of terrorist events, I hope that these guidelines will be perpetually updated and constantly used to support ongoing learning and training, and to set global standards in good quality casualty care.

Justine Lee

Editor
Specialty Doctor in Major Trauma, Queen Elizabeth Hospital, Birmingham
Clinical Reference Group Emergency Preparedness, Resilience and Response

It is important that these guidelines are practical, self explanatory, relevant to the users and updated regularly. Individual guidelines can be (and will be) updated independently. You can check that you are using the most up to date version of any guideline by checking the version number on the latest index page at the front or the guidelines or on the web www.epronline.gov.uk/ourwork

All feedback and suggestions, from current and future contributors will be gratefully received. Please email me directly: justine.lee@uhb.nhs.uk. I look forward to hearing from you.

Key:
The following symbols are used throughout these guidelines to emphasize the text, but have not been strictly applied. They may mean:

- must do’s, mandatory, immediate action
- check this has been done
- choices, look for, decision to be made
- consider, points of note
- alerts, warning
- avoid, do not
- link to external reference/online resource

If a Major Incident has been declared, turn to MI DECLARED and follow the guidance from this point. If there is time, the mechanism of injury section should be reviewed as the METHANE report communicates the types of injury mechanism(s) involved.
# Clinical guidelines for use in a trauma major incident or mass casualty event

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Major incident awareness

A mass casualty incident for UK health resources is an incident (or series of incidents) causing casualties on a scale that is beyond the normal resources of the emergency and healthcare services’ ability to manage.

- may involve hundreds or thousands of casualties with a range of injuries, the response to which will be beyond the capacity of normal major incident procedures to cope and require further measures to appropriately deal with the casualty numbers.
- casualties are likely to be a mixture of categories with 25% requiring immediate life saving intervention (P1), 25% requiring intervention that can be delayed (P2) and 50% being walking wounded or minor injuries (P3).
- usually caused by sudden onset events (big bang), and exclude casualties as a result of infectious diseases such as pandemic influenza.

Several smaller incidents may combine, or be geographically located, so as to require a mass casualty response to be enacted due to the large number of simultaneous casualties.

For specialist services such as burns, the trigger for activation of their mass casualty arrangements will be lower due to the limited availability of resource for incident response.

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**Major incident scene**

- Ambulance Service estimates number of live casualties (and produces METHANE report)

**Primary triage at scene** (Triage sieve as per NARU guidelines)

**Survivor Reception Centre** Non injured survivors

**Self presenters** of any age group may present to any medical facility. Expect to treat the casualty, as no ambulance transfers will be available that day.

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**Adult**

- 12 years old or over
- P1 Hold
  - Patients unlikely to survive their injuries.
  - Move to appropriate area and make comfortable

**Paediatric (<12yrs)**

- Under 12 years old or within paediatric triage tape
- P1 Hold
  - Patients unlikely to survive their injuries.
  - Move to appropriate area and make comfortable

**MTC**
- Adult Major Trauma Centre

**TU**
- Adult Trauma Units

**Any healthcare facility**
- Local emergency hospitals,
  - Walk in Centres,
  - Treatment on scene, GP

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**If regional capacity exceeded**

- Consider air transport to out of area MTCs/TUs

- Request mutual aid from NHS England to disperse casualties outside of the local region to further afield
Major incident awareness

A major incident is any occurrence that presents serious threat to the health of the community or causes such numbers or types of casualties, as to require special arrangements to be implemented. For the NHS this will include any event defined as an “emergency” as in section 6.4 of NHS England Emergency Preparedness, Resilience and Response Framework.

Under Section 1 of the CCA 2004 an “emergency” means
(a) an event or situation which threatens serious damage to human welfare in a place in the United Kingdom;
(b) an event or situation which threatens serious damage to the environment of a place in the United Kingdom;
(c) war or terrorism, which threatens serious damage to the security of the United Kingdom.

Your hospital’s emergency planning, preparedness, response and resilience to a major incident

A major trauma centre (MTC) should expect to receive predominantly (P1) patients, a Trauma Unit (TU) should expect to receive (P2) patients and other medical facilities will be assigned (P3) patients. However, a mix of casualties should be planned for, as there will be little (if any) ability to transfer patients between sites for the first 24 hours.

To assist a regional response to a mass casualty event, a pre-determined patient dispersal plan (casualty regulation) should be used, showing where casualties will be dispersed to by the ambulance service and how many casualties each hospital has pre-agreed to accept in the first hour.

The local emergency services (ambulance/police/fire) are usually the first to notice unusual activity in their control rooms and will notify their incident management director on call. They will decide if escalation of the incident is required and if this is a potential or actual major incident.

If there is a surge of casualties arriving in ED without warning, or if there is news (via social media or word of mouth) of an emerging incident, then the ED consultant on call/senior nurse on duty will contact the medical director or clinical site manager (see local MI protocol) and decide whether to self declare and start escalation of the hospital major incident plan.
Ballistic injury

Introduction

Bullets cause injury by two main mechanisms:
1. Tissue being crushed and lacerated along the bullet path.
2. Tissue being stretched and displaced by the temporary cavity.

The clinical effects will depend on the body area and underlying organs hit by the bullet.
Immediate casualty management follows the standard CABC approach and is dictated by the casualty’s clinical condition.

Diagrams below demonstrate the average path of bullets. However it must be appreciated that bullets will tumble, fragment and produce fragments that are not in the average path.

Casualty in defensive position (crouched and lying down)

Clinical presentation of casualty

Origin of gunfire – three shots fired

Figure shows same person, and how wound tracts look in a clinical setting
Note: four wound tracts

Catastrophic haemorrhage

Non-compressible? Does patient need to go direct to theatre?
Compressible? Apply direct pressure/junctional techniques/tourniquets. See immediate wound management IMED

KEY POINTS

Bullets that fragment may lead to multiple wound tracts across different body (or anatomical) regions.
Some tissues tolerate deformity from temporary cavitation better than others ie skeletal muscle versus bone.

Small entry and exit wounds may mask catastrophic internal damage

Investigations

The pattern of bone fragments and bullet debris may show the direction of travel of the bullet within the casualty.
Some bullets break up (‘fragment’) within the casualty producing multiple wound tracts.
CT is used to screen for bullet fragments prior to MRI (if needed).
Retained bullets and fragments are likely to have steel components and be affected and moved by the MRI magnetic field.
Imaging is covered in ED Resus

Gunshot involving face/neck – see Speciality Overview
Gunshot not involving face/neck = standard airway management.

Standard care.
Be guided by the clinical condition – ‘what you see may not be what you get’

The actual path taken by the bullet within the casualty will depend on how they were orientated when struck (standing, sitting, crouching, running) – which is often not the position the casualty is examined in by responding clinicians.
Bullets that ricochet off an intermediate surface or pass through intermediate targets (bags, clothes) may become unstable, hit side face on (rather than with the tip) and produce greater immediate energy transfer.

Some tissues tolerate deformity from temporary cavitation better than others ie skeletal muscle versus bone.
Ammunition

A round of ammunition consists of two main parts:
- Bullet (the part that leaves the gun and strikes the target).
- Cartridge case that contains primer and propellant.

The cartridge is ejected from the gun (a ‘spent case’ or ‘brass’) and may be present at the incident scene.

Ammunition is often described by width and length:
- A ‘9x19mm’ has a bullet head 9mm in width and a brass case 19mm long. This describes ammunition often fired from a handgun/pistol.
- A ‘7.62×39mm’ has a bullet 7.62mm wide and a case 39mm long. The longer case, compared to the 9x19mm ammunition, allows for more propellant to be packed into the case. This gives the bullet more kinetic energy when fired.

Ammunition can also be described using imperial measurements for the bullet width – usually fractions of an inch (eg .223) or using both imperial and metric measurements (eg .223in/5.56mm).

Bullet effects

When a bullet impacts a target, energy is transferred to the target. The effects depend on:
1. the material properties of the target
2. the bullet design

This is illustrated using the figures below depicting bullet impacts into 500×250×250mm 10% gelatine blocks (derived from high speed digital photography of actual impacts). When shot, 10% gelatine behaves in a similar way to muscle tissue.

The temporary cavity is also shown superimposed on the outline of a human torso to illustrate possible wounding effects.

The energy from the bullet impact creates a ‘temporary cavity’ within gelatine or muscle lasting for fractions of a second. This collapses down around a much smaller permanent tract created by the bullet.

If the bullet becomes unstable within the gelatine or muscle and begins to tumble, it will present its side face to the material rather than its tip. In this way more energy is transferred, due to a greater contact surface area between the bullet and tissue, and the cavity will be larger.

Pistol

9x19mm ammunition

The temporary cavity is smaller than that associated with rifle ammunition.

AK47

7.62x39mm ammunition

The bullet flies straight initially then becomes unstable, creating a large temporary cavity associated with tissue stretching and tearing.

Police rifle

.223 Remington exposed tip

This is an example of a bullet designed to flatten out (‘expand’) soon after impacting on a target, so that energy is transferred rapidly and the temporary cavity is large early in the bullet’s flight. The bullet is more likely to stay in the body of the first person shot and not go through and hit someone else.

Graphics used with kind permission from Defence Academy of the United Kingdom, Shrivenham, Nov 2017
**Blast injury**

**Introduction**
- Aggressive resuscitation is required in close range survivors.
- Look for occult injuries and monitor for evolving injuries.

**Catastrophic haemorrhage**
Does patient have a traumatic amputation or is this an isolated injury? Look for other associated injuries:
- **Blast Thorax** – High risk of catastrophic great vessel and aortic disruption – seek early cardiothoracic opinion.
- **Blast Lung** – early intubation, lung protective ventilation from outset and through to ICU care.
- **Blast Abdomen** – risk of significant intra-abdominal bleeding and late bowel perforation, even if abdominal wall is not breached.
- **Blast Pelvis** – High mortality rate from exsanguination, especially if SI joints are open (of relevance for landmines, IEDs and floor-based devices).
  - Apply pelvic binder, gain proximal control and resuscitate. Surgery may be required at any time to assist resuscitation. CT imaging is desirable as soon as possible, if the patient is stable enough.

**KEY POINTS**
- Early CT whole body (head to ankles)
- Use rapid transfuser (Level I/Belmont)
- Give tranexamic acid (TXA) early
- Do a blood-borne virus screen (BBV) if fragment injury
- Fasciotomy for blast limbs
- Plan for damage control surgery initially

**A**
- Have a high index of suspicion for airway compromise if blast and casualty were in a confined space (bus/underground/metro)
- Flash burns indicate a high risk of blast lung

**B**
- Have a high index of suspicion for blast lung (incidence increases when casualty in an enclosed space) see Speciality Overview
  - Blast Lung is the most common fatal injury among initial survivors
  - Low initial O2 Sats may indicate primary blast lung injury
  - Rib fractures, pneumothorax and lung contusions are commonly associated with a blast
  - Have a low threshold for chest decompression/chest drain
  - Consider early intubation and lung protective ventilation from outset and through to ICU care

**C**
- Neck
  - Penetrating neck injuries are common and often fatal
- Chest
  - Great vessel/aortic injury
  - Pericardial tamponade
  - Myocardial contusions - may lead to cardiac arrhythmias
- Abdomen
  - Blunt abdominal injury caused by secondary and tertiary blast mechanisms can cause significant bleeding and late bowel perforation, even if the abdominal wall is not breached
  - Liver/splenic rupture
  - Air embolism leading to mesenteric ischaemia
- Pelvis
  - Significant bleeding can occur with open SI joints
  - The wider the pubic symphysis, the greater the transfusion requirement
  - Manage initially with pelvic binder and rapid proximal control
  - Further resuscitation and surgery may be required

**D**
- Traumatic amputation
  - Check tourniquet(s) have been applied
  - Prepare to exchange for pneumatic tourniquet(s)
  - Avoid crystalloids during resuscitation (worsens coagulopathy)
# Blast injury

## Mechanism of Injury

### Blast injury environment

**Explosive devices**
- Explosive device may be predominately blast weapon, or packed with fragments, for example, with screws, nuts, ball bearings etc.
  - **Blast weapons** increase the risk of primary blast injuries such as blast lung and building collapse.
  - **Fragmentation weapons** increase the risk of fatality especially over longer distance in the open field – explosion outside, victim outside.

**Distance from blast**
- Primary blast injuries common in fatalities, but rare in survivors as overpressure effects reduce rapidly with increasing distance from the device.
  - **Close range injuries** – mutilating injuries common, traumatic amputations, open head, chest, abdominal injuries with exposed contents.
  - **Further away** – secondary and tertiary blast injuries predominate and survival much more likely, with increasing distance fragments are less numerous, and less serious unless vital structures damaged.

**Aggressive resuscitation in survivors is required**

### Classification of blast injury

- **Primary** – injury resulting in direct tissue damage from the shock wave hitting the body.
- **Secondary** – injury from fragments (‘shrapnel’) from a device or the environment.
- **Tertiary** – injury from displacement of the body (thrown against a wall/up in the air).
- **Quaternary** – other types of injury (for example: burns, inhalation injuries etc).
- **Quinary** – sequelae and late complications, for example fungal infection if major tissue damage.

## Blast injury

#### Explosive devices
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- **Aggressive resuscitation in survivors is required**

#### Blast location
- Enclosed space: explosion inside, victim inside (bus bombs, pub bombings etc.)
  - Complex blast environment with increased effects of overpressure due to reflection and amplification. Primary blast injuries especially blast lung common in both fatalities or survivors.
  - Effects may be localised if protection offered by walls or furniture.
- Explosion outside – victim inside building or vehicle.
  - Low risk of primary blast injury.
  - Victim also protected from fragments.
  - Tertiary blast injuries predominate, with civilian pattern fractures.
  - Safest environment, unless building collapse occurs.

#### Suicide bombers
- Main effects as above and related to type of explosive device and environment.
- Secondary fragments from bomber or other victim can occur – especially bone fragments.
- Risk of infection (e.g. blood borne viruses) from biological implantation.
Crush injury

**Summary**
- Patients may have multiple injuries affecting different tissues and organs and are at risk of crush syndrome.
- In explosions, additional injury types such as blast and fragmentation injury should also be considered.

- Prolonged entrapment may occur.
- Extrication after a long period of entrapment is associated with a high risk of cardiovascular collapse; may lead to worsened renal failure or cardiac arrest.

**A. Standard care**
- Do not use Suxamethonium for RSI – risk of hyperkalaemia/death

**B. Lung Protective Ventilation**
- For all ventilated patients from ED onwards
- Rib fractures
  - Early multimodal analgesia
  - Surgical stabilisation of flail segment if more than four ribs involved

**C. Risk of:**
- CV collapse on release from entrapment
- Risk of internal bleeding from organ contusions
- High risk of pelvic fracture with associated haemorrhage
- Consider need for pelvic binder

If prolonged extrication, patient may have had IV fluids at scene
- Continue adequate fluid resuscitation
- Patient is at risk of rhabdomyolysis
- Use blood if haemorrhagic shock is present, then give crystalloid solutions to ensure adequate urine output
- Do not apply tourniquet to a crushed extremity unless there is catastrophic haemorrhage

**D. Cranial trauma**
- Associated with poor outcome
- seek early neurosurgical advice
- Penetrating eye injuries
  - Are easily missed
  - inspect the globes (if unable to do so, refer to ophthalmology)
- Multiple fractures are common
- Look for occult nerve/tendon damage
- small child/frail older person with co-morbidities are at increased risk of death due to crush syndrome

**E. Treat hypothermia if present**

**KEY POINTS**

- Consider multiple other injuries:
  - burns
  - fragmentation injuries
  - blast lung
  - multi-fragmentary fractures
  - subdural haematoma
  - eye injuries
  - tympanic membrane rupture – steroids may salvage sensorineural hearing loss

- Have a high index of suspicion for crush syndrome
  - Rhabdomyolysis:
    - Check creatine kinase
    - Check urine myoglobin
    - Give crystalloid to establish good urinary output if rhabdomyolysis suspected or confirmed
Crush injury and crush syndrome

Pre-hospital, the patient may have had the following management:
- Intravenous fluids may have been given prior to releasing the crushed body to prevent systemic reperfusion injury. This is especially important in cases of prolonged crush (>4 hours), however may occur after as little as 1 hour entrapment.
- A tourniquet may have been used on the affected limb – slow release of tourniquet is required to prevent distal limb reperfusion injury.

⚠️ Observe all crush casualties, even those who look well

**Patients are at risk of:**

- **Reperfusion Injury**
  - Acute hypovolaemia with metabolic abnormalities
  - Release of toxins from necrotic tissues into the circulation may cause renal failure
  - May occur when a trapped limb or casualty is suddenly released

  Observe for:
  - cardiac arrhythmias (may be lethal)
  - myoglobinuria

- **Hypotension**
  - Casualties may require considerable fluid replacement in the first 24 hours (third space losses)

  Observe for:
  - Compartment syndrome (consider prophylactic fasciotomies)
  - Signs of renal failure

  ED Resus
  → Initiate (or continue) IV hydration—up to 1.5 L/hour

- **Renal Failure**
  - Rhabdomyolysis releases myoglobin, potassium, phosphorous, and creatine kinase into the circulation
  - Myoglobinuria may result in renal tubular necrosis if untreated
  - Release of electrolytes from ischaemic muscles causes metabolic abnormalities

  ED Resus
  - Patient may require IV fluids and mannitol to maintain diuresis of at least 30mls/hr, to prevent renal failure

  ITU
  - Patient may require haemodialysis

  Patients with acute renal failure may require up to one to two months of dialysis treatment; however, in the absence of any infection, patients are likely to regain normal kidney function.

- **Metabolic abnormalities**
  - **Hypocalcaemia:** Calcium flows into muscle cells through leaky membranes
  - **Hyperkalemia:** Potassium from ischaemic muscle
  - **Metabolic acidosis:** Lactic acid from ischaemic muscle may cause life-threatening cardiac arrhythmias, including cardiac arrest; metabolic acidosis may exacerbate this situation

  ED Resus
  - Consider correcting Hyperkalemia/Hypocalcemia
    - If required, give calcium gluconate 10% 10mls or calcium chloride 10% 5mls IV over two minutes
    - Sodium bicarbonate 1mg/kg IV slow push
    - Regular insulin 5–10 U and D5O 1–2 ampoules IV bolus
    - Kayexalate 25–50g with sorbitol 20% 100mL PO or PR

  ITU
  - Alkaline diuresis is not required. Use Hartmann’s (lactated Ringer’s) or N. Saline

- **Complications**
  - **Compartment syndrome**
    - Apply ice to injured areas and monitor for pain, paresis, pain on passive movement, and reduced temperature of affected limb
    - Fasciotomies ED injury management

  Open wounds
  - Manage open wounds with
    - Antibiotics Speciality Overview
    - Tetanus toxoid
    - Debridement ED injury management
Penetrating knife injury

Terror related stab wounds differ from inter personal and non-terror related penetrating blade injuries. There are usually a greater number of wounds with more body regions injured, particularly of the upper body and neck.

**Terror related stab injuries (TRS)**
- Usually inflicted by a powerful overhand grip, with the intention to kill.

**Interpersonal stab injuries**
- Most likely to be caused by an underhand grip, with the intention to threaten the victim.

The management of penetrating trauma is likely to involve:
- endotracheal intubation
- chest drain insertion
- IR (if available) and/or surgery

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**Catastrophic haemorrhage**

1. Non-compressible? ➔ Does patient need to go direct to theatre?
2. Compressible? ➔ Apply direct pressure/junctional techniques/tourniquets. See immediate wound management IMED

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**Key Points**

- Tertiary survey (don’t forget the back)
- Whole body CT imaging with contrast, as soon as patient is stable enough
- Timely clinical reviews and re-review of imaging, to look for occult injuries. GI/GU injuries are challenging to diagnose
- Blood Borne Virus PEP Speciality Overview
- Counselling signposting Speciality Overview
Penetrating knife injury

In general, casualties injured in TRS events:
- More likely to arrive in ED in worse condition (hypotensive with lower GCS and lower revised trauma scores)
- More likely to require blood transfusion
- Will require more hospital resources to manage these patients
- Half are likely to require emergency surgery
- One third will require critical care (ICU)
- Have a significantly longer hospital stay compared with other mechanisms of injury
- Six times more likely to die in hospital after TRS

Anatomy of TRS wounds

Head and face
- Associated with an increased number of head, face and neck wounds, of greater severity

Spine
- More injuries to the spine and upper extremities

Chest
- More likely to have thorax and MSK injuries
- Chest injuries are more severe

Abdomen
Abdominal injuries are less likely, however in TRS the wounds tend to be more severe.
In non-TRS stabbings, casualties are more likely to have abdominal and lower limb injuries.
Hazardous Materials (HAZMAT) and Chemical, Biological, Radiological and Nuclear events (CBRN)

The management of CBRN casualties including HAZMAT follows general principles as well as specific treatment priorities including trauma care. Priorities depend on the type of exposure and presence of any contamination or contagious casualty hazards.

Assistance on managing such incidents should be obtained quickly through the national ECOSA (Emergency Co-Ordinated Scientific Advice system) and the clinical management of individual patients supported by NPIS (National Poisons Information Service).


PRINCIPLES OF CBRN CASUALTY CARE

- RECOGNITION
- SAFETY
- SELF AID/FIRST AID
- TRIAGE
- QUICK LOOK
- LIFE SAVING INTERVENTIONS (T1 casualties)
- CASUALTY HAZARD MANAGEMENT
- SUPPORTIVE MANAGEMENT
- DEFINITIVE MANAGEMENT
- REHABILITATION

PRIORITIES FOR CASUALTY CARE

- ‘Quick Look’ <Cat Haem>
  - Airway (antidotes)
  - Breathing
  - Evacuate

- Re-assess <Cat Haem>
  - Airway (antidotes)
  - Breathing
  - Circulation
  - Decontaminate
  - Evacuate

- Triage point
- F - First Aid and/or Life-Saving Interventions
- L - Advanced Medical Care
- A - Contaminated casualties
- C - Decontaminated casualties

Hot Zone
(Enhanced) First Aid

Warm (Decon) Zone
Emergency Medical Treatment

Cold / Clean Zone
Advanced Medical Care

PoE
Fwd CCP
CCS
Hospital

(Fwd) CCP - (Forward) Casualty Collection Point
CCS - Casualty Clearing Station
Role 2/3 MTF - Medical Treatment Facility (Including R2-Afloat, R2-Light Manoeuvre and R2-Enhanced)
Hazardous Materials (HAZMAT) and Chemical, Biological, Radiological and Nuclear events (CBRN)

**CBRN Guidelines: Recognition**

- Any symptoms involving emergency services and hospital staff
- Multiple casualties with similar non-traumatic symptoms and signs (STEP 1-2-3 PLUS)
- Unusual taste, smell or mist
- Unexplained dead animals
- Unexplained symptoms including:
  - Altered vision
  - Eye pain
  - Headache
  - Excessive secretions
  - Chest tightness
  - Difficulty in breathing
  - Non-thermal burns (erythema, blistering and necrosis)
- Any unusual or unexplained symptoms, signs, illness or deaths
- Unusual investigation result(s) including laboratory and diagnostic imaging

**Chemical exposures are more likely to be associated with immediate or acute (minutes to hours) onset symptoms although not in all cases. Biological and radiological exposures may not be obvious and have a longer onset time.**

**STEP 1-2-3 PLUS - SAFETY TRIGGERS FOR EMERGENCY PERSONNEL**

(adapted from Joint Emergency Services Interoperability Programme for hospital use)

**If any ambulance or hospital staff have symptoms - Go straight to Step 3**

- **Step 1: One person incapacitated with no obvious reason**
  - Manage using standard protocols (consider standard precautions).
- **Step 2: Two people incapacitated with no obvious reason**
  - Manage with caution using standard protocols (consider personal protective equipment).
- **Step 3: Three or more people in close proximity, incapacitated with no obvious reason**
  - Manage in a safe area well ventilated area(s) (consider disrobing before handover).

