



# BURNS



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## 1. Key messages

The Victorian State Trauma System (VSTS) provides clinical support and retrieval services for critically injured patients requiring urgent transfer for definitive care and ongoing management. This burns guideline provides evidence-based advice on the initial clinical management and transfer of major trauma patients who present to Victorian health services with severe burn injuries.

This guideline is developed for clinical staff involved in the care of trauma patients throughout Victoria. It is intended for use by frontline clinical staff that provide initial care to major trauma patients; both those working directly at the Major Trauma Service (MTS) as well as those working outside of a MTS.

These guidelines provide the user with readily accessible resources to effectively and confidently provide early care for critically injured patients through the use of up to date and evidence-based guidelines. It also aligns with the Victorian state burns clinical practice guidelines that were developed by Victoria’s adult and paediatric burn services. This guideline aligns with the Victorian The guideline has followed the AGREE II methodology for guideline development and is under the auspice of the Trauma State Advisory Committee (TSAC) (1).

### Clinical emphasis points:

- A burn is a complex trauma requiring specialist multidisciplinary care.
- Patients with facial, neck and inhalation burns can have difficulty maintaining their airway and deteriorate rapidly, particularly when exposed to flame burns in an enclosed space. Any signs of oedema should prompt early intubation.
- Early management of burns patients aims to restore fluid loss, maintain adequate oxygenation, prevent heat loss, and address pain management.





# BURNS



- Supplemental warmed and humidified oxygen should be provided to all burns patients in the initial management.
- Accurate early identification of the burn depth and percentage of total body surface area (TBSA) will guide treatment.
- Severe and / or complex burns should be managed in a specialised unit.
- Once identified that the patient is suffering from a major burns trauma, early activation of the retrieval process is crucial.
- All inter-hospital transfer of adult major trauma patients should be referred via Adult Retrieval Victoria (ARV: 1300 368 661).
- All inter-hospital transfer of paediatric major trauma patients should be referred via Paediatric Infant Perinatal Emergency Retrieval (PIPER: 1300 137 650).