**PLUS: these safety interventions may include:**

- **Evacuate** - consider removing the patient, other patients and/or non-essential staff;
- **Communicate** - inform staff, management and/or emergency services;
- **Disrobe** - as a minimum remove clothing from P1 patients; and
- **Decontamination** - consider the requirement and type of formal decontamination, however where practicable life-saving interventions should be performed first.

**REFERENCE AND SPECIALIST ADVICE**

References:
- NATO Medical Management of CBRN Casualities (AMedP-7.1 Chapters 4 and 5)
- NHS Initial Operational Response (IOR) to a HAZMAT/CBRN Incident

Further advice:
- TOXBASE https://www.toxbase.org
Hazardous Materials (HAZMAT) and Chemical, Biological, Radiological and Nuclear events (CBRN)

CBRN Guidelines: Nerve Agents

Nerve agents are highly lethal organophosphorous compounds with varying physical properties ranging from volatile liquid and vapour hazard through to non-volatile liquid. Antidotes and supportive therapy are the main treatment options.

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<tr>
<th>TRIAGE</th>
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<tbody>
<tr>
<td><strong>P1 (Severe)</strong></td>
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<tr>
<td>Unconscious, convulsions, respiratory distress, respiratory paralysis / arrest, profound bradycardia (&lt; 40), cyanosis.</td>
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<tr>
<td><strong>P2 (Moderate)</strong></td>
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<tr>
<td>Not walking. Excessive secretions, confusion, not obeying commands, wheezing, incontinence.</td>
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<tr>
<td><strong>P3 (Mild)</strong></td>
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<tr>
<td>Walking. Pinpoint pupils, dimmed vision, eye pain.</td>
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<table>
<thead>
<tr>
<th>CASUALTY (CRESS) ASSESSMENT</th>
</tr>
</thead>
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<tr>
<td>Conscious</td>
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<tr>
<td>Convulsions</td>
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<tr>
<td>Unconscious</td>
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</table>

<table>
<thead>
<tr>
<th>EMERGENCY MEDICAL TREATMENT</th>
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</thead>
<tbody>
<tr>
<td><strong>NERVE AGENT ANTIDOTE AUTO-INJECTOR</strong></td>
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<tr>
<td>OXYGEN and IV/Io ACCESS</td>
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<tr>
<td>If seizures present, treat with anticonvulsants before oxime therapy</td>
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<tr>
<td>ATROPINE IV/Io 5-10mg (P1 patient)</td>
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<tr>
<td>PRALIDOXIME 2g IV/Io (total dose) over 5 minutes</td>
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<tr>
<td>REESESS</td>
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<tr>
<td>NA TOXICITY?</td>
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<tr>
<td>ATROPINE 5mg IV/Io</td>
</tr>
<tr>
<td>DIAZEPAM / MIDAZOLAM 5mg IV/Io</td>
</tr>
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</table>

* Common types of NA antidote auto-injectors

**COMBOPEN**
- 2mg Atropine
- 500mg Pralidoxime (PSS)
- 5mg Diazepam (equivalent)

**DUODOTE**
- 2mg Atropine
- 500mg Pralidoxime (PSS)

If delay in hospital level care, CBRN medically trained personnel may give all THREE nerve agent antidote auto injectors if:
- T1 patient
- Known nerve agent incident
- Patient has clinical features consistent with nerve agent intoxication

Pediatric Considerations
- Atropine (IV/Io) 0.02mg/kg
- Pralidoxime (IV/Io) 30mg/kg
- Lorazepam (IV/Io) 0.1mg/kg
- Midazolam (IV/Io) 0.2mg/kg
CBRN Guidelines: Nerve Agents

MECHANISM OF ACTION AND EFFECTS

Nerve agents cause the inhibition of the enzyme acetylcholinesterase that breaks down the neurotransmitter acetylcholine. This results in over-stimulation of the following parts of the nervous system:

Parasympathetic: Miosis, secretions (tears, bronchorrhea, salivation), vomiting, incontinence, bradycardia.
Central nervous system: Confusion, coma, seizures and central respiratory failure.
Sympathetic ganglia: Tachycardia, hypertension.
Neuromuscular junction: Fasciculation (systemic and local), depolarising paralysis, respiratory failure.

MEDICAL THERAPIES

Atropine: Atropine is an antimuscarinic and reverses nerve agent parasympathetic effects. The dose is titrated to effect based on the reversal of bradycardia (endpoint > 90), bronchospasm and secretions. High doses (up to 1000mg) have been used in the past especially in the absence of effective oxime therapy. Alternatives to atropine include hyoscine.

Oxime therapy: Oximes are enzyme reactivators and should be given as soon as possible to P1 patients. The first choice of oxime in the UK is pralidoxime and has good efficacy for sarin and VX. An alternative oxime is obidoxime and may be used if tabun or delayed enzyme reactivation is suspected especially with a requirement for high atropine doses or failure to reverse nicotinic effects.

Benzodiazepines: Benzodiazepines are used as anti-convulsants and are also neuroprotective.

Ventilation strategy: This is similar to the asthma ventilation strategy due to high airway pressures, and atropinisation can be monitored by reversal of bronchospasm and capnography normalisation.

REFERENCE AND SPECIALIST ADVICE

References:
- NATO Medical Management of CBRN Casualites (AMedP-7.1 Chapters 4 and 5)
- NHS Initial Operational Response (IOR) to a HAZMAT/CBRN Incident

Further advice:
- TOXBASE https://www.toxbase.org
Major incident STANDBY

Major incident STANDBY message has been announced;

- **External source of order**
  Message has been received from any of the emergency services or NHS England authorities, direct into ED, requesting your hospital to STANDBY for a major incident.

- **Internal source of order**
  Unusual activity reporting within ED, news via social media or other sources, may lead to a self declaration of major incident STANDBY by an ED consultant in discussion with the hospital on call team.

- Use the METHANE chart to record details of any alert messages. If you are self-declaring, other agencies may call you to ask for your METHANE information, so make it visible to all.

- Exact numbers are difficult, therefore estimates of total numbers of P1+P2 casualties may be given to help receiving hospitals understand severity of incident and numbers to prepare for.

⚠️ Self presenting casualties may start to arrive without warning, pre-alert or declaration, particularly if non-ambulance service transport is used.

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**Hospital Major Incident STANDBY**

### Emergency Department
- Initiate staff call in
- Locate and check the pre-printed/collated patient registration documents for a major incident
- Establish an ED Triage Station. Consider a location outside the ED (e.g., ambulance loading bay or external entrance)

### Critical Care
- Identify ICU patients suitable for transfer to ward
- Liaise with Theatre Co-ordinator for admissions to ICU

### All wards
- Assess ward patient potential for discharges/transfers
- Speciality Overview

- Send appropriate patients to the Discharge Ward
- Prepare Trauma Ward to accept admissions and ICU stepdowns

### Theatres
- Consider suspending all operations except for life-saving surgery
- Set up theatre co-ordination point
- Establish and attend clinical co-ordination meeting (aka Daily Trauma Conference)

### Resus
- Assemble Triage Teams and nominate roles
- ED Resus
- Aim for **one doctor and one nurse** per incoming casualty
- Include scribes and photographer if available
- Create checkpoints (to monitor patient flow. Ideally, patients should move in one direction away from the emergency department), with white boards, pens, casualty flow log/record book(s) and runners
- Porters to move all available trolleys to ED Reception
- Identify treatment areas, expanding Resus and Majors if required based on casualty estimates, consider creating a P3/non-urgent area away from ED
- Prepare to move patients already in the department

### Minors
- Discharge home (or to discharge area to await transport)
- Patients should receive a follow-up phone call the following day

### Majors
- Admit or transfer urgent cases requiring medical intervention

### Imaging department
- Aim to move cases away from ED CT Scanner if possible
- Urgent cases – remain in ED for imaging
- Cases in Majors – go to Inpatient imaging
- Urgent Imaging required within main hospital – go to OPD imaging
- OPD imaging may be suspended

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**METHANE**

- **M** Major incident STANDBY
- **E** Exact location of incident
- **T** Type of Incident
- **H** Hazards/potential hazards
- **A** Access (best routes for access to and exit from the hospital)
- **N** Number of casualties
- **E** Which emergency services are involved/needed?
THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK
METHANE report

METHANE is the recognised common model for passing incident information between services and their control rooms. All services have a common model which will mean information can be shared in a consistent way, quickly and easily, whoever the information is passing between.

<table>
<thead>
<tr>
<th>M</th>
<th>Major incident</th>
<th>Has a major incident been declared? (Yes/No)</th>
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</thead>
<tbody>
<tr>
<td>E</td>
<td>Exact location</td>
<td>What is the exact location or geographical area of the incident?</td>
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<tr>
<td>T</td>
<td>Type of incident</td>
<td>Blast/Explosion/Gunshots/Fire/Building Collapse/Flood/Chemical/Nuclear/Biological/Radiation</td>
</tr>
<tr>
<td>H</td>
<td>Hazards</td>
<td>What hazards or potential hazards can be identified?</td>
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<tr>
<td>A</td>
<td>Access</td>
<td>What are the best routes for access and exit?</td>
</tr>
<tr>
<td>N</td>
<td>Number of casualties</td>
<td>How many casualties are there, and what condition are they in?</td>
</tr>
<tr>
<td>E</td>
<td>Emergency services</td>
<td>Which, and how many, emergency assets and personnel are required or are already on-scene?</td>
</tr>
</tbody>
</table>

**MAJOR INCIDENT STANDBY**

Standby message received:
Date: 
Time: 

**MAJOR INCIDENT DECLARED**

Declared message received:
Date: 
Time: 

Please use the following spaces to write details and any changes/updates:
THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK
**Major incident DECLARED**

Be prepared to update the METHANE report or give out METHANE information to others

- **M** Major Incident has been DECLARED
- **E** The EXACT location is 
- **T** The TYPE of incident is 
- **H** HAZARDS identified are 
- **A** Casualties should ARRIVE by and ambulances should EXIT by 
- **N** Estimated NUMBER of Casualties are P1 P2 P3 
- **E** The EMERGENCY services involved are: Paramedics/HART/MERIT/HEMS/MCV/Others? Fire and Rescue/Police/Others?

### (H)MIMMS general checklist

- Prepare areas for clinical and administrative uses
- Call in appropriate number of staff (use cascade contact system)
- Maintain internal and external communications
- Provide a command and control structure for the medical, nursing and administrative staff

### ED checklist

- Staff already on duty should report to their clinical areas
- Called in staff should report to the Staff Reporting Area and await further instructions
- Review MOI section of these guidelines if mechanism(s) of incident known Mechanism of injury

- Hospital Ambulance Liaison Officers (HALO), if available will improve communications into the receiving hospital. They can also give real-time ED Resus capacity updates to the ambulance control centre and divert ambulances if required
- Know how many patients your hospital is expected to manage within the first hour (Patient dispersal framework and casualty capability chart) and plan/expect to exceed this number
- Minimal relatives should attend ED, however keep parents and children together if possible.
- Security may need to assist with management of relatives to the relatives area
- Documentation should be kept to a minimum
- Involve clinical photography early, to guide clinical care and for forensics
- Security screening (sanitization) of patients and relatives may be required and must be planned for

### ED Triage

- Should be established outside of ED, eg in the Ambulance reception area
- **Should be staffed by a Senior ED consultant and a Senior ED Nurse**
- Patients must be re- triaged at this point, in case of any change/deterioration since their on-scene triage category was given
- Patients should be given a pre-assigned (random) hospital ID number. This should remain their hospital number until the patient is on the wards, even if their real identity is known earlier
- Patients should be triaged to:
  - ED Resus (P1 Resuscitation)
  - Majors (P1&P2 likely to need surgery/critical care)
  - Minors (P2)
- Ideally, P3 walking wounded patients should not enter the ED but be directed to and managed in a separate area, given a clinic appointment, or advised to see a GP/other treatment facility
Major incident DECLARED

ED Resus

- There should be one treatment team per patient [ED Resus 1]
- A senior clinician should oversee all casualties in [Resus] and co-ordinate their transfer to theatre/imaging/critical care/ward as appropriate
- Identify, classify and record, patient’s identifiers and their injuries using the patient summary sheet

ED Majors

- All patients must have a careful primary and secondary survey
- Patients must be regularly observed to identify changes in their clinical condition
- Deteriorating patients may need a trauma team response, even though they have been in the department for some time
- Some patients may be well enough to discharge directly from ED, but should always have a follow up appointment with a hospital clinic or GP

ED Minors

- Most patients will be well enough to discharge directly from ED, but should always have some form of follow up arrangement made (eg. phone call the next day, or a letter to take to their GP)

ED Discharge Area

A common discharge area is useful in order to:
- Organise follow up arrangements
- Give patients time to talk to others and share their experiences
- Re-unite with relatives and friends prior to discharge. Allow this to be done away from any unwanted media attention
- Advise patients and their families how to cope with media attention
- Receive counsel from the hospital chaplaincy (multi-faith if available)

Psychosocial first aid is important:
- listening to stories, acknowledging a traumatic event, helping families
- talk to children about bad news
- patients may have worries about going home and getting back to normal

Immediate formal counselling is not often required and may make PTSD more likely to occur.

Some people have pre-existing mental health concerns and may need early referral [Specialty Overview 1]

Other considerations

1. Can refreshments be ordered for the clinical staff?
2. Are crèche arrangements required to support the staff response?
3. Consider placing non-MI major trauma on divert to other MTCs, whilst there is still a significant surgical workload
4. Consider diverting elective/other work load to other hospitals for several days/weeks
5. Consider an immediate ED team debrief once ED is cleared. (Hot debrief)
   - Take a roll call and ensure that all staff members (not just clinical) are invited to future debriefs
   - Multiple debrief sessions may be required to allow all staff who work shift systems to attend
   - Other debriefs will follow in the next few weeks and months

Check for tourniquets. They may be hidden under clothing or blankets. Not all patients will have a T (and the time) marked on their foreheads.

There should be a dedicated ED Porter assigned to keeping the blood fridge full with 10+ units blood ONeg (for females) OPos (for males) at all times
**NHS Clinical impact assessment call**  
- **Patient Summary Sheet** *(Patients 1 to 10)*

- This sheet gives early indication to NHS England, extent of resources required and plan support
- Precise details of injuries should not be recorded on this summary sheet
- Please only include admitted patients

- Recommended method: use one grid for patients with single injury and one for multiple system trauma

<table>
<thead>
<tr>
<th>Injury</th>
<th>Patient 1</th>
<th>Patient 2</th>
<th>Patient 3</th>
<th>Patient 4</th>
<th>Patient 5</th>
<th>Patient 6</th>
<th>Patient 7</th>
<th>Patient 8</th>
<th>Patient 9</th>
<th>Patient 10</th>
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<td>Hospital number</td>
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<td>On scene triage SIEVE (P1/P2/P3)</td>
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<td>Outcome (critical care/ward/RIP)</td>
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<td>Spinal injury – cord or fracture</td>
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# NHS Clinical impact assessment call
- **Patient Summary Sheet** (Patients 11 to 20)

- This sheet gives early indication to NHS England, extent of resources required and plan support
- Precise details of injuries should not be recorded on this summary sheet
- Please only include admitted patients

- Recommended method: use one grid for patients with single injury and one for multiple system trauma

<table>
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Emergency department triage (adults)

Priority for intervention

Introduction
This is an in-hospital clinical guideline for use in a major incident. It is designed to be used in times of SURGE in order to identify patients in need of a life-saving intervention and suggests the intervention(s) required.

- Early secondary assessment from senior clinicians is recommended to mitigate for initial over-prioritization.

⚠️ Note: This guideline is not designed for pre-hospital triage.

---

Catastrophic haemorrhage?

- YES
  - Low Priority walking wounded

- NO
  - Walking?
    - YES
      - Dead declare when resources allow
    - NO
      - Breathing?
        - YES
          - Responds to voice?
            - YES
              - High Priority (ABCDE)
            - NO
              - NO
                - NO
                  - Heart rate <100?
                    - YES
                      - Medium Priority reassess regularly

                - NO
                  - Respiratory rate 12–23?
                    - YES
                      - High Priority (ABCDE)
                    - NO
                      - NO
                        - NO
                          - Heart rate <100?
                            - YES
                              - Medium Priority reassess regularly

                          - NO
                            - NO
                              - respiratory rate 12–23?
                                - YES
                                  - High Priority (ABCDE)
                                - NO
                                  - NO
                                    - NO
                                      - Heart rate <100?
                                        - YES
                                          - Medium Priority reassess regularly

                              - NO
                                - NO
                                  - respiratory rate 12–23?
                                    - YES
                                      - HIGH Priority (ABCDE)
                                    - NO
                                      - NO
                                        - Heart rate <100?
                                          - YES
                                            - Medium Priority reassess regularly

                                        - NO
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                                            - NO
                                              - Heart rate <100?
                                                - YES
                                                  - Medium Priority reassess regularly

                                      - NO
                                        - NO
                                          - NO
                                            - NO
                                              - Heart rate <100?
                                                - YES
                                                  - Medium Priority reassess regularly

                                    - NO
                                      - NO
                                        - NO
                                          - NO
                                            - NO
                                              - Heart rate <100?
                                                - YES
                                                  - Medium Priority reassess regularly

                                - NO
                                  - NO
                                    - NO
                                      - NO
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                                          - NO
                                            - NO
                                              - Heart rate <100?
                                                - YES
                                                  - Medium Priority reassess regularly

                      - NO
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                                            - NO
                                              - Heart rate <100?
                                                - YES
                                                  - Medium Priority reassess regularly

 seconds

 The MPTT-24 is designed to minimise under-triage

 Adapted from Modified Physiological Triage Tool 24 (MPTT-24). Vassallo 2017 CC BY 4.0

---

High Priority for intervention
(big C)

Tourniquet
Pelvic binder
Haemostatic agents

Once applied, restart algorithm

---

High Priority for intervention
(ABCDE)

- Definitive airway
- Thoracostomy (needle/finger/tube)
- Chest seal
- Positive pressure ventilation
- ≥4units blood products OR un-crossmatched blood
- TXA
- Laparotomy/Thoracotomy/Pericardial window for trauma
- Surgery/IR for proximal vascular control
- ALS/ACLS for peri-arrest/arrest situations
- Neurosurgery for management of intra-cranial haemorrhage
- Spinal nursing for C1-C3 fracture
- Seizure-terminating medication
- Correction of hypothermia
- Correction of low blood glucose
- If CBRN suspected, consider chemical antidotes

---

i KEY POINTS

ED ‘triage for intervention’ principles
- Reassess patients regularly and repeat assessment after an intervention
- Is the patient now stable enough for CT whole body?
- Is the patient still a high priority for ‘direct to theatre’?
**Emergency department triage (adults)**

**List of life-saving interventions to be considered in a major incident or mass casualty event.**

These were defined through an international Delphi consensus of experts involved in major incident management.

1. Intubation for actual or impending airway obstruction
2. Surgical airway for actual or impending airway obstruction
3. Thoracostomy (needle/finger/tube)
4. Application of a chest seal (commercial/improvised)
5. Positive pressure ventilation for ventilatory inadequacy
6. Application of a tourniquet for haemorrhage control
7. Use of haemostatic agents for haemorrhage control
8. Insertion of an intra-osseous device for resuscitation purposes
9. Receiving un-crossmatched blood
10. Receiving ≥ 4 units of blood/blood products
11. Administration of tranexamic acid
12. Laparotomy for trauma
13. Thoracotomy or pericardial window
14. Surgery to gain proximal vascular control
15. Interventional radiology for haemorrhage control
16. Application of a pelvic binder
17. ALS/ACLS for a patient in a peri-arrest/cardiac arrest situation
18. Neurosurgery for the evacuation of an intra-cranial haematoma
19. Craniotomy/Burr hole insertion
20. Spinal nursing for a C1–3 fracture
21. Administration of a seizure-terminating medication
22. Active/passive rewarming for initial core temp < 32°C
23. Correction of low blood glucose
24. Administration of chemical antidotes

This process is designed to be used in circumstances when the receiving hospital is over-whelmed with casualties from a major incident i.e. in times of SURGE and when individual patients cannot be met by individual treatment teams. Casualties arriving at the hospital may not have undergone a pre-hospital triage process.

Under normal circumstances, casualties from a major incident will have undergone a pre-hospital triage process to determine their priority for treatment. On arrival at hospital, they will be met by individual and designated treatment teams.

The aim of this process is to rapidly identify those casualties in need of life-saving interventions. It can be completed by providers with all levels of experience in under 30 seconds.

The physiological assessments within the process are evidence-based (adapted from the MPTT-24) and have the greatest sensitivity for identifying those in need of life-saving interventions within both the civilian and military environments.

As a consequence of this, a greater proportion of casualties will be categorised as “High Priority” including a number of those who do not require life-saving interventions. At the earliest opportunity, and within a permissive setting, early secondary assessment by a senior decision-maker is required to review those categorised as “High Priority”.

References:

Emergency department triage (paediatric <12 years)

Introduction
In conventional triage, the objective is to sort and prioritise patients; to do the best for each individual. However the objective of triage in a mass casualty situation is to do the greatest good for the greatest number.

JumpSTART® is a system designed specifically for triaging children in disaster settings. Infants are seen first, followed by anyone who is or appears to be a child aged 12 or less.

- Allows paediatric casualties to be assessed based on physiology and should not prioritise paediatric casualties above sicker adult casualties
- Provides an objective framework when decision making may be stressful and emotive

KEY POINTS
- If a casualty appears to be a child, use this algorithm
- If a casualty appears to be an adult, use the Adult Triage tool ED Triage
- Speciality information
  - Reflects unique aspects of paediatric physiology
  - Can be completed within 30 seconds
# Emergency department triage (paediatric <12 years)

## Primary triage
- Typically performed at the scene of the incident
- Helps to prioritise patients for evacuation/transport
- Can occur at a hospital

## Secondary triage
- Performed to re-evaluate a patient after primary triage has been completed
- Typically done once the patient arrives in hospital
- Can also be done at an alternative care site, casualty clearing station or if time on scene is prolonged

## Priority 1 Immediate
Severely ill/injured but treatable. Able to be saved with relatively quick treatment and transport eg severe bleeding, sepsis, open chest or abdominal wounds, severe respiratory distress, emotionally uncontrollable.

## Priority 2 Delayed
Injured/ill and unable to walk on their own; potentially serious injuries/illnesses but stable enough to wait a short while for medical treatment eg burns with no respiratory distress, spinal injuries, moderate blood loss, conscious with a head injury.

## Priority 3 Minor
Minor injuries/illnesses that can wait for a longer period of time for treatment eg minor fractures, minor bleeding or minor lacerations.

## Priority 4 Expectant
Dead or obviously dying. May have signs of life but injuries are incompatible with survival eg cardiac arrest, respiratory arrest with a pulse*, massive head injury. It can be emotionally challenging to tag a child as expectant/deceased. Resist the tendency to assign a higher triage category to paediatric patients just because they are children. Using an objective triage tool during a major incident can provide emotional support for staff forced to make these decisions for children.

*In children, typically respiratory failure precedes circulatory failure. If a child is apnoeic but has a pulse, a brief trial of ventilations, may ‘jumpstart’ their respirations (trial: five rescue breaths)

## Main differences between adult and paediatric triage
1. In children, if positioning the airway does not restart ventilation, then give a trial of ventilation, as this may restart spontaneous ventilation. In adults, there is no trial of ventilation and the adult casualty is tagged expectant or dead.
2. In children, only peripheral pulses should be used to assess circulation.
3. In children, AVPU is used to assess mental status, not ability to follow commands.

Non-ambulatory children include:
- infants (who can’t walk yet)
- children with developmental delays
- children with acute injuries or chronic conditions prior to the incident that prevented them from walking

The JumpSTART® paediatric triage MCI triage tool (usually shortened to JumpSTART®) is a variation of the simple triage and rapid treatment (START) triage system. Both systems are used to sort patients into categories at mass casualty incidents (MCIs).

However, JumpSTART® was designed specifically for triaging children in disaster settings. Though JumpSTART® was developed for use in children from infancy to age 8, where age is not immediately obvious, it is used in any patient who appears to be a child (patients who appear to be young adults are triaged using START or other adult triage systems).
Emergency department outcomes, discharges and follow up advice in a major incident

In a major incident, decisions regarding the sickest patients need to be made quickly and decisively, so that these patients reach their treatment destination first time and without delay.

Less severely injured patients may be managed and discharged from ED with further management or follow up plans in place, if their wounds and physiological status allows this, to protect theatre and bed capacity for other more urgent cases.

This algorithm suggests rapid ED outcomes that are acceptable in a major incident, or mass casualty event.

**Q1**
Does patient need an operation/lifesaving intervention immediately?

**YES/MAYBE**
Discuss and triage with Resus Surgeon Commander (ideal dual Senior Consultant Surgeon/Anaesthetist)

**YES**
Inform Theatre Controller/ Surgeon Commander

**NO**
Patient can be transferred to Theatres holding area/ Critical Care/Trauma Ward to await surgery

**Q2**
Is the patient stable enough for imaging and requires it now?

**YES**
CT whole body

**NO**
Plain films

**Q3**
Can patient’s injuries be managed in ED?

**YES**
Patient can be discharged with advice

**NO**
Patient needs admission

**Critical Care**
- Inform ICU Controller and admit to Critical Care

**Trauma Ward**
- Inform ED Support Manager and admit to the Trauma Ward
- Create a basic management plan to assist the ward staff in caring for the patient

**Use Major Incident Discharge protocol**
- Patient be given letter for GP
- Follow up appointment(s)
- Injury advice sheet(s)
- Psychosocial advice leaflet Speciality Overview
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**Trauma team roles in a major incident**

The usual full ED trauma team response may not be possible. This guide suggests the essential roles and jobs to receive and resuscitate a trauma patient. Some roles can be quickly assigned to clinical staff who are not usually part of the trauma team and this guidance contains job lists for those roles.

- **Essential trauma team to receive the casualty**
- **Minimum medical team to remain with casualty** until delivered to theatre/critical care or trauma ward
- **Additional roles if staff available**

### Anaesthetist Support ODP

**Pre-Arrival:**
- Equipment check
- Collect emergency drugs

**On Arrival:**
- Places monitoring on patient
- Checks C-Spine collar correctly applied
- Assists Trauma Anaesthetist – AIRWAY
- Assists A-Line insertion
- Checks equipment ready for move to CT/Theatre/Other destination

### Trauma Doctor 1

**Pre-Arrival:**
- Preps thoracotomy tray
- Switch on USS/FAST
- Scissors for clothing removal

**On Arrival:**
- Removes casualty’s clothing
- Primary survey CABCDE
- Plans for any other procedures eg FAST, ICDs, as required/able
- When appropriate, conducts secondary survey

### Trauma Anaesthetist

**Pre-Arrival:**
- Equipment check with ODP

**On Arrival:**
- Assesses Airway and reports to TTL&Scribe
- Prescribes and gives O₂, fluids and drugs
- Plans for RSI if required
- Has analgesia been given? Is pain control adequate?
- Maintains C-Spine immobilisation for log roll
- Takes control of the log roll
- AMPLE (if patient conscious)
- Gives TXA bolus/infusion as early as possible
- A-line insertion once airway secure
- Remains with patient until final destination (Theatre/ICU/Ward)

### Senior Resus Nurse/Co-ordinator

- Receives METHANE updates
- Co-ordinates and supports nursing staff response
- Resus “crowd controller”

### Trauma Team Leader (TTL)

Controls Trauma Call
Stay with Scribe and stays ‘Hands Off’

**Pre-Arrival:**
- Assembles the team
- Universal precautions/ID bibs/lead aprons for all staff
- Delivers ATMIST report
- Gives likely diagnoses/injuries to need immediate management and makes a plan

**On Arrival:**
- Calls silence for handover
- Controls and manages the resuscitation
- Makes key decisions: eg MHP activation, RSI, Imaging, ICD insertion
- Keep writing/recording everything you see and hear in the bay
- Stay in one place

### Trauma Doctor 2/Nurse

**Pre-Arrival:**
- Preps cannulation, blood sample bottles, Imaging request form

**On Arrival:**
- Confirms that the imaging request has been made and CT is ready to scan
- Gains IV access and takes trauma bloods
- Places urinary catheter if required
- Plans for any other procedures eg FAST, ICDs, as required/able
- When appropriate, conducts secondary survey
- Calls silence for handover
- Controls and manages the resuscitation
- Makes key decisions: eg MHP activation, RSI, Imaging, ICD insertion

### Rapid Transfusion 1 (plus 2nd if available)

- (team of 2 works best in practice)
- Primes rapid transfuser with small vol (100mls) of crystalloid
- 2 bags of RBCs already hanging

---

**Scribe**
- Keep writing/recording everything you see and hear in the bay
- Stay in one place
**Trauma team roles in a major incident**

**Major Incident Trauma Team**
As part of the Major Incident STANDBY and DECLARED action, theatres, critical care, blood bank, surgical specialities and imaging will have also been informed and making ready to receive casualties.
- The MI Trauma Teams can focus on making their resus bay ready to receive a casualty
- Relatives should be managed by other hospital teams and should not come direct to ED Resus
- If required, the Senior Resus Nurse should manage any overcrowding in Resus

**Key Roles explained**

**Commanders**
- The area Commanders are senior doctors with knowledge to manage all activity in that area and be able to prioritise patients for resuscitation, imaging, procedures etc.
- They may also be responsible for overseeing the clinical plans and decision for all patients, however, some systems have additional Commanders (Senior Medical Clinicians with specialist knowledge of major trauma for instance Surgeon Commander, Major Trauma Consultant/CTC) to assist with individual polytrauma patient management.

  e.g.  
  **ED Resus Commander**
  - Oversees all Resus activity and prioritises patients for resus bays or move out to majors
  - Maintains hospital and pre-hospital situational awareness via regular hospital updates and METHANE reporting

  **Resus Surgeon Commander**
  - Usually senior/experienced trauma surgeon or trauma intensivist/anaesthetist
  - Supports TTLs and prioritises patients for theatres and imaging
  - Liaises with Imaging, Theatres and Critical Care for casualty demands
  - Also known as surgical triage commander, co-ordinating trauma consultant

**Co-ordinators**
- Area Co-ordinators can be senior clinical staff (doctors, nurses, AHPs), who support the Commanders in delivering care.
- They provide oversight of the department, keep informed of the pre-hospital situation and assist with patient movements between resus, imaging, theatres, critical care and the wards.
- The Theatre Co-ordinator will also need to keep the surgeon commander informed for theatre space, surgical kit availability, theatre staffing/skill mix etc.
- They will also keep Hospital control informed of capacity in their areas, after consultation with their area Controller.

  e.g.  
  **Resus Senior Nurse Co-ordinator**
  - Co-ordinates the nursing response in ED
  - Ensures that a scribe and a suitable nurse are available for each trauma team/resus bay
  - Informs hospital control of staffing needs and patient numbers
  - Liaises with Site manager/Bed manager when destination identified for patient
  - Responsible for crowd control (staff and relatives) in Resus

**Hospital Control**

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<tr>
<td><strong>ED Resus Commander/MT Consultant/CTC</strong></td>
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<tr>
<td>ED Resus Co-ordinator</td>
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</table>
### Pre-Arrival

**Trauma Team Leader (TTL)**
- Assemble team and ensure universal precautions are worn
- Relay ATMIST to team and identify possible injuries to prep for
- Check that the Resus Surgeon Commander/Speciality teams are aware of patient’s details
- Confirm with receiving Trauma Team that equipment is ready and are there any issues?

**Checklist:**
- Airways and emergency drugs
- Rapid Transfuser primed
- ONeg blood ready (OPos if male)
- Thoracotomy set ready
- Cannulation for IV access (plus alternative e.g. EZIO), blood bottles, A/VBG
- Trauma Documentation incl CT imaging request form
- Identifies bags for clothing and forensic specimens
- ALL casualties from an MI/MCE should remain under their hospital trauma number until in ICU/Ward and no further blood transfusion is required

### On Arrival

- SILENCE for pre-hospital handover to team (ATMIST)
- Control and manage the trauma resuscitation
- Remain HANDS OFF during the resuscitation
- Make key decisions and prioritise investigations, interventions and treatment (MAKE A PLAN)

**Checklist:**
- Activate Massive Transfusion Protocol
- Request “sitreps” from anaesthetics/airway team
- Hypothermia mitigation
- Check patient details on blood samples
- Has catastrophic haemorrhage been controlled?
- Is Airway secure/Breathing optimised/IV access gained?
- Is patient ready for CT Wholebody imaging?
- Is patient unstable/transient responder? – inform Resus Surgeon Commander, patient may need to go direct to theatre
- Transfer patient to CT
- Make a management plan with Trauma Anaesthetist
- Inform Resus Surgeon Commander of your findings and plan for destination after Resus
- Ensure Tetanus prophylaxis, IV antibiotics, TXA are considered and prescribed
- Ensure all documentation including decision making, blood products and drugs are documented/prescribed clearly
- Obtain CT HOT REPORT
- Handover patient to Trauma Anaesthetist

Patient moves to next clinical area with Trauma Anaesthetist and CT Hot Report

### Pre-Arrival

**Scribe**
- Familiarise yourself with MI documentation
- Assist by obtaining any request forms e.g. blood, imaging
- Locate yourself next to the TTL

### On Arrival

- Keep writing!
- Record times and details of decision making and any issues, as well as any responses to an intervention
- Don’t be afraid to speak to confirm findings/information

### Pre-Arrival

**Resus Anaesthetist- remains with patient**
- Check all essential equipment with your assistant
- Conduct RSI WHO checklist
- Ensure RSI drugs, analgesia and TXA are available
- Prep for any potential procedures (as suggested by TTL)

You are expected to stay with the patient until an appropriate handover after Resus (Theatres/ICU/Ward)

### On Arrival

- Co-ordinate the safe transfer of patient from pre-hospital trolley
- Secure the airway (after discussion of airway findings with TTL)
- Give O₂, airway interventions and RSI if required
- Maintain C-Spine immobilisation and control the log roll
- Take an AMPLE history if patient is conscious and able
- Prescribe all fluids and drugs given to the patient
- Discuss and finalise the management plan with TTL

You are expected to stay with the patient until an appropriate handover after Resus (Theatres/ICU/Ward)
### Pre-Arrival

#### Resus Anaesthetist Assistant
- Set up and check airway equipment
- Collect drugs from cupboard and fridge
- Ear thermometer
- Collect Trauma ID tag
- Prep monitoring equipment

#### On Arrival
- Assist the Trauma Anaesthetist with airway interventions
- Check C-Collar is correctly fitted
- Take temperature on arrival
- Attach Trauma ID on arrival
- Attach ECG monitoring, BP cuff and pulse oximeter
- Prepare and administer drugs as required/requested
- Ensure equipment and drugs are gathered for a safe transfer from Resus to destination e.g. CT

### Pre-Arrival

#### Trauma 1 (Senior Doctor ATLS trained)
- Prep thoracotomy tray
- Identify FAST scanner for use if required
- Scissors for clothing removal
- Confirms with Trauma 2 which skills they have, procedures they are comfortable with and if any support may be required.

#### On Arrival
- (C) Identify any catastrophic bleeding and manage accordingly
- (A) Confirm with Trauma Anaesthetist that airway is clear and secure
- BCDE (Primary Survey) as usual
- Relay finding clearly to TTL and Scribe
- Perform other procedures/investigations as required e.g. FAST, IV cannulation/access depending on skills and training
- If appropriate, proceed to secondary survey

### Pre-Arrival

#### Trauma 2 (Doctor/Nurse/PA)-remains with patient
- Prepare to secure IV access and obtain blood samples including venous/arterial blood gas, ROTEM/TEG if available
- Identify appropriately skilled operator for IO/Venous cutdown if not in skillset
- Prepare the blood request forms
- Scissors- prepare to unclothe patient, but be mindful of dignity, hypothermia and exposure

#### On Arrival
- Secure IV Access: Aim for minimum 2x large IV access. IO/Venous cutdown access may be required
- Obtain blood for:
  - A/VBG
  - FBC
  - U&Es
  - LFTs
  - Amylase
  - Clotting screen (INR, aPTT, Fibrinogen)
  - Group&Save
  - Crossmatch ___ units (confirm quantity with TTL)
  - CK
  - pregnancy test if female
- Assist Trauma 1 (Procedures such as ICD insertion etc)
- Place urinary catheter post CT (if no pelvic trauma and required)

You are expected to stay with the patient and assist the Trauma Anaesthetist, until an appropriate handover after Resus (Theatres/ICU/Ward)

You are expected to stay with the patient and assist the Trauma Anaesthetist, until an appropriate handover after Resus (Theatres/ICU/Ward)
Catastrophic haemorrhage and massive transfusion pathway in a major incident

The definition of major haemorrhage is bleeding that leads to HR >110 beats/min and/or systolic BP <90mmHg. Pre-hospital management focuses primarily on the prevention of further blood loss and the active management of hypothermia and hypoperfusion to prevent Trauma Induced Coagulopathy (TIC).

Pre-hospital
- Tranexamic Acid (TXA), an antifibrinolytic, should be given within three hours of injury (ideally within the first hour)
- Minimal non-haematological fluids should be used in order to maintain a central pulse

ED Resus
Once a major incident has been declared:
- Request one MHP1/MTP1/Shock pack for each P1 casualty expected
- Consider basing transfusion staff in ED (transfusion practitioners/medical staff) to support multiple ED transfusions
- A porter should be assigned to the ED blood fridge

Theatres
- Consider basing transfusion staff in theatres to support multiple ongoing transfusions
- NHS Blood Transfusion Service (NHSBT) is also responsible for holding CBRN (ie Nerve Agent) antidote pods MOI
- Once a patient has reached hospital, care should be as close to the gold standard as possible

Significant bleeding
HR >110
Systolic BP <90
No Radial pulse

Ongoing resuscitation
Standard CABC approach
- Secure IV Access
- Ensure patient has a hospital number and ID band
- Take blood samples for:
  - baseline blood tests (FBC, U&E, G&S)
  - clotting screen (PT, APTT, Fibrinogen)
  - Ca²⁺ and lactate
  - arterial blood gas (ABG)
  - ROTEM/TEG/VHA/Haemostatic testing if available

STOP THE BLEEDING
- Apply dressing +/- topical haemostat/gauze and direct pressure to any obviously bleeding wound
- Apply pneumatic tourniquet proximal to the bleed (limb)
- Is a pelvic binder indicated?

IF BLEEDING DOES NOT STOP
- Plan for theatre for definitive wound management and start massive transfusion

MASSIVE TRANSFUSION PATHWAY
Catastrophic haemorrhage and massive transfusion pathway in a major incident

**MASSIVE TRANSFUSION PATHWAY**

- **Open MHP1 pack**
  - Use rapid transfuser/blood warmer if available
  - Give FBC:FFP in 1:1 ratio (until coag monitoring available)
  - Anticipate the need for platelets and cryoprecipitate (fibrinogen)

**Reassess patient**

- Is there suspected continuing ongoing haemorrhage?
  - Repeat trauma bloods
  - baseline blood tests (FBC, U&E, G&S)
  - clotting screen (PT, APTT, Fibrinogen)
  - Ca²⁺ and lactate
  - arterial blood gas (ABG)
  - ROTEM/TEG/VHA/Haemostatic testing if available

**If bleeding continues**

- Open MHP2 pack

**If lab results are now available**

- (And use group specific blood if available)

**Goal directed therapy**

- Falling Hb
- APPT and/or ratio >1.5
- Fibrinogen <1.5 g/l
- Platelet count <75x10⁹/l

- **Lab bloods not yet available**

  - Continue to transfuse RBC:FFP:Platelets ratio 1:1:1
  - Consider cryoprecipitate (fibrinogen concentrate may be available)
  - Chase lab results to enable goal directed therapy

**MHP1 pack** may contain;

- Four units RBCs (may be obtained from an emergency stock of Group O blood)
- Four units plasma (Group A or AB)

**Other considerations**

- Is group specific blood now available?
  - Aim for goal directed therapy using group specific blood
- Has TXA bolus been given?
  - if <3hrs after injury, give TXA 1g IV bolus over 10 mins
- Is the TXA infusion now required?
  - Then, TXA 1g IV infusion over 8 hours
- Anticipate low Calcium
  - Consider 10mls of 10% Calcium Chloride IV bolus over 10 mins (after MHP1)

**MHP2 pack** may contain;

- Four units RBCs
- Four units Plasma
- One dose (ATD) Platelets
- One pool of cryoprecipitate

**Post resuscitation aims of Goal Directed Therapy**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hb</td>
<td>80–100 g/dl</td>
</tr>
<tr>
<td>Platelets</td>
<td>&gt;75 x10⁹/l</td>
</tr>
<tr>
<td>PT ratio</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>APTT ratio</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>Fibrinogen</td>
<td>&gt;1.5 g/l</td>
</tr>
<tr>
<td>Ca²⁺</td>
<td>&gt;1 mmol/l</td>
</tr>
<tr>
<td>K⁺</td>
<td>&lt;5.8 mmol/l</td>
</tr>
<tr>
<td>Temp</td>
<td>&gt;36°C</td>
</tr>
<tr>
<td>pH</td>
<td>&gt;7.35 (on ABG)</td>
</tr>
</tbody>
</table>
Catastrophic haemorrhage and massive transfusion pathway in a major incident

- Trauma Induced Coagulopathy (TIC) is the acute intrinsic coagulopathy arising in severely injured trauma patients and is considered to be an emergent property of tissue injury combined with hypoperfusion.
- Massive Haemorrhage Packs (MHP) = Massive Transfusion Packs (MTP) = Shock Packs
- Universal components (ABO compatible blood products) may be used in the initial shock packs, but group specific component should be used when safe to do so. MHP/Shock Packs vary between hospitals – be familiar with local practice.
- RBCs and Platelets should be RhD and K compatible to prevent the future development of antibodies, however Group O RhD and K Negative red cells may be in short supply and should be prioritised for children and women under the age of 50.
- Best practice requires two separate blood samples to confirm the ABO and RhD groups.

Blood Planning
Recent reviews of MCEs recommend planning for a red cell demand of 3 RBC units per 24 hours, for each casualty admitted to the hospital (usually P1 and P2s). An early estimate for more severely injured casualties admitted to trauma centres, i.e. P1 casualties with massive haemorrhage, is nearer 6 units of RBC in the first 24 hours. Many of these patients may also require plasma, platelets and cryoprecipitate as guided by Major Haemorrhage protocols. Hospital Transfusion Teams should be aware of their organisation’s pre-determined first hour capability (P1 and P2) in order to inform their EPRR planning.

Use of blood products, coagulation studies and VTE prophylaxis
- Serial coagulation studies (Platelet count, PT, APTT and fibrinogen) or ROTEM/TEGs should be done, before and after resuscitation and every 30–60 minutes depending on severity of haemorrhage, to guide use of blood products.
- Cryoprecipitate is the standard source of fibrinogen in the UK. Consider if Fibrinogen falls below 1.5g/l. 2 pools (from five donors each), will increase fibrinogen in an adult by 1g/dl approx.
- If FFP or Cryoprecipitate is required urgently for a patient, before the blood group is known, then Group A should be issued (adults). In massive haemorrhage, the risk of clinically significant haemolysis is likely to be very low.
- Thromboprophylaxis should be given after major haemorrhage and should be started as soon as possible after bleeding ceases. There is some evidence from obstetrics that those who bleed excessively have a higher rate of VTE.

Blood donations during/after a major incident
One of the immediate responses of the public is to offer to donate blood. The challenge for blood services is how to harness that spirit of public altruism that manifests after a disaster, without wasting any blood. In 2001 after the World Trade Centre and Pentagon attacks, 475000 units of blood were collected, but only 258 used. Please advise any prospective donors that their blood is likely to be needed in the future and that they should register as a blood donor and respond to the blood donation service’s requests for blood.
**MI senior clinical decision making**

- Dual senior decision making is preferred
- *Simplified to five clinical outcomes in a major incident*
- Reassess casualties often
- Consider palliation or upgrading care if the casualties condition changes or if the situation changes (for example delays to transfer)
- Using POC thromboelastography (TEG/ROTEM) to guide resuscitation is the gold standard
- Consider Interventional Radiology if capability is available locally (without need to transfer) and if theatre space is limited
- FAST not yet proven to be reliable in trauma however may assist prioritisation of patient to imaging or theatre

---

**Emergency Department Triage**

- Patient needs surgical assessment

**Clinical review by Senior Decision Maker(s)**

- Ideally a dual senior Surgeon and Anaesthetist combination

---

**Conventional workup and treatment**

**For active treatment**

- No immediately life or limb threatening injury

---

**ONGOING DAMAGE CONTROL RESUSCITATION**

- GIVE TXA

3. Occult injury

4. Obvious clinical indication for theatre

5. External bleeding

---

**Operating theatre**

- Responder
- Non-responder
- Not controlled
- Controlled

---

**Imaging**

- HEAD INJURY OR NEURO AXIAL INJURY

**Recovery/critical care or ward**

---

**Consideration of situation or resources may drive the decision to palliate earlier than would normally be considered in a single casualty situation**
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MI imaging (including CT whole body)

Imaging is vital for triaging patients, helping to plan surgery, for assessing urgency of surgery and to help guide ongoing surgery. Unusual mechanisms and unfamiliar pathology are the hallmark of MI patients.

- Plan for interval imaging over the next few weeks as injuries evolve, blast injuries in particular.
- Use FAST USS imaging to stratify multiple patients; to decide who needs a CT, who needs it urgently and who needs to go directly to theatre.

CT is no longer the ‘doughnut of death’. Patients can be resuscitated during a CT scan unless critically unwell, in which case the patient probably should have gone direct to theatre.

CT whole body takes two minutes, the rest of the time is spent on patient transfer and preparation. Regular team training will reduce this. CT whole body radiation exposure is approx 12mS.

Features of blast injuries seen on CT whole body

**Head**
- Haemorrhage
  - intra- or extra-axial
  - small petechial foci
  - at bone ridges
- Middle ear effusion
  - +/- ossicular disruption
- Fractures

**Neck**
- Oedema
- Larynx and oesophageal
  - penetration
  - rupture
- Laryngeal fracture

**Abdomen and pelvis**
- Hollow viscus rupture
- Solid organ
  - AVM/pseudo-aneurysm
  - cavitation effect
- Consider repeat interval CT imaging to look for evolving injuries

**Thorax**
- Pericardial and great vessel integrity
- Tracheobronchial integrity
- Pneumothorax/haemothorax
- Lung parenchyma
  - contusions
  - infiltrates
  - emboli (may be transient)
  - ARDS may develop over next 24-72 hrs

**Vascular injury**
- Haemorrhage or embolus
- Aneurysm or pseudo-aneurysm
- Vessel splaying
  - Fragment within 5mm of artery
- AVM/pseudo-aneurysm

**Bones**
- Spinal fractures and mal-alignment
- Long bone fractures
  - fat embolus
- Pelvic ring injury
  - SIJ integrity
  - sacral fractures

**KEY POINTS**

- Avoid MRI in acute phase
  - Assume all frag/metallic foreign bodies are ferromagnetic until proven otherwise
  - Pistol rounds tend to be non-ferrous but there are exceptions
  - MRI likely to be safe after six weeks with caveats
- RCR, PHE and Welsh guidance is available online

- CT whole body
  - Low threshold to image in mass events and in blast (blast radius can be large)
  - In blast injuries, CT whole body means head to ankles
  - CT traumagram means head to lesser trochanters (Bastion protocol)
  - Intraoperative CT can be done after haemorrhage control is gained
  - Repeat, delayed imaging at 5–7 days should be considered if solid organ injury

Department planning
- Consider senior consultant in ED to coordinate imaging flow
- Use USS in ED to triage to CT
- Two consultants per CT scanner
  - The first issues an acute report, the second completes a full report
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**MI anaesthesia** (for P1/Resus casualties)

**Anaesthesia Induction**
- RSI checklist – decide and designate responsibilities/tasks
- Patient in ‘star’/cruciform position

**Communication**
- WHO briefing: WHO is doing WHAT and in WHAT SEQUENCE?

---

**A**
- Uncut endotracheal tube (ET)
- Use a smaller size ET tube in anticipated airway difficulty
- Heat and moisture exchange filter (HME)

**B**
- Check tubes are not kinked
- Ensure bags/bottles are visible

**C**
- Major blood loss?
  - 8.5F central access for rapid transfusion and/or large peripheral line
- Hypovolaemia
  - Reduce doses of induction agents
  - Consider using Ketamine
  - Monitor urine output

Arterial line for:
- blood samples
- blood pressure

**E**
- Warm patient: blanket mattress, warm fluids, theatre temperature

---

**KEY POINTS**

- **Falling oxygen saturation**
  - Has IPPV caused an unrecognised pneumothorax to develop into a tension pneumothorax?
  - Is there developing lung contusion or ‘blast lung’?
  - Could there be emboli?

- **Circulation**
  In ‘non-star’ patient positions (eg lateral), is the patient position impeding:
  - diaphragm movement?
  - chest movement?

- **Circulation**
  Unexplained drop in blood pressure NOT due to hypovolaemia. Consider:
  - tension pneumothorax?
  - cardiac tamponade?
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MI neurotrauma (brain injuries)

The principal aim is to prevent or reduce secondary brain injury. Ideally a patient with a brain injury would be transferred to a neurosurgical centre, however in a major incident this may not be possible, or other injuries may dictate that a patient should be cared for at another specialist centre.

These guidelines are to assist in recognising which patients need to be transferred for surgery (once transfers are possible) and how to optimise their care prior to that transfer.

Most common blast brain injuries are diffuse axonal injury (DAI), cerebral contusions and subdural haemorrhage.

Assessing for brain injury

Conscious level
- AVPU Good for basic assessment
- GCS Preferred for monitoring patient and detecting subtle signs of deterioration
  - Mild GCS 14-15, Moderate GCS 9-13, Severe GCS <8
  - Please use the E4, V5, M6 breakdown when discussing with neurosurgeons
  - Record patients’ GCS prior to intubation if applicable

Pupil response
- Pupillary response is a lateralisign sign and can indicate the side of the injury

Limb weakness
- Simple documentation of a patient’s movements at each assessment, starting on scene is very important ie patient able to move all four limbs

Signs of injury
- Document any lacerations, bruising, open/closed/depressed skull fractures, extruding brain.
  - However, mild traumatic brain injury (mTBI) and simple contusions often occur without any external signs of injury

Other medical management

Keppra (Levetiracetam)
- Loading dose 1g then 500mgs BD for 7/7 should be used to prevent fitting in any patient with intracranial haemorrhage

Pneumococcal vaccine
- Should be given to patients with open cranial fractures and if there is any evidence of intracranial gas

Avoid:

Steroids
- Increased mortality at two weeks associated with steroid use in head injury (GCS<14) and should be avoided

Nimodipine
- No evidence to support its use in cranial trauma

Magnesium
- No evidence to support its use in cranial trauma

Antibiotics
- No evidence that antibiotics prevent infection in skull based fractures, with or without CSF leak

Does the patient require intubation to secure the airway?
- Intubate early if patient is aggressive or combative or has a low GCS
- Intubate to protect the airway and allow safe transfer to CT Scan

Manage chest injuries to optimise ventilation and reduce risk of hypoxic brain injury

Control haemorrhage and correct hypovolaemia
- Maintain systolic blood pressure >100mmHg
  - Volume replacement should be with blood until bleeding as a cause of hypovolaemia is ruled out.
  - Hypertonic saline may improve outcome, especially in TBI patients with GCS<8
  - Anticoagulants should be reversed (unless there is an overriding medical reason not to)

If ICP raised, there are some simple techniques to reduce ICP, including:
- Remove cervical collar (it may be strangling the patient)
- Avoid moving the patient (except for pressure relief)
- Nurse head-up (at 30°)
- Sedate and give analgesia. Most forms of sedation will reduce BP.
- Control ventilation. Aim for normocapnia and keep PEEP <12 H2O
- Mannitol (diuretic action): 0.5–1g/kg IV dose is given (can be repeated if required)
- Hypertonic saline: 6mL/kg of 5%, up to 350mls max dose

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### MI neurotrauma (brain injuries)

#### Types of brain injury

<table>
<thead>
<tr>
<th>Primary brain injury</th>
<th>Secondary brain injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>If patient requires surgery, it is unlikely that any medical intervention will replace surgical management. However, prevention of secondary injury is essential.</td>
<td>Protect airway, high flow oxygen with re-breathe mask during resuscitation. A single episode of hypotension between injury and resuscitation doubles mortality and morbidity.</td>
</tr>
<tr>
<td>Hypoxia</td>
<td>Poor cerebral perfusion secondary to hypovolaemia causes raised intracranial pressure: treat hypovolaemia early.</td>
</tr>
<tr>
<td>Ischaemia</td>
<td>Intracranial haematoma or oedema can raise intracranial pressure (ICP). This also reduces perfusion and causes ischaemia.</td>
</tr>
<tr>
<td>Raised intracranial pressure</td>
<td>Normal ICP is 5–15mmHg. When ICP &gt;20mmHg, contact the neurosurgical centre for advice on escalation of treatment.</td>
</tr>
<tr>
<td>Acidosis Coagulopathy</td>
<td>Injury at cellular level causes lactic acid production and coagulopathy: reduced cerebral blood flow results in accumulation and further cellular damage.</td>
</tr>
<tr>
<td>Abnormal blood glucose</td>
<td>Lack of glucose in the presence of oxygen results in neuronal necrosis; this is even more significant in hypoxia.</td>
</tr>
<tr>
<td>Others</td>
<td>Including cytotoxic cascade, vasospasm.</td>
</tr>
</tbody>
</table>

#### Classification and significance of brain injuries

| Extradural (epidural) haematomas (EDH) | Small EDHs can be managed conservatively, however most will require neurosurgical evacuation. |
| Subdural haematomas (SDH) | Usually associated with significant primary brain injury, and therefore outcome is usually worse than EDHs. May be due to an acute or chronic bleed. Acute bleeds must be recognised, as they may cause mass effect/midline shift and are likely to need neurosurgical intervention. |
| Subarachnoid haemorrhage | Unlikely to require surgical treatment and can be managed with good supportive care. Will need to have a non-urgent CT Angio to exclude aneurysmal cause. |
| Contusions and intracerebral haematomas | Discrete contusions and haematomas may coalesce and evolve. Tends to peak 48–72 hours post injury. Intracranial pressure may need to be monitored. Oedema and associated rise in ICP may make these minor cerebral injuries life threatening and difficult to treat. |
| Diffuse injuries | Full spectrum of injuries from mild concussion through to severe diffuse axonal injury (DAI). Little scope for surgical intervention and these patients are usually managed in regional severe brain injury centres. |

#### Signs of basal skull fractures

| CSF rhinorrhea | Use BM stix/urine dipsticks to test for Glucose (present in CSF but not in mucus). Give Pneumovax if unvaccinated. |
| Bilateral peri-orbital haematomas (Raccoon/Panda eyes) | Associated with fractures of the anterior cranial fossa (present in 50–60% of cases). May take 1-3 days to develop. |
| Subconjunctival haemorrhage | May indicate blood tracking from the orbital cavity. |
| CSF otorrhea | May be due to ruptured tympanic membrane (CSF leak) or blood from an external ear laceration. |
| Bruising over the mastoid(s) (Battle’s Sign) | May take 24-48 hours to develop. |
MI surgical/proximal haemorrhage control

If catastrophic haemorrhage cannot be stemmed by direct pressure or a tourniquet, so called “uncompressible haemorrhage”, it is essential to obtain control by surgical access. This is normally most rapidly achieved by exposing vessels proximal to the immediate zone of injury. To control retrograde filling, vessels distal to the injury should also be exposed.

- In the profoundly hypovolaemic patient a palpable pulse may not always be present so finding the vessels relies on knowledge of anatomical landmarks.
- REBOA may have a role but currently should be viewed as experimental and used as part of a trial.
- Interventional radiology is not recommended for genuine catastrophic haemorrhage in an unstable patient.

**Primary (Rapid Access) Incisions:**
1. Longitudinal incision along anterior border of the sternocleidomastoid muscle (ABSCM)
2. Clam shell thoracotomy
3. Supraclavicular for proximal control of arm vessels
4. Lower midline laparotomy for pelvic packing (can be extended to 15)
5. Clam shell thoracotomy
6. 4th intercostal space clamshell incision for all large thoracic vessels
7. 4th intercostal space anterolateral thoracotomy
8. Cardiac tamponade
9. Control of the descending thoracic aorta
10. If there is solid organ injury, rapid control is achieved by packing

**Key Points**
- Use extensile incisions
- Incision can incorporate wound line if required. If there is time, photograph wound before surgery. If not, document the wound and incision extension
- Aim to achieve proximal/ distal control outside of any haematoma or zone of injury

**Upper limb**
- Medial supraclavicular incision running parallel to the clavicle
  - control of the subclavian vessels as they cross the first rib
  - most proximal part of the axillary artery
- Lateral horizontal infraclavicular incision
  - access to the majority of the axillary artery
- Axillary incision and extending longitudinally down the arm in the medial bicipital groove
  - for the most distal part of the axillary artery and upper brachial artery
- Control distal to the upper part of the brachial artery is achieved with a tourniquet.

**Thorax**
- 4th intercostal space clamshell incision for all large thoracic vessels
- 4th intercostal space anterolateral thoracotomy
- Cardiac tamponade
- Control of the descending thoracic aorta

**Abdomen**
- 4th space anterolateral thoracotomy
  - Rapid proximal control in high abdominal injuries and peri-arrest situations
  - All other approaches to the aorta (and common iliacs) should be via a midline laparotomy.
- If there is solid organ injury, rapid control is achieved by packing

**Pelvis**
- For rapid haemorrhage control by pelvic packing
  - Extraperitoneal approach via a lower mid-line incision
  - by direct packing via a laparotomy.

**Lower limb**
- Control of external iliac vessels by direct dissection via a laparotomy
- Extraperitoneal approach by laterally extending a longitudinal groin incision
- Control distal to the upper part of the superficial femoral artery is achieved with a tourniquet.
Surgical approaches to control catastrophic haemorrhage in the following regions:

**Neck:**
- Zone 1 injuries may require proximal control of the great vessels via a median sternotomy. If necessary, divide the left brachiocephalic (innominate) vein to improve access.
- The carotid tree and internal jugular vein can be accessed in Zones 2 and 3 by an oblique longitudinal incision along the anterior edge of the sternocleidomastoid muscle. The sternal head can be divided as can omohyoid and the facial vein. Preserve the hypoglossal nerve. With good retraction it is possible to reach the base of the skull via a distal extension of this incision.

**Thorax:**
- All large vessels in the thorax can be accessed via a 4th intercostal space clamshell incision.
- A 4th intercostal space anterolateral thoracotomy alone can be used for diagnosis, relief of cardiac tamponade, internal cardiac massage and control of the descending thoracic aorta. It does not give easy access to other vessels.
- The left subclavian artery is more easily accessed via a median sternotomy.

**Abdomen:**
- Probable high abdominal injuries and peri-arrest situations may be addressed more quickly by control of the descending thoracic aorta via a 4th space anterolateral thoracotomy.
- All other approaches to the aorta and common iliacs should be via a midline laparotomy.
- For large vessel injury rapid control is achieved by supra-coeliac compression immediately below the diaphragm or infra-renal compression at the root of the mesentery – depending on the level of the injury.
- For solid organ injury rapid control is achieved by packing.
- Further dissection is dictated by the exact location of the vascular injury or organ involved.
- Access to the main vessels is achieved by entry into the retroperitoneum either directly at the root of the mesentery or by medial visceral rotation from the left or right.

**Upper limb:**
- Control of the subclavian vessels as they cross the first rib and the most proximal part of the axillary artery can be achieved via a medial supraclavicular incision running parallel to the clavicle. This requires division of the clavicular head of sternocleidomastoid and then the anterior scalene muscle with preservation of the phrenic nerve. The trunks of the brachial plexus are in close proximity.
- The majority of the axillary artery is accessed through a lateral horizontal infraclavicular incision. The fibres of pectoralis major should be split horizontally and then the deeper pectoralis minor muscle divided through its tendon. This then reveals the axillary vessels in a fat-pad. The cords of the brachial plexus are in close proximity.
- It is rare to need to violate the clavicle but if access to the exact portion of the axillary artery beneath it is required it can be divided with a saw in its mid portion.
- The most distal part of the axillary artery and upper brachial artery are best approached via an axillary incision and extending longitudinally down the arm in the medial bicipital groove. If necessary, infraclavicular and bicipital groove incisions can be joined with the vessels exposed by dividing the pectoralis major tendon at its humeral insertion.
- Control below the upper part of the brachial artery is achieved with a tourniquet (mid-humerus).

**Pelvis:**
- Rapid control by pelvic packing can be achieved by an extraperitoneal approach via a lower midline incision or by direct packing via a laparotomy.
- Common and internal iliac vessels are most rapidly control by direct dissection via a laparotomy.

**Lower limb:**
- External iliac vessels can be controlled by direct dissection via a laparotomy or by an extraperitoneal approach by laterally extending a longitudinal groin incision and dividing the inguinal ligament lateral to the deep ring.
- The common femoral artery to beyond its bifurcation and the lower part of the external iliac vessels are accessed via a longitudinal groin incision centred over the mid-inguinal point.
- Control distal to the upper part of the superficial femoral artery is achieved with a tourniquet (distal to proximal third of femur).
MI surgical/proximal haemorrhage control (Additional options for vascular exposure)

- Use extensile incisions
- Incision can incorporate wound line as required
- Aim to achieve proximal/distal control outside of any haematoma or zone of injury

**KEY**

**Primary (Rapid Access) incisions:**
17. Lower midline laparotomy for pelvic packing (can be extended to 15)
19. Longitudinal groin incisions for proximal control of leg vessels

**Alternative incisions for Vascular Access:**
15. Midline laparotomy incision
18. Supra inguinal incision
20. Anterior-lateral thigh
22. 1 cm behind the posterior border upper half of tibia
24. Anterior-lateral leg

**Extensions:**
21. to extend/connect 19 and 20 to allows full exposure of common femoral and femoral vessels
23. to connect 20 and 22 to improve exposure of popliteal vessels

---

**Pelvis**

Incision: lower midline laparotomy into extra peritoneal plane to level of SI joints 17
- allows pelvic packing with an extensile incision

Example wound for use:
- pelvic injury without requirement for laparotomy

Incision: supra inguinal 18
2 cm above and parallel to the inguinal ligament, extending from the lateral rectus sheath to a point 2 cm cephalad to the anterior superior iliac spine
- allows extra peritoneal control of proximal external iliac vessels

Incision: longitudinal groin 19
Over the femoral pulse with 1/3rd of the incision above the inguinal ligament and 2/3rds below inguinal ligament
- if no palpable pulse then incision should extend longitudinal through mid point between pubic symphysis and ASIS

Proximal control: distal external iliac vessels
Distal control: common femoral vessel bifurcation

Example wound for use:
- exposure of injured femoral segment in conjunction with more proximal and distal control
- proximal control for thigh injury

---

**Abdomen**

Incision: midline laparotomy from xiphisternum to pubic symphysis 15
Proximal control: supra coeliac aortic supra coeliac and intra abdominal IVC. Visceral vessels.
Distal control: distal external iliac vessels and proximal internal iliac vessels

Example wound for use:
- penetrating or blunt abdominal/pelvic injury

---

**Lower limb**

Incision: thigh - parallel to the antero-lateral border of the sartorius muscle 20
Proximal control: femoral and profunda femoris vessels
Distal control: proximal 1/3rd popliteal vessel segments

Example wound for use:
- proximal control for popliteal artery injury

Improve exposure: Connect groin and thigh incisions 23
- allows full exposure of common femoral and femoral vessels

Incision: 1 cm behind the posterior border upper half of tibia 22
- incorporate into leg fasciotomy wounds where used

Proximal control: distal 1/3rd popliteal vessel segments
Distal control: Origin of anterior tibial artery, tibial peroneal vessels and proximal posterior tibial and peroneal vessels

Improve exposure: Connect thigh and leg incision 23
- allows exposure of middle 1/3rd popliteal vessel segments through division of dividing the tendons of the semitendinosus, gracilis, and sartorius muscles

Incision: Anterolateral leg 24
- incorporate into leg fasciotomy wounds where used
If no fasciotomy wound exists, then a longitudinal incision is made in the anterolateral leg, halfway between the tibia and fibula over 10-15cm
- allows exposure of mid anterior tibial artery
MI surgical/proximal haemorrhage control (Additional options for vascular exposure)

**Neck**
- **Incision:** Longitudinal incision along the anterior border of the sternocleidomastoid muscle (ABSCM), extending from the clavicular head to the retromandibular region
  - should be curved slightly and extended just inferior to the lobe of the ear at its distal end
- **Proximal control:** Common carotid artery to root of neck
- **Distal control:** Internal carotid artery to base of skull
- **Example wound for use:** Zone 2 carotid vessel injury
- **Improve exposure:** Connect bilateral ABSCM incisions distally and lift a sub platysma flap for good vascular aerodigestive tract exposure for example in a through-and-through penetrating injury

**Shoulder and proximal upper limb**
- **Incision:** Supraclavicular
  - An incision is made 1 cm above and parallel to the clavicle, beginning at the clavicular head and extending approximately 8 cm laterally
  - **Proximal control:** Extra thoracic subclavian vessels, vertebral artery
  - **Distal control:** Extra thoracic subclavian vessels
  - **Example wound for use:** Shoulder/upper limb junctional wound
- **Improve exposure:** Connect supraclavicular (+/- division of clavicle), median sternotomy and 5th space left anterolateral (trap door)
  - allows improved exposure to root of neck and left intrathoracic apex
- **Incision:** Infraclavicular
  - A horizontal skin incision is made 2 cm below the middle 1/3rd of the clavicle, extending for approximately 8 cm
  - **Proximal control:** Proximal 1/3rd axillary vessels
  - **Distal control:** Middle 1/3rd axillary vessels
  - **Example wound for use:** Shoulder/upper limb junctional wound
- **Improve exposure:** Connect supraclavicular and infraclavicular incisions with division of clavicle
  - allows improved exposure of proximal 1/3rd axillary vessels

**Thorax**
- **Incision:** Median Sternotomy
  - 2cm above sternal notch to 2cm below xiphoid process
- **Proximal control:** Origin of aortic branch vessels
- **Distal control:** Distal extent of intra thoracic aortic branch vessels
- **Example wound for use:** Zone 1 carotid vessel injury
- **Improve exposure:** Connect median sternotomy incision to ABSCM incision
  - allows junctional exposure of wound once proximal/distal control has been achieved

- **Incision:** Clam shell thoracotomy
  - **Proximal control:** Proximal descending thoracic aorta
  - **Distal control:** Distal descending thoracic aorta
  - allows aortic occlusion through the chest and thoracic (supra hepatic) IVC control

**Upper limb - forearm**
- **Incision:** Along groove between biceps and triceps
  - **Proximal control:** Brachial vessels
  - **Distal control:** Brachial vessels/brachial bifurcation
  - **Example wound for use:** Mid-distal brachium wound
- **Improve exposure:** Connect to infraclavicular incision
  - allows junctional exposure of axillary vessels through delto pectoral approach

- **Incision:** Medial to lateral lazy S across anti-cubital
  - **Fossa (M-LLSACF)** - from biceps/triceps groove to mid forearm, 2-3cm above and below elbow crease
  - **Proximal control:** Distal brachial vessels/brachial bifurcation
  - **Distal control:** Distal brachial vessels/brachial bifurcation
  - **Example wound for use:** Proximal and mid forearm wound
- **Improve exposure:** Connect biceps/triceps groove incision to M-LLSACF incision
  - allows full exposure of brachial vessels

- **Incision:** Use/adapt forearm volar fasciotomy incision
  - Where possible (M-LLSACF to radial mid forearm to distal ulna, transverse at wrist crease to line of radial boarder of ring finger to kaplan’s cardinal line)
  - **Proximal control:** Distal brachial vessels/brachial bifurcation
  - **Distal control:** Mid forearm radial vessels, distal ulnar vessels
  - allows exposure of forearm vessels without additional volar fasciotomy incision
MI vascular trauma

Do the MINIMUM surgery to preserve life and limb, in that order

Remember:
- Non-vascular specialists may need to undertake vascular interventions due to casualty numbers
- Temporary vascular shunts and vessel ligation will be the mainstay of treatment for vascular injury in a MI, and not reconstruction
- Amputation rate may be high. Recognise futility in limb reconstruction; decision to amputate should be made by two surgical consultants
- Interventional radiology has a limited role in mass casualty situations, however IR could be utilised for diagnostics to provide the most effective targeted interventions in theatre, such as thoracic aortic stenting or IVC filter placement

Catastrophic haemorrhage
- Gain proximal control and STOP THE BLEEDING
- In uncontrolled haemorrhage, patient should go direct to theatre and can have a CT Traumagram/imaging once the bleeding is controlled

Initial management
- Orientate applied force to compress wound against the underlying axial skeleton
- Small wounds can be managed with a single gauze swab and digital pressure
- Larger cavities can be managed with internal gauze packing (e.g. Kurlix®) and palmar pressure
- Manage pain with IV opiate analgesia concurrent with any wound manipulation
- Avoid application of haemostats to any visible vessels
- Transfer to theatre as soon as possible

Temporary vascular shunts
- Indications
  - All axial vessels above knee/elbow
  - Distal axial vessels, if all continuity lost
  - As a shunt, prior to application of an external fixator:
    - ensure you account for movement created by orthopaedic surgeon when you choose length of shunt.
    - if possible, the vascular surgeon should be at the table when the orthopaedic surgeon is placing the shunt
- What to use
  - Vascular shunt (e.g. Pruitt), if available
  - Sterile plastic tube of appropriate sized for vessels (IV tubing/Nasogastric / Nasopharyngeal tubes – whatever is available and appropriate)
- How to use
  - Confirm inflow and back bleed (embolectomy may be required)
  - Fill shunt with Heparinised saline (5000U in 500 ml saline) and clamp
  - Place shunt in uninjured vessel above and below zone of injury
  - Secure with tie around vessel and shunt
  - Shunt can remain in place for up to 48 hrs
- Document
  - That a shunt has been placed
  - Frequency of post-op distal limb checks required (e.g. every 30 mins)
  - Actions if shunt falls out away from theatre (where to press/which vessel loops to pull)

Hard signs
- Pulseless cold pale limb
- Expanding haematoma
- Palpable thrill or audible bruit
- Active bleeding

Soft signs
- History of active bleeding
- Non-expanding haematoma
- Neurological deficit
- Penetrating injury close to major vessel

Clinical features of vascular injury

STAY THING THE BLEEDING
- Proximal/distal control
- Shunt or ligate to stop further blood loss
- Consider simple repair (if possible) to restore blood supply
- Use temporary vascular shunt as a bridge to definitive repair
- Liberal use of fasciotomy (should be default)
- Anticoagulation is not needed for shunts
- Antibiotics & Tranexamic acid as per standard/local guidelines

KEY POINTS
- STOP THE BLEEDING
  - Proximal/distal control
  - Shunt or ligate to stop further blood loss
  - Consider simple repair (if possible) to restore blood supply
  - Use temporary vascular shunt as a bridge to definitive repair
  - Liberal use of fasciotomy (should be default)
  - Anticoagulation is not needed for shunts
  - Antibiotics & Tranexamic acid as per standard/local guidelines
Surgical planning

Plan

- Use a (truncated) WHO checklist
- Communicate injuries identified to the theatre team
- Deliver the damage control plan (with order of priorities)
- Equipment required
- Cavity or cavities to be opened
- Communicate to staff that plan may change at short notice e.g. may need to open an additional cavity
- Set parameters for theatre team/anaesthetist to alert surgeon (blood product use threshold) – recognise intraoperative futility; resources may be best invested elsewhere – communicate early through coordinators; arbitration from senior clinician may be required

Intraoperative phase

- Place in “star”/cruciform position
- Be prepared to enter multiple cavities
- Must have access to be able to gain proximal and distal control
- Gain control through the access you are most comfortable with (e.g. laparotomy for junctional control of the iliac artery if unfamiliar with Rutherford Morrison approach; median sternotomy for Zone 1 neck injury.
- “SITREP” Plan regular communication between anaesthetist and surgeon. You must all be aware of: physiological status, inotrope requirements, transfusion situation and evolving operative plan (set alarm and update each other every 15 minutes)
- Use of Doppler is key in assessing flow
- On table angiography may be indicated if flow is not restored despite appropriate manoeuvres (vascular dissection)
- Limb viability should be assessed prior to revascularisation or amputation by two surgeons

Postoperative phase

- Document operative details carefully, anticipate relook surgery may be performed by another team or even in another hospital
- Document clearly details of:
  - List antibiotics
  - Anticoagulation
  - Physiological parameters for return to theatre
  - Actions for major post-op bleeding
- Plan to return the patient to theatre for reconstruction when stable (typically 24-48 hours) and when vascular specialist available (liaise with your regional Network coordinators who can arrange for a specialist surgeon to come to you)
MI thoracic trauma

Do the MINIMUM necessary surgery to save life: keep on-table time as short as possible. In a mass casualty context, surgery should be complete within 1 hour.

Fragments from blast and other ballistic projectiles do not respect anatomical boundaries:
- Clam-shell thoracotomy is the incision of choice.
- Be prepared to operate on junctional area (eg. neck) and enter adjacent body cavities e.g. laparotomy if there is evidence of co-existing abdominal injury

Surgery should be physiological not anatomical (for non-anatomic resection use gastrointestinal staplers, and consider pulmonary tractotomy for penetrating lung injury before attempting lobar resection).

**Catastrophic haemorrhage**
- Immediate return from chest tube of approx. 1.5 litres in an unstable patient
- On-going blood loss of approximately 200 ml/hr

**Indications for damage control thoracotomy:**
- For resuscitation in a peri-arrest patient, (or loss of cardiac output in ED)
- Consider REBOA, if the source of blood loss is extra-thoracic to extend resuscitation time
- For massive air-leak compromising ventilation
- Outcome after pre-hospital cardiac arrest is likely to be very poor and in the context of a MCI, other casualties may have higher priority

**Delayed thoracic surgery is indicated for:**
- Persistent bleeding
- Persistent air leak
- Thoracic empyema
- Other complications or concern: liaise closely with your regional thoracic surgical team

**Thoracotomy does not have to be done ‘routinely’ to retrieve fragments following ballistic injury**

**KEY POINTS**

Select appropriately-sized chest drains, as a rule of thumb:
- Infant: 12-16F
- Child: 16-24F
- Adult: 24-32F

For every patient with chest injury: ensure effective pain relief and chest physiotherapy

Early antibiotics are essential; however, surgical antibiotic prophylaxis is not often required beyond chest drain insertion or the duration of the primary operation see Speciality Overview

A dual lumen tube is not always necessary - choose an anaesthetist with thoracic experience if possible

Majority of patients with chest injury only require chest tube placement
- Consider lung protective ventilation if intubated
- Reduced tidal volume
- Peak pressures minimised
- High FiO₂ for first 8 - 24 hours then reduce and use lowest FiO₂
- Consider ‘permissive hypercapnoea’ but also consider ‘permissive hypoxia’

Resuscitate to normovolaemia
- Avoid fluid over-resuscitation
- Early urinary catheter is advised, as UO is a sensitive measure of end organ perfusion and resuscitation status of patient

Potential for fragment and air embolisation (from IPPV)

Examine the back and posterior chest
- Patient may not have had log roll prior to theatres

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- For resuscitation in a peri-arrest patient, (or loss of cardiac output in ED)
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- Other complications or concern: liaise closely with your regional thoracic surgical team

Thoracotomy does not have to be done ‘routinely’ to retrieve fragments following ballistic injury
**MI thoracic trauma**

### Prepare for a damage control thoracotomy

Plan for a damage control operation (with planned re-look when the patient is stable)

- **Place patient supine with arms abducted** (“star”/cruciform position)
- For unilateral injury, a bolster bag (e.g. pressure infusor bag) behind the patient’s chest on the injured side help but **DO NOT** formally turn the patient on their side as endo-bronchial bleeding from an injured lung can contaminate the (dependent) un-injured lung and turn a crisis into a disaster.

- **Double-lumen tubes are not often necessary**
- **Prep patients’ chest to knees**; once prepped, patient can be draped appropriately and covered to maintain temperature.

- **Make a clamshell incision**: limited left thoracotomy gives insufficient access.
- Always open the pericardium to exclude or treat haemopericardium.
- Remember to control the internal mammary vessels on the underside of the sternum; above and below your incision.
- Non-anatomic resection of damaged lung can be done with gastrointestinal staplers.
- **Pulmonary tractotomy** should be done when possible to control bleeding and/or air leak from penetrating pulmonary injury rather than attempting major resection.
- **Remember to check the diaphragms and think of abdominal injury.**

- Use the vacuum-pack technique for temporary thoracic closure, attaching the dressing to wall suction at 120mmHg. Patients should be intubated and ventilated after trauma thoracotomy and managed in an ICU setting.

- **“SITREP”** Maintain intra-operative dialogue with your anaesthetic team. You must be aware of:
  - physiological status including inotrope requirements
  - transfusion situation
  - how long you have been operating

- **Plan to take the patient back to theatre at 24-48 hours with a thoracic surgeon**; liaise with your regional Network coordinators who can arrange for a specialist surgeon to come to you.
MI abdominal trauma

Do the MINIMUM necessary surgery to save life: think DAMAGE CONTROL.

Remember:
- Fragments from blast and other ballistic projectiles do not respect anatomical boundaries.
- Look for ‘paired’ injuries in hollow organs.
- Be prepared to enter adjacent body cavities e.g. you may need to do a thoracotomy after exploratory laparotomy. If the source of on-going bleeding is from the chest, blood may be coming through a diaphragmatic injury.

Catastrophic haemorrhage
- Gain proximal control and STOP THE BLEEDING.
- In uncontrollable haemorrhage, patient should go direct to theatre for proximal control. Patient can have a CT Traumagram with 4 quadrant abdominal packing in situ, once the bleeding is controlled.

Selection for laparotomy
- Use your clinical judgement: examine the patient carefully and don’t forget to roll the patient and inspect the back.
- Use CT sparingly to help guide selection for surgery.

Pre- laparotomy
- WHO Checklist
- Senior decision making
  - A senior team (surgeon plus anaesthetist is ideal) to maintain oversight of departmental activity, to act as point of contact for incident commanders and to act as arbiter for difficult surgical decisions (such as transfer to palliation).

KEY POINTS
- Have “two consultant” operating where possible
- Make a full midline incision
- The priorities are:
  - First: stop the bleeding
  - Then: control contamination
- Do not do definitive intestinal repairs or stoma formation
- Make a temporary abdominal closure and plan for re-look at 24-48 hours
- Get the patient off the table as soon as possible: at 1 hour you should be finished or finishing
- Maintain a dialogue between surgery and anaesthesia and don’t get ‘task fixated’ on complex reconstructive surgery.
**MI abdominal trauma**

### Damage Control Laparotomy
Maintain intra-operative dialogue with your anaesthetic team: you must be aware of:
- physiological status including inotrope requirements
- transfusion situation
- the time your surgery is taking (regular updates from anaesthesia will improve situational awareness)
- wider context of demands on theatres and the evolving major incident (are new patients still arriving?)

#### Pre-laparotomy
- Antibiotics are essential prior to your incision; however, you do not need to continue surgical antibiotic prophylaxis beyond the duration of the primary laparotomy.
- The WHO Checklist should be used.
- “Two consultant” operating is very helpful, if staff are available.
- If possible; have a senior surgeon in the department moving between operating rooms to maintain oversight of departmental activity, to act as point of contact for incident commanders and to act as arbiter for difficult surgical decisions (such as transfer to palliation).

#### Patient positioning
- Place patient supine with arms abducted (crucifix position).
- Prep patient’s: chest & abdomen to knees; once prepped, patient can be draped appropriately and covered to maintain temperature.

#### The operation
- Make a full midline incision: xiphisternum to pubis.
- **Firstly, aim for haemorrhage control.** In a very unstable patient - your assistant should digitally occlude the aorta at the hiatus while the surgeon evacuates blood and clot and then finds the source of blood loss and controls it.
- **Next goal is control of contamination:** do not attempt definitive intestinal surgery (i.e. with repair, resection & anastomosis or formation of stoma). If there are multiple bowel injuries in one segment, or destructive injury, use stapling devices to resect damaged bowel and leave the bowel ends ‘stapled in discontinuity’ in the abdomen. Minor injuries can be simply over-sewn with sutures.
- Do a thorough exploration once you have control of bleeding and contamination.
- Beware the following areas:
  - Diaphragm, left and right
  - High on stomach around OGJ
  - Lesser sac
  - Mesenteric border of intestine
  - Retroperitoneal colon
- Think about extraperitoneal rectal injury; on table sigmoidoscopy (flexi if possible) may help you make the diagnosis.
- In a patient with continuing instability despite apparent control in the abdomen, think about adjacent cavities: chest / pericardium. A pericardiectomy can be done via your laparotomy incision.
- Look for ‘paired’ injuries in hollow organs; think about the retroperitoneum, be prepared to operate on junctional area and enter adjacent body cavities e.g. thoracotomy after laparotomy if the source of on-going bleeding is from the chest and coming through diaphragmatic injury.

#### Temporary abdominal closure
- Use the vacuum-pack technique for temporary abdominal closure, attaching the dressing to wall suction at 120mmHg.
- Patients can be woken and extubated with this form of temporary abdominal closure but ensure the dressing is properly applied, as there is an increased risk of evisceration in an awake patient compared to a patient intubated in an ICU setting.

#### Planned re-look
- Plan to take the patient back to theatre at 24-48 hours. At first re-look laparotomy: do a thorough exploration of the entire abdomen & pelvis to exclude missed injury.
- **Over-sewn intestinal injuries should be taken down and re-done.** There is always a ‘zone of injury’ with penetrating injury and so the bowel should be debrided to healthy, vascularized bowel and then re-repaired. The extent of the debridement will vary according to the energy of the injurious mechanism (minimal for knife or low energy fragment, more extensive for GSW or destructive fragment) if (at first re-look) the patient is relatively stable, restoration of bowel continuity by anastomosis is a real option with avoidance of stoma in both small and large bowel injury in many cases. Formation of a colostomy may be appropriate in the most severely injured, with massive transfusion, on-going inotrope requirement etc.
- Form a defunctioning colostomy for patients with penetrating rectal injury; repair the injury if you can access it and manually remove faeces from rectum and washout. The ‘damage control’ technique for rectal injury is as above, but don’t mature the colostomy – divide colon with stapling device and leave ends inside.

#### Imaging
- **CT is not mandatory; rely on your clinical indications for laparotomy:** reserve scarce CT scan resources for patients who need them (patients can always be scanned later in their clinical course if necessary).
- Thoughtful clinical examination and surgical judgement is required; remember the abdomen has a posterior aspect, examine the back thoroughly during the log roll, do a PR.
- Look carefully for penetrating injury.
- Catheterise early, blood in the urinary tract is a helpful physical sign.
- Evisceration of bowel and omentum is relatively common after blast injury.
- If a patient has had CT: remember blast-injured patients may have pneumo-peritoneum without visceral injury; look for corroboration (clinical status or associated evidence of organ injury on CT-such as free fluid) before operating.
MI pelvic and long bone injuries

Key considerations
- Could the casualty have a pelvic injury?
- In limb injuries, is the wound open or closed?
- Is there uncontrolled haemorrhage?

Catastrophic haemorrhage
- Get MTP 1* (4U blood and 4U FFP)
- Actively resuscitate with red cells and plasma. Avoid crystalloids, give platelets early.

1 – Pelvic injury
- Apply pelvic binder, reassess and x-ray
- Aim to keep binder time < 6 hours
- Could the pelvic bleed be managed by IR?
- Is patient stable for transfer?
- Transfer to IR Suite if available and ready
- Does patient need to go to theatre? If so:
  - Pack against binder not ex-fix
  - Anticipate coagulopathy and activate MHP if required
  - Attempt one pass at urinary catheterisation. If unsuccessful, refer to urology to confirm urethral continuity

2 – Closed limb injury
- Can the patient simply be splinted?
- Realign limb
- Apply POP backslab
- Use Thomas splints/skin traction/pre-fabricated splints if suitable
- Only ex-fix if clinically indicated
- Regular distal neurovascualr checks
- Perform fasciotomies
- Peripheral nerve blockade required?
- Does the patient really need to go to theatre now? Can it wait?

3 – Actively bleeding limb
- Apply pressure dressing and change prehospital tourniquet to a pneumatic
- Inflate it and note tourniquet start time
- Realign limb and splint it
- Does patient now need to go to theatre to stop the bleeding?
- Get proximal control
- Ligate distally
- Fasciotomise (shunt only if needed)
- Repair vessel if time, unlikely in MI event
- Do not operate longer than 60 minutes

Specialty checklist
- Repeat primary survey
- Give TXA (bolus or infusion as appropriate)
- Peri-op antibiotics see Speciality Overview
- Keep patient warm
- Give blood proactively – plan for one MTP* per destroyed lower limb
- Carry out the coagulation studies available in your unit

*MTP 1 – or blood products available in your unit as starter ‘shock pack’ for red blood cells and plasma
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**MI immediate wound management**

Aim: to make a diagnosis for each wound to a sufficient degree that priority for surgery and need for specific specialties can be correctly informed.

- All wounds must be examined so all dressings must come off. Be methodical. Don't forget the back.
- Photograph, or review with a surgeon present, to avoid unnecessary re-looks, especially in complex wounds and for concerns regarding vascularity.
- Consider examining sequential areas rather than the whole body in a single go (hypothermia mitigation, access, concurrent activity).

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**Catastrophic haemorrhage**

A Functional and intra-cavity ongoing bleeding is an indication for surgery (or IR).
- Give TXA as soon as possible
- If the situation is calm then do not rush for tourniquets
- Use tourniquets if pressure dressing with elevation fails (if practicable)

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**Age**

- Young – may have significant blood loss but normal physiology
- Older patients have impacting comorbidities and medications eg β-blockers or anticoagulants.

**Time**

- May be a risk of compartment syndrome or pressure effects if prolonged tourniquet use, entrapment or unknown LOC.

**Mechanism**

- Initially treat the patient, then the wound – do not treat the weapon. Be aware of the mechanism but do not be distracted by it.

**Injuries**

- Look for more wounds than were handed over.

**Signs and symptoms**

- Listen to the patient. Note the pre-hospital observations.

**Treatment given**

- Any tourniquets/pressure dressings/haemostatic dressings?
- Know the tourniquet time.
- Any pre-hospital drugs? eg. TXA, ABx.

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**Specialty checklist**

- Administer systemic antibiotics as per microbiology guidelines (local/Trust or MI guidelines).
- Are there any obvious wounds that require the patient to go immediately to theatre without further assessment? Uncontrollable haemorrhage is probably the only indication.
- Are there any wounds that require immediate attention to prevent deterioration?
- Any exposed viscera/brain? Place a saline soaked gauze on these, do not use antiseptic solutions.
- In all types of blast and ballistic wounding, a CT ‘whole body’ scan should be performed.
**MI immediate wound management**

### Examination of wounds

Aim: to diagnose each wound to a sufficient degree such that the decision and priority for surgery and the need for specific specialties can be correctly identified.

- All wounds must be examined so all dressings must be removed.
- Do this in a methodical and thoughtful manner.
- Don’t forget the back.
- Consider doing it with a surgeon present to avoid unnecessary re-looks. Particularly relevant in complex wounds and for vascular issues.
- Consider doing sequential areas rather than the whole body in a single go.
- If there is a risk of significant haemorrhage when removing a dressing, consider doing under tourniquet control.

Note the general state of the patient in terms of clothing (torn? shredded? burnt?) and dirt (dust? soil? soot?). Non-specific but helps with the overall assessment. A patient covered in dirt has a higher risk of dirty wounds.

- Are there any patterns to the wounding?
  - Aim to get as much information as possible without exploring the wound. By simple observation it is normally possible to ascertain:
  - Is there obvious contamination with foreign bodies?
  - Is it obvious that the deep fascia has been breached?
  - Is bone exposed?
  - Then, formally examine for vascular, nerve and tendon deficits.

Probing the wound with instruments or fingers provides no further useful information and is potentially harmful.

### Documentation and planning

- Once the wounds have been fully assessed the findings must be documented.
- Take quality photographs if it is at all possible.
- Have pre-agreed (in the plan!) who has responsibility for documenting the forensic description of the wounds (precise anatomical location, exact size and structures involved) because it must be done at some-point. Probably best done by the surgical team in theatres supplementing the CT findings.
- The findings must be presented to the relevant clinical coordinator for planning of next steps. This will generate a priority list for timings to theatre and dictate where the patient will be held until it is their turn.
- If there is any penetration of a body cavity or deep fascia, exposed bone or open fractures or alteration in normal function there is requirement for the wound to be formally explored. This should be done in an operating theatre.

### Non-surgical control of haemorrhage

- General oozing from the wound can be controlled with a pressure dressing and/or elevation.
- There are several types of topical haemostatic agents available. These are primarily designed for pre-hospital use to mitigate for a lack of surgical capability where tourniquets and pressure dressings prove inadequate, such as in junctional areas. Once within a hospital, where surgeons and operating theatres are available, the approach to continuously bleeding wounds should be formal surgical control. The use of haemostatic dressings within hospital should be limited to extreme situations only.
- If the patient has a tourniquet in place either from pre-hospital or applied on arrival during the primary survey this should be evaluated before the wound is addressed. An inflated tourniquet makes a patient a priority for theatre.
- If the tourniquet is a simple windlass type, as is common for pre-hospital use, this should be replaced by a pneumatic tourniquet, as soon as is practicable.
- This can be placed proximal to the windlass but not inflated initially nor applied too tightly such that it restricts venous outflow. The windlass can then be released and the wound observed.
- If there is no significant haemorrhage then the pneumatic tourniquet does not need to be inflated immediately but should remain in place as a precaution or for use during debridement. At this point an assessment of distal vascularity can be made.
- If on releasing the windlass tourniquet there is significant bleeding, then inflate the pneumatic tourniquet and formal surgical vascular control should be obtained as a priority.
- If the initial tourniquet has been on for significantly more than two hours, discussions about managing the patient’s general condition, overall distal viability and potential need for fasciotomies should be had, before the tourniquet is released.

### Timing of wound management

For patients likely to go to theatre within the next 12 hours:

- Place a saline soaked swab on the wound and secure with an outer dressing. Do not be tempted to irrigate the wound. There is no evidence to support the use of antiseptic solutions.
- In significant mass casualty situations, patients with soft tissue wounds may not get to theatre in the first 12 hours. In this case there is still no clear evidence to support irrigation in ED or the ward even with such a delay to formal debridement.
- The presence of grossly contaminated wounds should be part of the surgical triage assessment, and these patients prioritised for theatre before 12 hours where possible.
- Administration of systemic antibiotics as early as possible has been shown to reduce the proliferation of contaminating bacteria and so does buy time. Application of a saline soaked swab will suffice.
- For those with superficial wounds (where there is no evidence of damage to deeper or important structures and the degree of contamination is such that formal debridement in theatre is not considered necessary)
  - These wounds can be cleaned according to usual practices under appropriate analgesia.

**No ballistic wounds should be primarily closed.**

- Provision must be made for follow up of the patient to ensure appropriate delayed closure occurs.
MI universal fasciotomies

These universal fasciotomies have been designed to decompress compartments and allow adequate vascular access, without compromising future soft tissue reconstruction.

- Use extensile incisions
- Incision can incorporate wound line as required
- Aim to achieve proximal/ distal control outside of any haematoma or zone of injury

Fasciotomy Incisions (that can be used for vascular access)

Volar Forearm fasciotomy
Medial leg fasciotomy
Lateral leg fasciotomy wound, allows exposure of mid anterior tibial artery and decompression of lower leg compartments

Two incision, four compartment fasciotomy for the lower leg

Use a skin marker to draw the surface markings of the medial and anterior borders of the tibia.

Release of superficial and deep posterior compartments:

1. Make an incision through skin 2 cm posteromedial to the marked medial border of the tibia from the tibial flare down to behind the medial malleolus.
2. Deepen the incision without undermining the skin and then incise the fascia along the whole length of the skin incision. This will have fully released the superficial posterior compartment.
3. Identify the posterior tibial neurovascular bundle, most easily done distally, and incise the thinner fascia over it. This will have gained entry into the deep posterior compartment.
4. Extend this along the whole length of the skin incision to fully release the deep posterior compartment.
5. Access to the more proximal part will require dissecting the soleus muscle off the tibia.

Release of the anterior and lateral compartments:

1. Make an incision through skin 2 cm anterolateral to the marked anterior border of the tibia from the tibial flare down to just in front of and above the lateral malleolus.
2. Deepen the incision without undermining the skin and then incise the fascia along the whole length of the skin incision. This will have fully released the anterior compartment.
3. Sweep the exposed muscle bellies medially and follow the deep aspect of the fascia laterally until the fibular is felt. This will have revealed the intramuscular septum.
4. Incise this along the whole length of the skin incision to fully release the lateral compartment.
Acute acoustic trauma (AAT) and hearing loss after a major incident

Symptoms common to acute acoustic trauma include hearing loss, tinnitus, earache or vertigo. The ear is highly susceptible to injury after blast, and this is often missed as the trauma teams manage life threatening injuries first. Patients may self present days later, to the ED or GPs.

> Patients with abnormal audiograms should be referred and reviewed urgently and if appropriate, steroids given.
> If hearing tests are normal, no immediate action is required.
> If tinnitus persists, then other therapies may be useful at a later stage.

\[ \text{**AAT and steroid use**} \]

\[ \text{See overleaf before prescribing} \]

\[ \text{**PAEDIATRIC <16 (Priority 1)**} \]

If hearing loss is suitable for management with steroids
> All cases must be managed with paediatric consultant input
> Discussion with parents re: contraindications of steroid use in a young patient
> Consider oral steroids and ITSI (particlarly if patient has GA/Sedated for any other reason)
> Titrate dose by weight (Prednisolone 1mg/kg PO OD 7 days to a maximum dose as per local policy)
> Discuss use of gastric cover if appropriate

\[ \text{**ADULTS (Priority 1)**} \]

Check contraindications for steroids
Discuss intratympanic and/or oral steroids
Recommendation for oral regime: Prednisolone 1mg/kg to a max of 60mg OD for 7 days, after appropriate consent
Gastric cover with PPI and Gaviscon Advance
Ensure patient has ENT follow up after 7 days, if oral steroids only selected, intratympanic steroid injection (ITSI) should be reconsidered

\[ \text{**Pure conductive loss**} \]
\[ \text{Sensorineural or mixed loss} \]

\[ \text{**Adult and Paediatric follow up**} \]

by ENT at local hospital (or Regional co-ordinating ENT Department) (Priority 2)

> If persistent sensorineural loss after 7 days of oral steroids, consider intratympanic steroids (ITSI)
> If persistent mixed loss, where conductive element is related to a perforated drum, consider aural toilet and topical steroids

\[ \text{**I was near the blast and my hearing has been affected. I think I need a hearing test”} \]

Do not wait!
Use phone app or urgently arrange non-hospital audiogram to confirm hearing loss

Hearing loss diagnosed.
Phone GP urgently for hospital audiology referral for further assessment

GPs/Other non-hospital audiology providers.
> Request formal audiogram with Regional Co-ordinating Audiology Department (RCAD)
> (Other providers may be commissioned/authorised depending on surge demand)
> This is a clinical priority treatment options are severely time limited
> MI audit - Report all cases of hearing loss/abnormality to RCAD

RCAD audiogram confirms hearing loss.
URGENT referral to Regional Co-ordinating ENT Department (RCENTD)

Regional Co-ordinating ENT Department (RCENTD).
Consultant Otologist - ‘Paper’ review of audiogram, endoscopic images if available and other clinical information. (Documentation to include NHS number and advice given)

> Triage patients to Outpatient appointments
> If necessary repeat Pure Tone Audiogram and Tympanometry
> (plus TM Endoscopic photography if resource available)

Case not appropriate for steroids.
Monitor patient as per local policy and provide Hearing Aids if appropriate

Your regional coordinating ENT resource

Please include
> Patients contact details
> Clinical examination
> Contraindications to high dose steroids
> NHS number if known

PRE HOSPITAL

IN HOSPITAL
Acute Hearing Injury

There are many reasons for patients to perceive a reduction in the quality of their hearing following trauma. The flowchart overleaf is designed to streamline the management of hearing injury without associated temporal bone fracture, in the mass casualty situation. The evidence on which these protocols are based, is rapidly maturing and a pragmatic approach has been taken as evidence related to the rescue of sensorineural hearing loss (SNHL) associated with noise and blast exposure evolves.

Treatment options are severely time limited. For adults and children, with symptoms or proven hearing loss, hearing tests should be performed by the Regional Coordinating Audiology Department (RCAD).

- In the presence of a severe hearing loss however, early assessment and treatment is imperative and it is perfectly appropriate to test earlier.
- For children, tests need to be age appropriate, however, standard ‘adult’ Pure Tone Audiometry can often be performed with children above the age of five. This should be considered if the numbers injured place pressure on paediatric audiology services or the location dictates and there is a wish to keep parents and children together.

If hearing tests are normal, no immediate action is required. If tinnitus persists, then other therapies may be indicated, as per local ENT guidance.

If abnormalities are detected, results should be passed on URGENTLY to the Regional Coordinating ENT Department (RCENTD) for assessment.

If the loss is purely conductive which may be due to;
- blood in the external auditory canal
- tympanic membrane perforation
- ossicular discontinuity
- No immediate action is needed.
- Keep the ear dry.
- Patients can be followed up routinely in outpatients at an interval appropriate to their pathology.

If hearing loss is mixed or purely sensorineural steroids may be beneficial.

In the presence of associated polytrauma, oral/IV steroids may be contraindicated, however, intratympanic steroids may be considered particularly if the patient is having operative procedures during which the intratympanic steroids can be also be concurrently administered.

For children, oral Prednisolone should be considered in the absence of contraindications and after a joint paediatric/ENT consultation (to ensure all are aware of possible side effects).

For both adults and children gastric protection should be considered and usually given.

Updated Advice (2017)

FOR YOUNG PEOPLE AND CHILDREN - remember to

- TITRATE STEROID DOSES to weight.
- Be meticulous to explain the possible side effects. The information given on this, and other treatment options, must be documented for all patients.
- Have a joint consultation if possible, ENT with a paediatric consultant present is the ideal.
- Intra tympanic injection of steroid may give good effect, reducing the relative risk of complications associated with systemic steroid use. This should be considered if a patient, especially a child, is sedated or has a GA for any reason.

OTHER CONSIDERATIONS

- Patients who have a conductive hearing loss can be helped in the immediate period with a bone conduction aid e.g. in order to complete informed consent, or simply to reduce the injured patients’ sense of isolation.
- Your audiologist may have some ideas such as;
  - “Alice band” secured aids (used pre BAHA).
  - Bone conduction aids that stick to the mastoid.

In the presence of associated polytrauma, oral/IV steroids may be contraindicated, however, intratympanic steroids may be considered particularly if the patient is having operative procedures during which the intratympanic steroids can be also be concurrently administered.

*AT and steroid use

- Intratympanic steroids should be considered as an alternative to oral steroids at first presentation or as salvage after one week of oral steroids.
- If a mixed loss persists to treat the sensorineural part in the presence of a perforated ear drum topical steroids given regularly rather than an ITSI may be appropriate.
- Consider steroid use (ITSI or topical drops if perforation present) if there is a strong suspicion patient has sensorineural loss but unable to subjectively test e.g. intubated patient with severe scalp burns.
- In severe trauma, where objective evidence of SNHL or high suspicion exists but relative contraindications to systemic steroids are present, ITSI should be considered. If vision is lost, this consideration should be given a high priority.
Antimicrobial prophylaxis

Introduction
Blast wounds are extensive and contaminated (and will remain so even after extensive debridement, or will rapidly become recolonised); whereas gunshot wounds (GSW) are relatively clean.

- Give your microbiologist as much information as possible.
- How was the injury sustained?
- What was the environment in which it was obtained?
- Any organic contamination or water exposure?
- Keep to simple measures and antibiotics
- Recognise your patient will have a huge inflammatory response and it may not be due to an infection.

CSF leak post skull fracture

- No antibiotics required
- Give Pneumovax (if sinus/auditory canal breached)

Penetrating CNS injury

- Ceftriaxone 2g bd iv + Metronidazole tds iv
  - Non-severe Penicillin allergy: Meropenem 2g tds iv
  - Severe Penicillin Allergy (Anaphylaxis): Ciprofloxacin 400mg bd iv + Vancomycin 1g bd iv + Metronidazole 500mg tds iv
- All courses two weeks duration

Penetrating eye injury

- Ciprofloxacin 400mg bd iv + Clindamycin 450mg tds iv
  - Give for ≥ two weeks after removal of foreign body

Penetrating chest trauma

- Co-amoxiclav 1.2g tds iv (if unavailable, give Cefuroxime 750mg tds iv and Metronidazole 500mg tds iv)
  - Penicillin allergy: Clindamycin 450mg qds iv
- One to two weeks, depending on progress or presence of intercostal drains

Penetrating abdominal trauma

- Co-amoxiclav 1.2g tds iv (if unavailable, give Cefuroxime 750mg tds iv and Metronidazole 500mg tds iv)
  - Penicillin allergy: Ciprofloxacin 400mg bd iv and Metronidazole 500mg tds iv. Add Vancomycin 1gm bd if significant soft tissue damage
  - Add Fluconazole if GI perforation and risk of spillage of GI contents
- Continue until surgical exploration. Continue for 5 days if perforation.

Open fracture limb/hands

- Co-amoxiclav 1.2g tds iv (if unavailable, give Cefuroxime tds iv and Metronidazole 500mg tds iv)
  - Penicillin allergy: Clindamycin 450mg qds iv
- Until soft tissue cover or 72 hours, whichever is soonest (BOAST4 guidelines)

Penetrating soft tissue injury

- Co-amoxiclav 1.2g tds iv
  - (if unavailable, give Cefuroxime 750mg tds iv or Metronidazole 500mg tds iv)
  - Penicillin allergy: Clindamycin 450mg qds iv
- Until first surgical debridement/washout

KEY POINTS

Bacterial infection in blast or ballistic injury, is the same as other wounds but don’t just treat the microbiology report.
- Consider if this is colonisation or infection?
- Close liaison with a microbiologist within the multidisciplinary team is essential.
- Common things occur commonly, but be on alert for an unusual clinical picture.

Tell the lab about the unexpected findings or unusual clinical picture, as diagnostic labs are set up to look for common pathogens and may overlook others.
- Be aware or suspicious of wounds with evolving (unexpected) necrosis.
Antimicrobial prophylaxis

Post event transfers: Infection Prevention and Control (IPC) teams need advance notice of patient movements and suspect organisms if possible, to ensure the receiving unit is prepared and can mitigate risk (is there a side room available?).

Prevention of Blood Borne Virus Transmission (Hepatitis B, C and HIV)

Follow principles of Inoculation Accident Injury.

Obtain blood sample from patient
- As soon as possible, a blood sample from the patient should be stored for baseline.
- Refer to Bloodborne viruses: managing risk in bomb blast victims PHE Guideline on BBV

Hepatitis B Vaccination
- Start vaccination course within 48 hours of injury.
- Give accelerated vaccine schedule.
- Store blood and check for seroconversion at three and six months.
- Will have some opioid sparing effect.

Hepatitis C Vaccination
- No vaccine/antiviral strategy possible.
- Store blood and check for seroconversion at three and six months.

HIV
- Post exposure prophylaxis not routinely recommended.
- Risk assessment will be directed by Public Health England.
- Store blood and check for seroconversion at three and six months.
Blast lung in a major incident

Introduction
Casualties with a primary blast lung injury (PBLI) will probably be symptomatic by the time they reach hospital. Casualties with PBLI will develop varying degrees of respiratory distress with impaired gas exchange. They may require supportive care in a high dependency or intensive care environment and up to 80% will require mechanical ventilation.

⚠️ The combination of blast injury and haemorrhagic shock is particularly life threatening and requires rapid and aggressive treatment.

Catastrophic haemorrhage
- Catastrophic haemorrhage may result from a massive haemothorax
- Needs prompt recognition, haemostatic resuscitation and damage control surgery

Patient may present with:
- mild to moderate respiratory distress
- Pneumothorax/pneumatoceles
- Broncho-pleural fistula in severe cases

CT chest to exclude pneumothorax

No specific therapy for PBLI currently exists and patients should be ventilated as per current best practice for acute lung injury.

Intensive Care Management
- Ventilate in accordance with current best practice
- Early CPAP at 5cm H2O, once pneumothoraces are drained
- Moderate PEEP levels on case by case basis if broncho-pleural fistula
- Use pAPRV and/or ECCO₂R (local experience and resources permitting)
- Euvolaemic volume status
- Expect a good recovery

Hypotension may be due to myocardial impairment and decreased SVR

Consider vasopressor use to avoid excess administration of IV fluids

Casualty identification
- If asymptomatic at two hours, patient will not need mechanical ventilation.
- If asymptomatic at six hours, significant PBLI is unlikely to occur.

Has patient been exposed to:
- Toxic industrial chemical exposure (eg Chlorine/Phosgene/Cyanide).
- Other toxic or smoke exposure.

⚠️ Tympanic membrane rupture is not a sensitive or specific risk factor for PBLI.

Risk factors
- Explosion in confined space
- Close proximity to explosion

KEY POINTS

Figure 1

Figure 2

Updated: 08/01/2020

v2.0
Blast lung in a major incident

Background
Primary blast injury syndrome is a life threatening, multi-system disease, of which primary blast lung injury (PBLI) is normally the predominant injury. PBLI is defined as “radiological and clinical evidence of acute lung injury occurring within 12 hours of exposure and not due to secondary or tertiary injury”, and results from exposure to a supersonic explosive shockwave (Figure 1).

Solid organs and the long bones may also be injured by the shockwave, however in the lung, significant damage manifests as alveolar and parenchymal rupture, haemorrhage, lung laceration, and pneumothoraces. Immediate fatalities are the result of venous air embolism.

The exponential decline in shock wave energy means that in an open air explosion, just a matter of a few metres can make the difference between suffering a fatal blast injury and suffering virtually no injury at all. However, when an explosion occurs in a confined space such as buildings or trains, the energy within the shock wave does not dissipate so readily, but self-propagates and augments itself in a chaotic manner. The stand-off distance in a confined-space explosive event is as a result less important and the risk of injury much greater.

Presentation and diagnosis
PBLI was seen in 63% and 54% of the critically injured casualties suffered in the Madrid and London train bombings, respectively.

Respiratory compromise and possibly haemoptysis, are early signs of PBLI.
- The absence of respiratory compromise 2 hours after injury suggests that the need mechanical ventilation due to PBLI alone is unlikely.
- Patients who are asymptomatic 6 hours after exposure are unlikely to develop clinically important disease.
- Tympanic membrane rupture is poorly correlated with PBLI but non the less should be sought for and identified.
- The possibility of co-existing toxic lung injury (with cyanide or phosgene for example), gastric aspiration and pulmonary contusion from blunt injury should be considered.

Casualties with PBLI require management in a high-dependency or critical care environment and the majority will require mechanical ventilation.

CT imaging is the imaging of choice:
- Clearly demonstrates the distribution and extent of alveolar haemorrhage and parenchymal haemorrhage.
- Better demonstrates pneumatoceles and pneumothoraces which may not be apparent with plain film radiography.

Figure 2 overleaf, is an example of a CT scan in a patient with severe PBLI, shortly after injury

Plain film radiography may demonstrate:
- Contusions, which may be denser on the side of the incident shock wave
- Characteristic ‘bats-wing’ distribution of consolidation may be seen, although this is not typical (Figure 1 overleaf)

Medical management
Casualties with PBLI require management in a high-dependency or critical care environment and the majority will require mechanical ventilation. The combination of blast injury and hemorrhagic shock is particularly life threatening and such patients should be triaged and prioritised accordingly.
- No specific therapy exists for the management of PBLI though this is an active area of research.
- Tranexamic Acid and recombinant factor VIIa have been studied but demonstrated no benefit.
- Hepatitis B vaccination must be considered when prophylaxis against HIV infection in such circumstances and so a case by case consideration should be made locally.

Computerised modelling studies (unpublished at the time of writing) have looked at the potential benefit of early ambient-air CPAP and at optimal modes of mechanical ventilation (Figure 3).
- These studies demonstrate the potential for significant improvements in oxygenation and reduction in respiratory rate with the application of 5 cmH2O CPAP on air within an hour of injury. Use of oxygen enriched air augments this effect.
- They also suggest that airway pressure release ventilation (APRV) and in particular ultra-protective tidal volume ventilation (facilitated by extracorporeal carbon dioxide removal (ECCO2R)) may offer significant physiological benefits to the patient.
- ECCO2R requires large bore venous access and full anticoagulation with heparin and so has obvious limitations in the trauma population.

Figure 3. The results of computerised modelling studies demonstrating the potential improvements in oxygenation suggested by these studies.

Figure 3a shows the modelled effect on arterial oxygenation of the early application of ambient-air CPAP. Figure 3b compares the effect on oxygenation of standard conventional ventilation, airway pressure release ventilation and ultra-protective tidal volume ventilation.
Burn injury in a major incident

In a MI event normal referral practices will be stopped and burns services will be closed. Burn injured patients will remain in the receiving hospital(s) until an appropriate burns bed is found. Burn Incident Response Teams (BIRTs) can be mobilised by NHS England to support these receiving hospitals.

The BIRTs team:
- 1 Consultant Burns Surgeon
- 1 Consultant Burns Anaesthetist/Intensivist
- 1 Burns Nurse
  - mobilised from burns services furthest away from the receiving hospital

BIRTs provide specialist advice, log all burns casualties, document injuries and liaise with the clinical cell. The clinical cell will decide on patients’ destination. They will also assist with continued local care and advise on fitness for transfer, ideally within the first 72 hours.

Hospitals must:
- Maintain a list of patients referred to BIRT
- Assign a point of contact for the BIRT prior to arrival of team

For each patient:
- Copy of patient notes
- BIRT Team paperwork (when completed)
- Completed Lund and Browder chart
- All available test results
- Details of all other injuries (after secondary survey)
- Details of fluid requirements, fluid administered and urine output

National Burn Bed Bureau
01384 679 036

KEY POINTS
- If in doubt, intubate
- Don’t cut the ETT
- Don’t forget C-Spine
- Don’t include simple erythema in estimation of burn wound size
- Hypothermia kills

A

Take a good history quickly from the patient (patient may need early intubation).

B

Loss of airway patency can occur suddenly, especially in children. Oedema will increase rapidly once IV Fluids given.
- Always give supplemental O2 15L/min via non-rebreath mask until COHb <5%

Consider intubation if:
- GCS <12. Can be caused by trauma, drugs, alcohol, carbon monoxide. Consider CT Head
- Impending upper airway obstruction
  - Pharyngeal oedema
    - INTUBATE NOW
  - Inspiratory stridor
    - INTUBATE NOW
  - Difficulty swallowing secretions
    - INTUBATE NOW
  - Intra-oral burns including tongue
    - Intubate
  - Intra-oral swelling. No stridor
    - Intubate
  - Burns around mouth or nose
    - Soot in mouth or nostrils, singed nasal hairs
      - Observe carefully

- Respiratory distress
- Ventilatory inadequacy caused by circumferential burns to chest and/or abdomen
- Deep facial burns and circumferential neck burns
- Increasing swelling of head and neck. May be particularly obvious once fluid resuscitation commenced.
- Other serious trauma / significant associated injuries

IF IN DOUBT, INTUBATE. (DO NOT cut the ET tube)

C

- Sit the patient up if possible. IV Fluid resuscitation may cause rapid oedema formation particularly in patients lying flat
- Place lines through unburned skin if possible (femoral site is often preserved)
- Regularly review anchor sutures. May ‘cut out’ of burned or oedematous skin
- Expect tachycardia (HR x2 is common). Hypotension and cardiovascular instability are late signs. If there is early hypotension, look for another cause.
- Consider using long lines for IV access. Indwelling lines may migrate as a result of tissue oedema.

D

- Circumferential full thickness burns can cause limb ischaemia.
- Is escharotomy required?
Burn injury in a major incident

- Complete the secondary survey.
- Prevent hypothermia.
- Hypothermia adversely affects outcomes in burns
- Keep the patient covered
- Warm the fluids and the environment if possible
- If possible, measure core and peripheral temperature
- Start fluid replacement as soon as possible to prevent ‘Burn Shock’

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Management of ‘Burn Shock’
Start fluid replacement as soon as possible to prevent ‘Burn Shock’.
- Crystalloid based IV Fluids (e.g. Hartmanns) is better than normal saline.
- Calculate 3-4mls/kg/%TBSA (this is the total volume for the first 24 hours).
- Calculate fluid requirements from time of injury.
- Give half of this volume in the first 8 hours, and the second half over the next 16 hours.
- After 24 hours, titrate fluids to urine output. 0.5mls/kg/hr (Adults) and 1.0mls/kg/hr (Children).
- REDUCE fluid input if urine output exceeds this amount.

Palliation of unsurvivable burns injury
Local non-burns specialists staff should not make decisions on survivability of burns injuries without discussion with the burns network, even in a MI. The decision to invoke the P4 casualty category for expectant patients will made by NHS England. This decision will be time limited, continually under review and only used at a time when NHS resources are overwhelmed.

References
- Concept of Operations for the Management of Mass Casualties (Burns Annex) NHS England EPRR
- National Burns Incident Clinical Management Guidance NHS England EPRR

Further advice on Chemical Injuries
- Chemical injuries are treated with the same principles as burns injuries.
### Special Circumstances:

#### Carbon Monoxide Poisoning Suspected
- Affinity of Carbon Monoxide (CO) for Hb is 240x that of oxygen
- COHb causes a functional anaemia and displaces the oxygen dissociation curve to the left, worsening tissue hypoxia.
- Signs and symptoms:
  - essentially those of reduced oxygen delivery to the tissues i.e. shock.
- Pulse oximeter is unreliable in the presence of COHb. Use a co-oximeter.
- Review Airway Management
- CO dissociates from Hb very slowly. Half-life in air > 4 hours. Half-life in 100% oxygen 40 mins. Use 100% oxygen until COHb <5%

#### Cyanide Poisoning
- Cyanide gas (HCN) is 20 x more toxic that carbon monoxide
- Suspect in all cases of smoke inhalation, but particularly in patients with significant lactic acidosis and raised venous oxygen
- Review Airway Management
- Consider treatment with hydroxocobalamin

#### Hypermetabolism
- Burn injuries of more than 20% TBSA result in a hypermetabolic response.
- Cardiac output and heart rate can often increase by 150–200%. The patient will also typically have a hyperglycaemic insulin resistant state and often require insulin supplementation.
- Manage in a thermoneutral environment. Early excision of deep burns where possible.
- Signs and symptoms:
  - hyperdynamic circulation, increased body temperature, catabolism and inefficient energy substrate cycling.

#### Infection
- Burns patients are vulnerable to infection in the early stages due to loss of the protective skin layer and immunosuppression secondary to major trauma
- The massive SIRS response in major burns makes diagnosis of sepsis challenging. A high index of suspicion is essential
- Isolation in a single cubicle and an ante-room is the gold standard
- Stringent infection control precautions cannot be over emphasised. All clinical staff should follow hospital standards for hand washing and wear aprons and gloves as a minimum

#### Hyperpyrexia
- When core temperature greater than 39°C
- Patients with major burns are often hyperthermic.
- A short period of very high temperature can cause significant morbidity
- Temperatures of 41.6 to 42°C can cause irreversible cell damage in as little as 45 minutes
- Management of core temperature >39°C
  - Septic screen, check U&E, CK
  - Antipyretics
  - Open burn wound dressings (discuss with burn surgeon first if possible)
  - Consider ice packs to axilla and groin
  - Refrigerate NG/NG feed and flush
- Management of core temperature >40°C for more than 6 consecutive hours
  - As above (>39°C) plus
  - Consider immediate active cooling e.g. CVVHDF, oesophageal cooling, coolguard.
- Management of core temperature >41°C for more than 2 consecutive hours
  - As above (>40°C) plus
  - Consider additional active cooling methods e.g. CVVHDF, oesophageal cooling, coolguard.

#### Stop active cooling measures when the core temperature reaches 38.5°C. Core temperature of up to 38.5°C can be considered normal, secondary to the massive SIRS response to thermal injury.
Forensic awareness* in a major incident

Critical patient treatment takes precedence over evidence collection. These guidelines have been created for clinicians forced to disturb items of potential evidential importance by treating a patient.

- Make at least one record of any items with potential evidential significance;
  - Photograph and/or Clinical Sketch (with scale) and/or written notes/description
  - Avoid contamination between patients (crime scenes), or by introducing material of your own (DNA, fibres etc)

Major crime scenes are complex events, and admissions to hospital tend to occur at their outset before a clear investigative structure has been established.

Dealing with multiple casualties from a single suspicious incident

If you are dealing with multiple casualties from the same suspicious incident, be aware of the risks of cross-contamination between them.
- If possible, request that staff only care for one of the casualties.
- If not, ensure you change all of your protective equipment between the two casualties and document the change.
- If patient is under suspicion, they should be cared for by a separate team in a separate area if possible

Injuries
- The recording of injuries before treatment can provide vital evidence. Use in hospital photographers/DIY cameras/apps. Police photographers are only likely to record the injury once it has been stitched, glued or dressed/bandaged.
  - Take scaled photographs of an injury;
  - one wide ‘locating shot’ showing where the injury is,
  - and another detailed shot showing its extent is ideal.
  - Clinical sketches and clear written notes are also very valuable.

Clothing and footwear

Fibre, DNA and blood pattern evidence on clothing, and damage to clothing, can assist in reconstructing the nature and sequence of an attack.
- When removing/cutting clothing avoid cutting through existing cuts and tears in the fabric.
- Avoid putting multiple items with wet bloodstains in a single plastic bag. Package items in individual plastic bags before grouping them together in a single plastic bag.
- Do not clean seized footwear. When removing footwear from a patient, avoid obvious bloodstains/tears/cuts when cutting through the uppers. For example, cut through the posterior part of a shoe upper to preserve evidence on the front upper.

Drugs

If you find a substance on a patient that you believe might be a form of drug:
- Avoid direct contact with the substance. Handle it sparingly with a gloved hand.
- Store the substance in a plastic bag somewhere secure.
- When describing a substance in notes, exhibit labels or in statements, describe what it looks like but do not guess what it may be.

Weapons

**Edged weapons (knives etc)**
- If an edged weapon is found on a patient, be mindful that it might harbour evidence on both the handle and the blade.
- Consider your safety; handle the weapon minimally and with care.
- Handle sparingly with gloved hands.
- Move the knife by handling uncommon points of contact, such as the edges of the hilt or the pommel (base).
- Place into a clean rigid tub, rather than a plastic bag.

**Firearms**
- If you recover what you believe to be a firearm, do not touch or handle it. Call the police to inspect the weapon and make it safe.

**Ammunition components (bullets, shot or wadding)**
- Rounds (a bullet with a metal cartridge containing propellant) or shotgun cartridges are potentially live. You should inform the police immediately.
- A bullet or shot removed from a suspected gunshot wound will have been expended and is no longer live.
- These can be packaged individually in a small plastic pot lined with a plastic bag to stop it rattling. Shotgun shot can be stored collectively.

*These guidelines have been created for clinicians forced to disturb items of potential evidential importance by treating a patient. They are not intended to act as a professional reference for forensic collection.
Forensic awareness in a major incident

These guidelines have been created for clinicians forced to disturb items of potential evidential importance by treating a patient. They are not intended to act as a professional reference for forensic collection.

Communication

Police/Forensic teams present at the hospital may not understand your clinical priorities, or know what items the victim/suspect had on their person.

- Assist the police by noting:
  - The number, position and description of injuries
  - What clothing and footwear has been removed from the victim/suspect
  - How these removed items have been packaged and where they are currently stored

- Make good clear clinical notes, with time and place, as these may be used as evidence in any subsequent inquiry.

Exhibits

An exhibit is any item, image or document entered into the police chain of custody (see below).

An item isn’t covered by the rules of evidence before it is seized, but you should still take sensible precautions to optimise any potential value as evidence by:

- Recording the appearance, location and nature of an item of interest.
  - This will avoid confusion about the nature and origin of an item that later becomes an exhibit.

Exhibits will be packaged and stored according to the evidence types associated with it by the police/forensic teams.

- Allow police to collect discarded clothing/items. For example, a shirt with bloodstaining may be packaged in a tamper evident bag and frozen for DNA analysis.

- If you are likely to handle multiple exhibits from the same suspicious incident, be aware of the risk of cross-contamination by wearing two pairs of nitrile gloves and discarding the outer pair after handling each item.
Head, face and neck injuries in a major incident

Severe trauma to the head, face and neck rarely results in exsanguination despite appearances, and facial injuries are only addressed during the primary survey if bleeding is impacting on airway or circulation. However, important significant life changing disability can result if injuries to visual, auditory, gustatory, vestibular and olfactory systems are not recognised and the psychological impact of facial disfigurement can be devastating.

Catastrophic haemorrhage
- Excessive bleeding from a scalp laceration
  - Manage bleed with a tight, compression bandage
  - Within the hairy scalp, haemostats, staples or deep silk sutures can be used tamponade the bleeding
- Facial arterial bleeding. If direct pressure fails, consider applying pressure proximally
  - Chin, lip, midface, nose (facial artery). Apply pressure to the lower border of the mandible, just anterior to masseter muscle. Do not blindly place haemostats due to risk of damaging the facial nerve
  - Scalp above the ear (superficial temporal artery). Apply pressure to the scalp, just anterior to the crux of the pinna
- Distally displaced loose maxilla (Le Fort fracture) causing obstruction of the airway.
  - (Intubated patient) Use two fingers on the soft palate to reduce the fracture and clear the nasopharynx.
- Comminuted mandible fractures.
  - De-rotate the mandible fragments to clear the oropharynx.
- Distally displaced tongue obstructing airway.
  - Anterior tongue silk suture can be used to secure tongue.
- Other causes of airway obstructions:
  - Missing teeth/fractured dentures
  - Congealed blood and vomit
- Anterior nasal packing with ribbon gauze or nasal tampons (ie Rapid Rhino®)
- Posterior nasal haemorrhage may require both posterior and anterior nasal packing (ie Epistat® or Foley catheter with additional anterior packing)

KEY POINTS
- Severe facial trauma should be regarded as an indicator of potential intracranial trauma or cervical spine injury.

A
- C-Collar: may cause a patient with maxillofacial injuries to obstruct.
  - Sit patient up, face forwards if conscious and no spinal injury, or consider if C-Spine can be cleared to remove C-Collar as soon as possible
- Distally displaced loose maxilla (Le Fort fracture) causing obstruction of the airway.
  - (Intubated patient) Use two fingers on the soft palate to reduce the fracture and clear the nasopharynx.
- Comminuted mandible fractures.
  - De-rotate the mandible fragments to clear the oropharynx.
- Distally displaced tongue obstructing airway.
  - Anterior tongue silk suture can be used to secure tongue.
- Other causes of airway obstructions:
  - Missing teeth/fractured dentures
  - Congealed blood and vomit

B
- As per standard trauma resuscitation

C
- As per standard trauma resuscitation

D
- Head and neck wounds
  - All wounds deep to the platysma muscle should be explored in theatre
  - Facial wounds and abrasions with grit and foreign particles are at risk of tattooing if not scrubbed out
  - If direct pressure does not stop a bleeding neck wound, then a foley catheter can be inserted into the wound and filled with saline, to tamponade the bleed
- Nasal haemorrhage
  - Anterior nasal packing with ribbon gauze or nasal tampons (ie Rapid Rhino®)
  - Posterior nasal haemorrhage may require both posterior and anterior nasal packing (ie Epistat® or Foley catheter with additional anterior packing)
Head, face and neck injuries in a major incident

Important injuries in the head and neck

**Eyes**
- Globe perforation
- Retrobulbar haemorrhage
- Foreign bodies (incl contact lens)
- Retinal detachment
- Children’s white eye blow out
  - Check visual acuity

**Face**
- Soft tissue laceration with deep structure involvement
  - Is there potential risk to the parotid duct or facial nerve?
  - Must be assessed prior to surgery/GA

**Ears**
- Tympanic membrane rupture
- Inner ear damage
- Hearing test in the next few days

**Nose/ears**
- CSF leak or bleeding from the nose or external auditory meatus

**Maxilla**
- Distally displaced Mobile Le Fort fractures (airway obstruction)

**Mandible**
- Communited fractures, especially in the elderly, may allow airway obstruction
  - The tongue may lose its anterior attachments and displace distally, obstructing the airway

**Teeth**
- Missing teeth – are they on the floor, in the lip or lung(s)?

**How to pack anterior and posterior nasal cavities**
- Insert Epistat catheter along the nasal floor until the tip passes the soft palate. Fill the posterior balloon with < 10mls saline. Pull gently on the catheter until it meets resistance and then fill the anterior balloon with <30mls.
- A Foley catheter (12-14G) can also be used, with additional anterior packing such as ribbon gauze and saline/TXA.

**Neck**
- Penetrating neck trauma is potentially fatal
  - Look for external haemorrhage or an expanding haematoma that may indicate a vascular injury
  - Penetrating objects should not be removed

**Zone 1**
- Clavicle to cricoid cartilage
  - great vessels
  - trachea
  - oesophagus (dysphagia, haematemesis)
  - lung apices
  - brachial plexus

**Zone 2**
- Cricoid cartilage to angle of the mandible
  - carotid arteries
  - internal jugular vein
  - larynopharynx (stridor, haemoptysis, surgical emphysema, hoarseness of voice)

**Zone 3**
- Between angle of mandible and skull base
  - internal carotid artery
  - internal jugular vein
  - cranial nerves (IX-XII)
Paediatric casualties in a major incident

This guideline has been created for non-paediatric specialists. The paediatric groups are defined as:
- Baby 0–6 months
- Infant 6–12 months
- Toddler 1–2 years
- Child >3 years
- >12 years can cautiously be managed as an adult

History – take an AMPLE history
- A Allergies
- M Medications
- P Past medical history
- L Last food/liquids
- E Event

Extras
- Is child up to date with routine vaccinations?
- Birth History: As child becomes older, this is less significant.
- In infants, postnatal respiratory difficulties may contribute to a condition worsening beyond what would be expected based on injury

Blood volume is relatively larger 80–90mls/kg (adult 65–70mls/kg)
- Record all blood loss (100mls in a 5kg child = 10% of total blood volume)
- Hypotension is a late sign
- If there small vessels: consider IO, scalp veins and ext. jugular vein

Normal paediatric vital signs by age group

<table>
<thead>
<tr>
<th>Age group</th>
<th>Resp rate</th>
<th>Heart rate</th>
<th>Min sys BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term baby</td>
<td>40–60</td>
<td>100–170</td>
<td>50</td>
</tr>
<tr>
<td>3 month</td>
<td>30–50</td>
<td>100–170</td>
<td>50</td>
</tr>
<tr>
<td>6 month</td>
<td>30–50</td>
<td>100–170</td>
<td>60</td>
</tr>
<tr>
<td>1 year old</td>
<td>30–40</td>
<td>110–160</td>
<td>70–90</td>
</tr>
<tr>
<td>1–2 years</td>
<td>25–35</td>
<td>100–150</td>
<td>80–95</td>
</tr>
<tr>
<td>2–5 years</td>
<td>25–30</td>
<td>95–140</td>
<td>80–100</td>
</tr>
<tr>
<td>5–12 years</td>
<td>20–25</td>
<td>80–120</td>
<td>90–110</td>
</tr>
<tr>
<td>&gt;12 years</td>
<td>15–20</td>
<td>60–100</td>
<td>100–120</td>
</tr>
</tbody>
</table>

Head
- 0–18 months have open sutures and fontanelles
  - Bulging fontanelle = intracranial bleeding (ICP)
  - Sunken fontanelle = significant blood loss

Chest
- The force transmitted may not fracture ribs but may still cause significant internal injuries
  - Mobility of mediastinum increases the likelihood of a simple pneumothorax developing into a tension pneumothorax, or a mediastinal vessel transection.

Abdomen
- Thin abdominal wall, with less muscle and sub-cutaneous fat, offers less protection to abdominal organs than in adults
  - Increased likelihood of bladder, liver and spleen injury

Musculoskeletal
- Fractures through growth plates may influence x-ray interpretation, however if missed can seriously affect future growth of the fractured bone

Increased risk of multiple organ involvement from blunt trauma
- Monitor plasma glucose. Children have a higher metabolic rate and smaller glycogen stores than adults.
- Heat loss: large surface area to volume ratio therefore increased risk of heat loss. Remember the patient’s exposed head

Place infant head in neutral position (larger occiput than adults)
- Fulcrum of C-Spine is C1-2 (high C-Spine injury more likely)
Pain management in a major incident

1 – Chest injury
- Intercostal nerve blocks
- Serratus plane blocks

2 – Abdominal injury
- Transverse abdominus plane (TAP) block
- Epidural Analgesia or LA (Lignocaine) infusion

3 – Limb injury
- Single shot nerve block
- +/- Indwelling nerve catheter for continuous infusion
- Regional or epidural analgesia
  - Consider regional analgesia at every step
    - Single shot block +/- continuous nerve blockade
  - If spinal and epidural analgesia
    - Urinary catheter may be required
  - Beware:
    - Hypovolaemia
    - Coagulopathy
    - Distorted spinal anatomy eg crush fractures in explosive injury
- Direct or anticipated nerve injury
  - Pregabalin
  - Tricyclic anti-depressants

KEY POINTS
- Start analgesia as soon as possible
- Use multi-nodal medication principles
- ‘Reverse’ WHO pain ladder
- Consider peri-operative nerve blocks
Pharmacology

Multi-modal analgesia using the reverse WHO pain ladder.

I. Opioids eg morphine
  - **Morphine** is familiar to most trauma clinicians. Multiple routes available but in acute situations is best given by intravenous bolus: 1–5 mg as bolus and then additional 1–2 mg doses every 2–5 minutes, titrated to effect.
  - Relatively large doses may be required in young athletic casualties and analgesia is slow in onset.
  - **Fentanyl** is a faster acting alternative. 50 micrograms i/v as a bolus and repeat doses of 25–50 micrograms every 2–5 minutes.
  - Degree of sedation more closely related to acute overdose than respiratory rate.
  - Accidental overdose requires intravenous naloxone. Take one ampoule (0.4 mgs) and dilute to 8 mls with water for injection. Inject 1 ml (0.05 mgs) and repeat until sedation reversed and respiratory rate ≥ 8.
  - Effect is short acting – observe casualty closely.

II. Weak opioids eg Tramadol, Codeine
  - **Tramadol** - Synthetic weak opioid with noradrenergic and serotonergic effects.
  - Alternative to codeine.
  - Recognised role in neuropathic pain.
  - 50-100 mgs QDS po. Start at 50 mgs if patient is opiate naive.

III. Non-opioids
  - **NSAIDs** - Avoid with acute haemorrhage/coagulopathy or critical illness.
  - Side effects more likely in elderly patients. Ibuprofen (200 –400 mgs tds, po, pr) or diclofenac (50 mgs tds, po, iv, pr) commonly used.

  - **Paracetamol** - 1g iv/po/pr QDS (500 mgs if body weight less than 50 kgs).
  - Few contraindications.
  - Will have some opioid sparing effect.

Adjuncts – Co-analgesics

A. Ketamine
  - 10–20 mg intravenous aliquots can be used de novo or to supplement opiate analgesia. Particularly effective prior to patient movement or splint procedures.
  - Effect will persist for 10–15 minutes.
  - Administrator should be resuscitation proficient as anaesthesia is possible with inappropriate dosage.

B. Tricyclic Antidepressants
  - Neuropathic injury – start as soon as possible. Reassess need at two weeks.
  - Amitriptyline often assists sleep at night – a useful effect.
  - Start amitriptyline dose at 25mg and titrate to effect.

C. Gabapentinoids eg. Pregabalin
  - Start as soon as possible – reassess need at two weeks.
  - Initial dose = 75mg bd.
  - Review every day, increasing dose if necessary and tolerated.
  - Dose range is 150 to 600 mg per day PO given in either two or three divided doses.

D. Clonidine
  - Anxiolytic/ analgesic.
  - PO 50 – 600 mcg 8 hourly (150–200 mcgs per 24hrs typical co-analgesic dose).
  - IV bolus – 50–150 mcg over 1–10 mins. May be repeated eight hourly.
  - Infusion in HDU/critical care: 1–2 mcg/kg/hour.

E. Lignocaine
  - Can assist in difficult situations – alternative to epidural in abdominal surgery.
  - 1–2 mg/kg iv bolus over 30 mins.
  - Infusion – 0.5 -2 mg/kg/hr.

Input from hospital acute pain services

**Patient Controlled Analgesia (PCA)**
- Encourage use of PCA when appropriate.
- PCA can be employed prospectively before surgery.

Pain management in a major incident

Establish pain control early and stop medications as and when appropriate.
Management of a pregnant casualty in a major incident

<20 weeks
Fundus below the umbilicus
- Gynaecology input

>20 weeks
Fundus above the umbilicus
- Obstetric team for emergency LSCS
- Midwife input for baby

Predict need for blood/fluids early
- Maternal hypotension due to shock is a late sign of haemorrhage – associated with 80% foetal mortality.
- Treating the mother gives the best outcomes for the child.

Primary survey

Standard <C>ABC care as for any trauma patient
- O₂
- 2 × IV Access
- Pelvic binder as usual (cut to fit if necessary)

However, RSI may be difficult
- If >20 weeks, tilt scoop to 30° to the left or manually displace uterus to avoid compression of IVC.

Secondary survey

- Secondary survey as usual
  Plus observe for:
  - uterine contractions
  - vaginal bleeding
  - amniotic fluid PV
  - Obstetric team should do the vaginal exam

Trauma checklist

Tranexamic Acid (TXA)
- Give if strong suspicion of significant haemorrhage
- If LSCS is planned, give after delivery of the child

Bloods
- Inform blood bank that patient is pregnant
- Add Kleihauer test (extra FBC bottle and G&S bottle)
- Consumptive coagulopathy can develop rapidly

KEY POINTS

- If mother is Rh D-ve, consider Rh Immunoglobulin therapy. Discuss with Haematology. If needed, should be given within 72 hours.
- Maternal bicarb is low in pregnancy
- Obstetric ward is not appropriate place for patient requiring head injury monitoring
- Discuss with obstetrics for destination after ED

The patient or spine board can be log rolled to 15-30 degrees to displace the uterus to the left, in a hypotensive, pregnant patient.
THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK
How can I help myself or others to overcome these difficulties?

Do:
- Take time out to get sufficient sleep (your normal amount), rest and relax, and eat regularly and healthily.
- Tell people what you need. Talk to people you trust. You don’t have to tell everyone everything but telling nobody anything is often unhelpful.
- Take care at home or when driving or riding - accidents are more common after a traumatic or stressful event.
- Try to reduce outside demands on you and don’t take on extra responsibilities for the time being.
- Make time to go to a place where you feel safe and calmly go over what happened in your mind. Don’t force yourself to do this if the feelings are too strong at the moment.

Don’t:
- Bottle up these feelings. Think whether it would be helpful to talk about them with somebody you trust. The memories may not disappear straight away.
- Get embarrassed by your feelings and thoughts, or those of others. They are normal reactions to a very stressful event.
- Avoid people you trust.

More information on post trauma reactions

www.rpsych.ac.uk/healthadvice/problemdisorders/posttraumaticstressdisorder.aspx
www.nhs.uk/Conditions/Post-traumatic-stress-disorder/Pages/Treatment.aspx

Where to find more help?

Contact your GP or NHS111 about possible symptoms of anxiety, depression, or post traumatic disorder, visit NHS Choices - www.NHS.uk or call the Samaritans on 08457 90 90 90

Coping with stress following a major incident

You may find this leaflet helpful if you have been involved in, or affected by, a traumatic incident. It provides information on how you may expect to feel in the days and months ahead, and to help you understand and have more control over your experience.
In addition, if a child has witnessed or experienced a traumatic event it is quite natural for them to be stressed. They may be very upset and/or frightened. This should not usually last beyond four weeks.

If symptoms of being very upset continue beyond four weeks, this may indicate Post Traumatic Stress Disorder (PTSD) and it is important to seek help for your child.

These are typical reactions after a traumatic event:

- Nightmares.
- Memories or pictures of the event unexpectedly popping into their mind.
- Feeling as if it is actually happening again.
- Playing or drawing about the event time and time again.
- Not wanting to think or talk about the event.
- Avoiding anything that might remind them of the event.
- Getting angry or upset more easily.
- Not being able to concentrate.
- Not being able to sleep.
- Being more jumpy and being on the lookout for danger.
- Becoming more clingy with parents or carers.
- Physical complaints such as stomach aches or headaches.
- Temporarily losing abilities (e.g. feeding and toileting).
- Problems at school.

How to help your child:

- Try to keep things as normal as possible: keeping to your usual routine and doing normal activities as much as you can, will help your child feel safer more quickly.
- Be available to talk to your child as and when they are ready. If it is difficult for you to do this, ask a trusted adult such as a family member or teacher to help.
- Try to help your child understand what has happened by giving a truthful explanation that is appropriate for their age. This may help reduce feelings of confusion, anger, sadness and fear. It can also help correct misunderstandings that might, for example, lead the child to feel that they are to blame. They can also help reassure the child that although bad things can happen, they don’t need to be scared all the time.
- In the event of a death, particularly a traumatic one, it can be difficult to accept the reality of what has happened. It is important to be patient, simple and honest in response to questions about a death. Some children, for example, will seem to accept a death but then repeatedly ask when that person is coming back. It is important to be patient and clear when dealing with these questions: for example, it is better to say "John has died" than "John has gone on a journey".

What to look for:

Children experiencing PTSD might show that they think differently either about themselves or other people. They might:

- Blame themselves or show lowered self-esteem.
- Describe thinking that they are a bad person or talk about thoughts of deserving bad things to happen to them.
- Show less trust in other people and be less able to experience a sense of safety.
- Experience overwhelming feelings in the form of shame, sadness and fear.
- Avoid situations that they fear could increase their emotional response – i.e. might make them feel more frightened, threatened, ashamed or reminded of the event.

What to do:

If you have any concerns about your child, it is important to seek help via your GP. There are some very effective treatments including Cognitive Behavioural Therapy (CBT) for children and young people experiencing the effects of trauma.
Psychosocial support for staff after a major incident

‘Psychosocial’ refers to the emotional, cognitive, social and physical experiences of people in the context of particular social and physical environments. Mental healthcare refers to delivering biomedical interventions from which people with disorders may benefit.

After a major incident, staff who attended to support as first responders and those who worked to provide subsequent care in hospital settings, are at risk of developing mental health disorders.

Most people involved in a major incident are likely to suffer short-term effects. In most cases, distress is transient and not associated with dysfunction or indicative of developing mental health disorders. Some people’s distress may last longer and be more incapacitating, for example where there are social factors maintaining their distress (e.g. separation from family, loss of home and possessions, social isolation).

A small proportion of people may require access to specialist mental healthcare. However, it is important to access the right help at the right time. Immediately following a traumatic event, personal, brief, single session interventions that focus on the particular event, should not be routine practice and do not need to be organised. Instead, follow Phase 1 advice below.

The following phased strategy is advised to support all those involved in a major incident, to prevent mental disorders and to identify those who may need specialist mental health services.

Major incident response

Initial support

- Peer and family support
- Organisation acknowledges staff efforts
- Community activities and public support
- External professional support (e.g. Mind BlueLight infoline)

Early intervention

Getting advice

- Occupational Health primary healthcare
- GP Primary Care Support
- NHS 111

Additional support

Monitoring and sign posting

- TRIM service (Trauma risk management) or equivalent
- Screen and Treat
- IAPT (Improving access to psychological therapies)

Specialist support

Treatment

Specialist Mental Health Services
# Psychosocial support for staff after a major incident

## Phase 1 Initial support
- **Launched in reaction to the event**
  - Psychological first aid (PFA) and peer support
  - Includes the employer’s leadership response to a major incident by communicating key messages of acknowledgement, self-care and support services, internal and external to the organisation
  - Access to advice and support as necessary through existing universal services (community, primary care/GP and specialist services)
  - Intervene using low level interventions such as peer support leaving biomedical mental healthcare for people who need it

## Phase 2 Getting advice
- **Weeks two to four**
  - Psychosocial support
  - Aim to manage distress, but an emphasis on maintaining social connectedness and people receiving social support
  - Involves listening, advice and support
  - With their consent, some staff may be referred to a programme that offers monitoring over a longer period of time and access to screening

## Phase 3 Additional support/getting help
- **From two weeks onwards**
  - Continuing psychosocial support
  - Monitoring staff at risk via occupational health
  - This may include referring people to:
    - Primary care
    - The TRiM service or equivalent (if available)
    - Specially created services to identify people who may need continuing support beyond four weeks
    - The IAPT service for more intensive psychosocial care

## Phase 4 Specialist support/getting more help
- **When symptoms are still present between four and twelve weeks after an event**
  - People with a history of the following may be at higher risk of developing a mental disorder than the general population:
    - Staff injured in the event or during the response
    - Exposure to high-severity of trauma
    - Close proximity to event
    - Dissociative response during the event
    - Significant (pre- or post-event) personal trauma, including developmental trauma and previous history of a mental disorder
    - Personal or significant family psychiatric history
    - Perceived absence of social support network
    - Substance misuse
    - Traumatic bereavement
  - If people are distressed or have symptoms of a mental disorder after 4 weeks and any of these risk factors are present, an early referral to a specialist mental health service may be advised.

Advice available from:
- MIND mind.org.uk/news-campaigns/coping-with-traumatic-events

Advice available from:
- Mind Blue Light Programme mind.org.uk/news-campaigns/campaigns/bluelight
- NHS 111 (to signpost to an appropriate service)

Advice available from:
- Primary care/own GP (for referral to IAPT)
- Improving access to Psychological Therapy Services (IAPT) for specialist PTSD support england.nhs.uk/mental-health/adults/iapt
- Mind Blue Light Programme mind.org.uk/news-campaigns/campaigns/bluelight

Advice available from:
- Primary care/own GP (for referral to IAPT)
- Improving access to Psychological Therapy Services (IAPT) england.nhs.uk/mental-health/adults/iapt
Rehabilitation co-ordination and medical support in a major incident

High quality hyperacute rehabilitation methods can support the major incident response and optimise patient outcomes.

Roles of the hyperacute rehab team in a major incident:
- To assist in creating capacity in the whole healthcare community to create beds (Back door)
- Hyperacute rehabilitation for new patients (Front door)

Ideas to create capacity (Back door)
- At any one time in a Major Trauma/Neuroscience Centre, there will be a significant number of patients who are ‘transfer ready’
- Usually there are more than 20 patients with medical clearance and more than 20 patients with predominantly R&R needs but partial medical clearance

When creating capacity:
- Ensure routine healthcare is not put on pause
- Understand that creating capacity takes time
- Too much capacity is the default position in a major incident

Estimate the scale of the response required and over-react

Example: How the rehab team could support a major incident response

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liaise with the MI Duty Physician to permit displacement of patients from priority beds</td>
<td>Form up into a hyperacute team, consisting of:</td>
</tr>
<tr>
<td>Prioritise specialist beds for creating capacity – neurosurgery, orthopaedics, ICU, Burns/Plastics – and focus on these</td>
<td>an occupational therapist</td>
</tr>
<tr>
<td></td>
<td>a physiotherapist</td>
</tr>
<tr>
<td></td>
<td>a discharge liaison nurse</td>
</tr>
<tr>
<td></td>
<td>an administrator/clerical support</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Step 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify ‘Transfer Ready’ patients</td>
<td>For each patient transferred:</td>
</tr>
<tr>
<td>Can the next care provider admit the patient now?</td>
<td>Identify the level of medical clearance and if community follow up is required?</td>
</tr>
<tr>
<td>Is there a community based rehab bed suitable for the patient?</td>
<td>Ensure equipment, care and rehab plans have been arranged.</td>
</tr>
<tr>
<td>Can support be provided for families wishing to have patients at home?</td>
<td>Liaise with next providers and families.</td>
</tr>
<tr>
<td>Can they be safely moved to an alternate bed within the hospital?</td>
<td>Record discharge destinations and contact numbers centrally, for all displaced patients</td>
</tr>
<tr>
<td>Can any behavioural or care needs be met with the next provider?</td>
<td></td>
</tr>
<tr>
<td>Are there any equipment issues? Can these be met by the next care provider?</td>
<td></td>
</tr>
</tbody>
</table>

If a regional response is required to meet the scale of capacity expected:
- Alert other regional rehab services to create/declare capacity
- Alert community trusts to open Level 2b and 3 rehab beds
- Contact Care Commissioners: They may be able to release/prioritise funding for exceptional cases or additional capacity

KEY POINTS

- Back door processes first - hyperacute rehab teams should assist in creating capacity in a major incident
- Front door processes second – hyperacute rehab optimises patient outcomes and supports the early major incident response
Rehabilitation co-ordination and medical support in a major incident

High quality hyperacute rehab methods can support the major incident response and optimise patient outcomes

Front door hyperacute rehabilitation

For patients with;

Acquired Brain Injury
- Does the patient have a Traumatic brain injury (TBI) or Hypoxic-ischaemic brain injury (HIBI)?
- Classification of Injury (Diffuse axonal injury(DAI), mild traumatic brain injury(mTBI), minimally conscious state (MCS) or vegetative state (VS)
- Prognosis and Triage – futility?
- CRASH Algorithm http://www.crash.lshtm.ac.uk/Risk%20calculator/index.html
- Differential diagnosis: drugs, toxins, fat embolism, metabolic causes

Spinal Cord Injury
- ASIA assessment
- Establish early spinal clearance or spinal plan
- Early respiratory support – Cough Assist, diaphragmatic screening
- Application of the ‘Spinal Bundle’ care plan incl. bowel regime, feeding/nutrition
- Cervical collar prescription and application
- Spinal cord injury (SCI) centre referral (Gold standard-within 4 hours)

Plexopathy
- Early identification is key
- Imaging
- Peripheral nerve injury- surgical referral

Peripheral nerve injury
- Clinical and neurophysiology assessment
- Orthotics (ie futuro splint for wrist drop in brachial plexus nerve injury)

Seizures and seizure prevention

Movement disorder

Functional neurological disorder and dissociation

Spasticity
- Identify and treat (Consider early antispasmodics: baclofen, early botulinum toxin (BTX-A))
- Identify afferent stimuli acting as triggers
- Identify and treat paroxysmal sympathetic hyper-reactivity
- Positioning and splinting
- Identify and treat heterotrophic ossification

Injuries to Special Senses

Vision
- Fundoscopy: Purtscher’s retinopathy, eye trauma
- Orbital haematoma
- Visual function assessment with Optokinetic Nystagmus (OKN)
- Hearing disturbances especially in blast injury
- Pain, especially neurogenic pain

Agitation and Delirium
- Exclude underlying causes
- Treat to protocol with lorazepam/carbamazepine/olanzapine
- Identify environmental triggers and de-escalate

Post acute Interventions

Orthotics and Prosthetics:
- Collars and braces
- Pressure relief ankle foot orthoses (PRAFO)/Dorsi-Wedges
- MDT Amputation planning including surgeons, rehab team and prostheticians
- Targeted re-innervation planning

Cognitive Assessments
- Post Traumatic Amnesia (PTA) assessment
- Classification and prognosis
- Breaking bad news
- Forensic and witness issues
- Functional Neurological disorder

Communication tools
- Open circuit ventilation (eg Phillips V60 + Passey Muir Valve)
- Pointing charts
- Partner assisted scanning charts
- Over-bed mirrors
- Adapted call switches
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The project is indebted to the following for their guidance, expert knowledge and access to extensive professional networks.

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Guideline MOI/5 graphics were produced by Surg Cdr Steve Bland RN

These guidelines have been heavily influenced by many military and open source materials:

Clinical guidelines for operations (CGOs) (JSP999) Ministry of Defence
https://www.clinicalguideforops.co.uk

Advance Trauma Life Support
(USA) https://www.facs.org/quality-programs/trauma/atls/about
(UK provider) https://www.rcseng.ac.uk/education-and-exams/courses/search/advanced-trauma-life-support-atls-provider-programme/

Hospital Major Incident Medical Management and Support (HMIMMS)
Advanced Life Support Group https://www.alsg.org/home

Oxford Desk Reference Major Trauma
Jason Smith, Ian Greaves, Keith M. Porter

Role 4 Trauma Website and Combat Trauma App
www.4trauma.org.uk
‘Combat Trauma’ is available for download from the App Store - Apple (UK) (tablet only)
RCDM – Royal Centre for Defence Medicine, Birmingham, UK
ABO refers to blood group types A, B and O
ABSCM Anterior Border of the SternoCleido Mastoid muscle
ABx Antibiotics
ATD Adult Therapeutic Dose
ALS Advanced Life Support
A-line Arterial line
AK47 Automatic Kalashnikov assault rifle
AMPLE Allergies, Medications, Past Medical History, Last eaten, Events leading up to injury
ARDS Adult Respiratory Distress Syndrome
ASIA American Spinal Injury Association
ATLS Advanced Trauma Life Support
ATMIST Age, Time, Mechanism of Injury, Injuries, Signs (vital signs), Treatments given
AVM Arterio-Venous Malformation
AVPU Alert, Voice, Pain, Unresponsive (levels of consciousness)
BBV Blood Borne Virus
BM stix Trade name for blood glucose test strip (Boehringer Mannheim, now called Roche)
BOAST4 British Orthopaedic Association Standards for Trauma Pathway 4, for patients with open lower limb injuries
BP Blood Pressure
BTX-A Botulinum Toxin Type A
big bang a serious transport accident, explosion or series of smaller incidents
°C degrees centigrade
C1 Cervical Spine 1 (Atlas)
CABC approach Catastrophic Haemorrhage, Airway, Breathing, Circulation (standard ATLS/ALS assessment routine)
CABCDCE Catastrophic Haemorrhage, Airway, Breathing, Circulation, Disability, Environment/Exposure
CBRN Chemical, Biological, Radiation, Nuclear
C-Collar Cervical spine immobilisation collar
CCS Casualty Clearing Station
CHL Conductive hearing loss
CK Creatine Kinase
clotting screen eg. INR, PT, APTT, Fibrinogen
cloud on the horizon a serious threat such as a significant chemical or nuclear release developing elsewhere and needing preparatory action
CPAP Continuous Positive Airway Pressure
CPE CPE Carbapenemase producing Enterobacteriaceae
C-Spine Cervical Spine
CSF CerebroSpinal Fluid
CT Computed Tomography scan/imaging
CT Hot Report first report issued by radiologist reviewing a trauma CT scan, usually within 15mins
CTwb Computed Tomography whole body imaging
D50 Dextrose 50% in water
DAI Diffuse Axonal Injury
DNA DeoxyriboNucleic Acid
Dr1, Dr2 Doctor 1, Doctor 2
EA Epidural Analgesia
ESBL Extended Spectrum Beta-Lactamase
ECO R Extra Corporeal Carbon Dioxide Removal
ECMO Extra Corporeal Membrane Oxygenation
ECOSA Emergency Co-ordination Scientific Advice system
ED Emergency Department
EDH Extra Dural Haemorrhage
ENT Ear, Nose and Throat surgical specialty
EPRR Emergency Preparedness, Resilience and Response
ET Endotracheal tube
Ex-Fix External Fixator
EZIO® battery powered intra-osseous driver with needle
fVIIa Factor VIIa
FAST Focused Assessment with Sonography in Trauma
FBC Full Blood Count
FFP Fresh Frozen Plasma
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>FiO2</td>
<td>Fraction of Inspired Oxygen</td>
</tr>
<tr>
<td>FTL</td>
<td>Full Thickness Loss (in burns)</td>
</tr>
<tr>
<td>(Fwd)CCP</td>
<td>(Forward) Casualty Collection Point</td>
</tr>
<tr>
<td>GA</td>
<td>General Anaesthesia</td>
</tr>
<tr>
<td>GCS</td>
<td>Glasgow Coma Score</td>
</tr>
<tr>
<td>GP</td>
<td>General Practitioner</td>
</tr>
<tr>
<td>GSW</td>
<td>GunShot Wound</td>
</tr>
<tr>
<td>HALO</td>
<td>Hospital Ambulance Liaison Officer</td>
</tr>
<tr>
<td>HAZMAT</td>
<td>Hazardous Material, accidental incident involving hazardous material</td>
</tr>
<tr>
<td>headline news</td>
<td>public or media alarm about an impending situation, reputation management issues</td>
</tr>
<tr>
<td>HIBI</td>
<td>Hypoxic-Ischaemic Brain Injury</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
</tr>
<tr>
<td>HME</td>
<td>Heat and Moisture Exchanger</td>
</tr>
<tr>
<td>hot debrief</td>
<td>meeting that occurs immediately after an incident or period of duty</td>
</tr>
<tr>
<td>HR</td>
<td>Heart Rate</td>
</tr>
<tr>
<td>l/hr</td>
<td>litres per hour</td>
</tr>
<tr>
<td>LEH</td>
<td>Local Emergency Hospital</td>
</tr>
<tr>
<td>IAPT</td>
<td>Improving Access to Psychological Therapies</td>
</tr>
<tr>
<td>ICD</td>
<td>Intercostal Chest Drain</td>
</tr>
<tr>
<td>ICP</td>
<td>IntraCranial Pressure</td>
</tr>
<tr>
<td>ICU</td>
<td>Intensive Care Unit</td>
</tr>
<tr>
<td>IED</td>
<td>Improvised Explosive Device</td>
</tr>
<tr>
<td>in</td>
<td>inches</td>
</tr>
<tr>
<td>IO</td>
<td>Intra-Osseous</td>
</tr>
<tr>
<td>IOR</td>
<td>Initial Operational Response</td>
</tr>
<tr>
<td>IPC</td>
<td>Infection Prevention &amp; Control</td>
</tr>
<tr>
<td>IPPV</td>
<td>Intermittent Positive Pressure Ventilation</td>
</tr>
<tr>
<td>IV</td>
<td>Intra-Venous</td>
</tr>
<tr>
<td>IVC</td>
<td>Inferior Vena Cavae</td>
</tr>
<tr>
<td>LA</td>
<td>Local Anaesthetic</td>
</tr>
<tr>
<td>LCSC</td>
<td>Lower Segment Caesarean Section</td>
</tr>
<tr>
<td>LFTs</td>
<td>Liver Function Tests</td>
</tr>
<tr>
<td>mass casualty</td>
<td>typically events with casualties in the 100s, where the normal major incident response must be augmented with extraordinary measures</td>
</tr>
<tr>
<td>METHANE</td>
<td>Major Incident?, Exact location, Type of incident, Hazards?, Access/arrival/egress, Number of casualties, Emergency services on scene</td>
</tr>
<tr>
<td>MCE</td>
<td>Mass Casualty Event</td>
</tr>
<tr>
<td>mcg</td>
<td>micrograms</td>
</tr>
<tr>
<td>MCS</td>
<td>Minimally Conscious State</td>
</tr>
<tr>
<td>MDT</td>
<td>Multi Disciplinary Team</td>
</tr>
<tr>
<td>mg</td>
<td>milligrams</td>
</tr>
<tr>
<td>MHP</td>
<td>Massive Haemorrhage Pack</td>
</tr>
<tr>
<td>MIND/Mind</td>
<td>mental health charity, Mind, delivers the blue light programme for all first responders</td>
</tr>
<tr>
<td>mmHg</td>
<td>millimetres of mercury, eg. unit of blood pressure measurement</td>
</tr>
<tr>
<td>mL</td>
<td>millilitres</td>
</tr>
<tr>
<td>mL/hr</td>
<td>millilitres per hour</td>
</tr>
<tr>
<td>M-LLSACF</td>
<td>Medial to Lateral Lazy S across the Ante Cubital Fossa incision</td>
</tr>
<tr>
<td>MPTT-24</td>
<td>Modified Physiological Triage Tool-24</td>
</tr>
<tr>
<td>MRSA</td>
<td>Methicillin Resistant Staphylococcus Aureus</td>
</tr>
<tr>
<td>MSK</td>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>mTBI</td>
<td>Moderate Traumatic Brain Injury</td>
</tr>
<tr>
<td>MTF</td>
<td>Medical Treatment Facility</td>
</tr>
<tr>
<td>MTFA</td>
<td>Marauding Terrorist, Firearms Attack</td>
</tr>
<tr>
<td>MRI</td>
<td>Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>MI</td>
<td>Major Incident, Myocardial Infarction</td>
</tr>
<tr>
<td>mm</td>
<td>millimetres</td>
</tr>
<tr>
<td>NaCl</td>
<td>Sodium Chloride (normal saline)</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Government Organisation</td>
</tr>
<tr>
<td>NHS</td>
<td>National Health Service</td>
</tr>
<tr>
<td>NA</td>
<td>Nerve Agent</td>
</tr>
</tbody>
</table>
## Glossary/list of terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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</thead>
<tbody>
<tr>
<td>NHSBT</td>
<td>NHS Blood Transfusion Service</td>
</tr>
<tr>
<td>NBM</td>
<td>Nil by mouth</td>
</tr>
<tr>
<td>NPIIS</td>
<td>National Poisons Information Service</td>
</tr>
<tr>
<td>STEP1-2-3PLUS</td>
<td>safety triggers for emergency personnel in CBRN events</td>
</tr>
<tr>
<td><strong>O</strong></td>
<td>Oxygen</td>
</tr>
<tr>
<td><strong>OD</strong></td>
<td>multi dose, every day</td>
</tr>
<tr>
<td>ODP</td>
<td>Operating Department Practitioner</td>
</tr>
<tr>
<td><strong>OGJ</strong></td>
<td>Oesophageal Gastric Junction</td>
</tr>
<tr>
<td><strong>OPD</strong></td>
<td>Outpatient department</td>
</tr>
<tr>
<td><strong>P1</strong></td>
<td>Priority 1, needing life-saving resuscitation or intervention</td>
</tr>
<tr>
<td><strong>P1 Hold</strong></td>
<td>Expectant, serious injuries with a poor chance of survival, or needing extensive treatment, casualties receive treatment compatible with resources</td>
</tr>
<tr>
<td><strong>P2</strong></td>
<td>Priority 2, needing early resuscitation and/or surgery, but some delay is acceptable</td>
</tr>
<tr>
<td><strong>P3</strong></td>
<td>Priority 3, requires treatment but a longer delay is acceptable</td>
</tr>
<tr>
<td><strong>P2S</strong></td>
<td>Pradinoxime (nerve agent antidote)</td>
</tr>
<tr>
<td><strong>pAPRV</strong></td>
<td>partial Anomalous Pulmonary Venous connection</td>
</tr>
<tr>
<td><strong>PBLI</strong></td>
<td>Primary Blast Lung Injury</td>
</tr>
<tr>
<td><strong>PCA</strong></td>
<td>Patient Controlled Analgesia</td>
</tr>
<tr>
<td><strong>PEEP</strong></td>
<td>Positive End Expiratory Pressure</td>
</tr>
<tr>
<td><strong>PEP</strong></td>
<td>Pre-Event Planning, Post-Exposure Prophylaxis</td>
</tr>
<tr>
<td><strong>PFA</strong></td>
<td>Psychological First Aid, Psychosocial First Aid</td>
</tr>
<tr>
<td><strong>PHE</strong></td>
<td>Public Health England</td>
</tr>
<tr>
<td><strong>PO</strong></td>
<td>per os, by mouth, orally</td>
</tr>
<tr>
<td><strong>POC</strong></td>
<td>Point Of Care</td>
</tr>
<tr>
<td><strong>PPI</strong></td>
<td>Proton Pump Inhibitor</td>
</tr>
<tr>
<td><strong>PR</strong></td>
<td>per rectum, rectal examination, rectal administration of medication</td>
</tr>
<tr>
<td><strong>PRAFO</strong></td>
<td>Pressure Relief Ankle-Foot Orthoses</td>
</tr>
<tr>
<td><strong>PTA</strong></td>
<td>Post Traumatic Amnesia</td>
</tr>
<tr>
<td><strong>PTL</strong></td>
<td>Partial Thickness Loss</td>
</tr>
<tr>
<td><strong>PTSD</strong></td>
<td>Post Traumatic Stress Disorder</td>
</tr>
<tr>
<td><strong>PV</strong></td>
<td>per vaginam, vaginal examination, describes vaginal blood loss through the vagina</td>
</tr>
<tr>
<td><strong>QDS</strong></td>
<td>quarter die sumendum, four times a day</td>
</tr>
<tr>
<td><strong>R&amp;R</strong></td>
<td>Rest and Relaxation</td>
</tr>
<tr>
<td><strong>RA</strong></td>
<td>Regional Analgesia</td>
</tr>
<tr>
<td><strong>RBC</strong></td>
<td>Red Blood Cell(s)</td>
</tr>
<tr>
<td><strong>Resus</strong></td>
<td>Resuscitation area in the emergency department</td>
</tr>
<tr>
<td><strong>REBOA</strong></td>
<td>Resuscitative Endovascular Balloon Occlusion of the Aorta</td>
</tr>
<tr>
<td><strong>RhD</strong></td>
<td>Rhesus D, a protein found on surface of RBCs</td>
</tr>
<tr>
<td><strong>rising tide</strong></td>
<td>a developing infectious disease epidemic, or capacity/staffing crisis or industrial action</td>
</tr>
<tr>
<td><strong>ROTEM</strong></td>
<td>ROTational ThromboElastoMetry</td>
</tr>
<tr>
<td><strong>RSI</strong></td>
<td>Rapid Sequence Induction</td>
</tr>
<tr>
<td><strong>RT</strong></td>
<td>Rapid Transfuser</td>
</tr>
<tr>
<td><strong>RT1/2</strong></td>
<td>Rapid Transfusionist 1 and 2</td>
</tr>
<tr>
<td><strong>Rx</strong></td>
<td>prescription, prescribes</td>
</tr>
<tr>
<td><strong>SAGM</strong></td>
<td>solution of Saline, Adenine, Glucose and Mannitol used for storing red blood cells for transfusion</td>
</tr>
<tr>
<td><strong>scribe</strong></td>
<td>medic who records results and actions during a trauma alert</td>
</tr>
<tr>
<td><strong>shock pack</strong></td>
<td>'pack' issued by blood bank in response to massive haemorrhage</td>
</tr>
<tr>
<td><strong>SIEVE</strong></td>
<td>Initial on scene triage of casualties by ambulance/pre-hospital services</td>
</tr>
<tr>
<td><strong>SI(J)</strong></td>
<td>Sacro-Iliac (Joint)</td>
</tr>
<tr>
<td><strong>SNHL</strong></td>
<td>Sensorineural hearing loss</td>
</tr>
<tr>
<td><strong>SORT</strong></td>
<td>Secondary triage of casualties</td>
</tr>
<tr>
<td><strong>SVR</strong></td>
<td>Systemic Vascular Resistance</td>
</tr>
<tr>
<td><strong>TAP</strong></td>
<td>Transverse Abdominis Plane</td>
</tr>
<tr>
<td><strong>TBI</strong></td>
<td>Total Brain Injury</td>
</tr>
<tr>
<td><strong>TBSA</strong></td>
<td>Total Body Surface Area (used in Burns)</td>
</tr>
<tr>
<td><strong>TDS</strong></td>
<td>ter die sumendum, three times per day</td>
</tr>
<tr>
<td><strong>TEG</strong></td>
<td>ThromboElastoGraphy</td>
</tr>
<tr>
<td><strong>TIC</strong></td>
<td>Trauma Induced Coagulopathy</td>
</tr>
<tr>
<td><strong>TM</strong></td>
<td>Tympanic Membrane</td>
</tr>
<tr>
<td><strong>TRS</strong></td>
<td>Terror Related Stab (injury)</td>
</tr>
</tbody>
</table>
### Glossary/list of terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>TTL</td>
<td>Trauma Team Leader</td>
</tr>
<tr>
<td>trauma bloods</td>
<td>FBCs/U&amp;Es/G&amp;S/Clotting (PT, APTT, fibrinogen), Ca2+, lactate, A/VBG, (plus ROTEM if available)</td>
</tr>
<tr>
<td>Trauma ID</td>
<td>patient identifier</td>
</tr>
<tr>
<td>TRIIM</td>
<td>Trauma Risk Management</td>
</tr>
<tr>
<td>TU</td>
<td>(major) Trauma Unit</td>
</tr>
<tr>
<td>TXA</td>
<td>Tranexamic Acid</td>
</tr>
<tr>
<td>U</td>
<td>Unit</td>
</tr>
<tr>
<td>U&amp;Es</td>
<td>Urea and Electrolytes</td>
</tr>
<tr>
<td>UK DMS</td>
<td>United Kingdom Defence Medical Services</td>
</tr>
<tr>
<td>USS</td>
<td>UltraSound Scan</td>
</tr>
<tr>
<td>VBG</td>
<td>Venous Blood Gas</td>
</tr>
<tr>
<td>VHA</td>
<td>Viscoelastic Haemostatic Assays</td>
</tr>
<tr>
<td>VS</td>
<td>Vegetative State</td>
</tr>
<tr>
<td>VTE</td>
<td>Venous Thrombo Embolic (disease)</td>
</tr>
<tr>
<td>VX</td>
<td>nerve agent</td>
</tr>
<tr>
<td>WBCT</td>
<td>Whole Body Computed Tomography</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
</tbody>
</table>

**Hot debrief**
- Immediately after the incident or period of duty

**Cold/Structured/Organisational debrief**
- Within 2 weeks post incident

**Multi-agency debrief**
- Within 4 weeks of the close of the incident

**Post incident reports**
- Within 6 weeks of the close of the incident

**P1**
- Priority 1, needing life-saving resuscitation or intervention
- Expectant, serious injuries with a poor chance of survival, or needing extensive treatment, casualties receive treatment compatible with resources

**P1 Hold**
- Priority 1 Hold
- Expectant, serious injuries with a poor chance of survival, or needing extensive treatment, casualties receive treatment compatible with resources

**P2**
- Priority 2, needing early resuscitation and/or surgery, but some delay is acceptable

**P3**
- Priority 3, requires treatment but a longer delay is acceptable

**P4**
- Priority 4
- Dead or for palliation. Use of this category can only be authorised by NHS England

**M**
- Major Incident?,

**E**
- Exact location,

**T**
- Type of incident,

**H**
- Hazards?,

**A**
- Access/arrival/egress, from the scene or from hospital

**N**
- Number of casualties,

**E**
- Emergency services on scene

**C**
- Catastrophic Haemorrhage, also <C>, CatHaem, bigC

**A**
- Airway,

**B**
- Breathing,

**C**
- Circulation

**D**
- Disability

**E**
- Exposure (of the patient), Environment, Everything Else,