## 2. Overview

Initial Management of Severe Burns		CONTACT DETAILS
<p>Burn injuries &gt;20%TBSA (adults) &amp; &gt;10%TBSA (paediatrics) considered major trauma.</p> <p>Initiate early consultation (&lt;60mins) with ARV for timely transfer</p>		<p> Ambulance Victoria <b>000</b></p> <p> Adult Retrieval Victoria <b>1300 36 86 61</b></p> <p> Royal Children's Hospital PIPER <b>1300 13 76 50</b></p> <p> Alfred Hospital <b>03 9076 2000</b></p>
<p><b>Specific points to note in the primary survey with respect to burn injury:</b></p>		
<p><b>AIRWAY</b> </p>	<p>Assess for history of burn in enclosed space, signs of upper airway oedema, sooty sputum, facial burns, respiratory distress (dyspnoea, stridor, wheeze, hoarse voice). If any of the above present, airway is at risk. Consider need for intubation and secure airway as required. Maintain spinal precautions as required especially with explosion or electrical burns.</p>	
<p><b>BREATHING</b> </p>	<p>Assess breathing and support as required. Assess adequacy of breathing where circumferential burns on chest wall and consider escharotomy. Administer humidified 100%FiO2. Establish baseline ABGs and SaO2 (goal: &gt;95%)</p>	
<p><b>CIRCULATION</b> </p>	<p>Assess circulation: colour, refill, HR, BP. Insert 2 large bore peripheral IV lines. If unable consider central or intraosseous access.</p>	
<p><b>Specific points to note in the secondary survey and initial management of burn injury:</b></p>		
<p><b>FLUID RESUSCITATION</b></p>	<p>For burns &gt;20%TBSA in adults and burns &gt;10%TBSA in paediatrics. Use Parklands formula/ Ambulance Victoria CPG (below) to estimate initial fluid resuscitation requirements. Insert urinary catheter and titrate fluid resuscitation to urine output. <b>Urine output goals:</b> Adults: 0.5 – 1ml/kg/hr (30 – 50 mls/hour) Paediatrics &lt;30kgs: 1ml/kg/hr Maintain accurate fluid balance chart.</p>	
<p><b>PAIN MANAGEMENT</b></p>	<p>Assess pain score to determine analgesic requirements. Adults: 2 – 5 mg Morphine repeated every 5 minutes. Paediatrics: 0.1mg/kg Morphine repeated every 5 minutes. Maximum: 0.3mg/kg Re-assess pain score (goal: Adult VAS pain score &lt;4) and adjust analgesia accordingly. Consider Morphine infusion for ongoing pain relief.</p>	
<p><b>MANAGING THE WOUND</b></p>	<p>Assess extent of burn using Rule of Nines or Lund &amp; Browder chart. Clean then cover the wound (see below).</p>	
<p><b>CIRCUMFERENTIAL BURNS</b></p>	<p>Elevate limbs where circumferential burns present. Assess perfusion distal to burn: capillary refill, pulse, warmth, colour. Liaise with burn service if escharotomy required (cool to touch, weak or no pulse distally).</p>	
<p><b>OTHER</b></p>	<p>Cover the patient to minimise heat loss. Insert nasogastric tube for burns &gt;20% TBSA adults and 10%TBSA paediatrics. Keep nil orally. Administer tetanus immunoglobulin if required. Investigative tests as indicated</p>	
Wound Care for Transit	Fluid Resuscitation	Transfer Checklist
<p><b>First Aid:</b> Cool running H2O for 20 mins</p> <p><b>Clean:</b></p> <ul style="list-style-type: none"> <li>Normal Saline/0.1% Chlorhexidine.</li> <li>If transfer delayed consider debridement of loose dermis and blisters &gt;2.5cms. Additional analgesia required.</li> </ul> <p><b>Assess:</b></p> <ul style="list-style-type: none"> <li>Depth of burn</li> <li>Extent of burn (%TBSA)</li> <li>Circumferential injury</li> </ul> <p><b>Cover:</b></p> <ul style="list-style-type: none"> <li>&lt;6 hours:Cling wrap longitudinally</li> <li>&gt;6hours: paraffin gauze/ silver dressing</li> </ul>	<p><b>%TBSA Burns: &gt;20% (adults) &amp; &gt; 10% (paediatrics)</b></p> <p><b>Modified Parkland formula:</b> <b>3-4mls X %TBSA X Kgs/24hours</b> ½ fluid in first 8 hours post injury. ½ fluid in next 16 hours post injury. Use Crystalloid: Hartmanns/Normal Saline.</p> <p><b>Ambulance Victoria</b> %TBSA burn X Weight (Kgs)= IV fluid 2/24</p> <p><b>Paediatric Maintenance Fluids:</b></p> <ul style="list-style-type: none"> <li>Up to 10kgs: 100mls/kg/day.</li> <li>10 – 20kgs: 1000mls + 50mls/kg/day.</li> <li>20 – 30kgs: 1500+20mls/kg/day.</li> <li>Use: 5% Dextrose &amp; ½ Normal Saline.</li> </ul>	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Airway secure</li> <li><input checked="" type="checkbox"/> O2 insitu</li> <li><input checked="" type="checkbox"/> IV access established &amp; secure</li> <li><input checked="" type="checkbox"/> Fluid resuscitation commenced</li> <li><input checked="" type="checkbox"/> Urinary catheter inserted and secure</li> <li><input checked="" type="checkbox"/> Pain controlled</li> <li><input checked="" type="checkbox"/> Wounds are covered</li> <li><input checked="" type="checkbox"/> Measures implemented to prevent heat loss</li> <li><input checked="" type="checkbox"/> Elevate burnt area as appropriate</li> <li><input checked="" type="checkbox"/> Tetanus Immunoglobulin as required</li> <li><input checked="" type="checkbox"/> Nasogastric insitu</li> <li><input checked="" type="checkbox"/> ARV &amp; MTS aware</li> <li><input checked="" type="checkbox"/> NOK aware</li> <li><input checked="" type="checkbox"/> History and documentation copied</li> </ul>

### 3. Introduction

There are approximately 4800 presentations per year to Victorian Emergency Departments due to burn injuries (2). There has been a gradual decrease in the number of overall burns presentations, however, there has been no change in the number of severe burns presentations.

Severe burns accounts for 2% of all major trauma in Victoria each year (3). This figure has remained consistent over the last 5 years, with no significant change in morbidity or mortality. However, the rates of burns remains high in males, children and older people.

A burn is a complex trauma that requires multidisciplinary care and ongoing therapy. Burns can range from minor to severe and may be thermal, electrical, or chemical. Burn injuries can have a devastating impact on both the patient and family, resulting in both physical and psychological scarring.

Burn assessment can be challenging in the pre-hospital setting especially regarding determining burn depth when burns may not have fully evolved. Once the patient has reached the designated health service, accurate early identification of the burn depth and percentage of total body surface area (TBSA) will guide definitive treatment.

#### *Thermal burns*

A heat induced, or thermal, burn occurs when the skin comes into contact with a source of heat such as a fire, a hot surface, scalding liquid, or heated objects. Thermal burns are the most common type of burn and account for over 95% of major trauma burns presentations in Australia per year (4).

There is a greater risk of inhalation injury with flame burns in an enclosed space than with scalds to the neck and face for example. Any suspected inhalation injury should be managed promptly with a thorough assessment of airway stability.

#### *Electrical burns*

Electrical injuries are classified as low voltage (< 1,000 volts) or high voltage (> 1,000 volts) however arc flash or arc explosion should also be treated as a high voltage injury presentation (5). A thorough history of the incident is crucial to understanding the degree of injury. The size of the entry or exit wound does not necessarily correlate with the amount of deep-tissue damage that may have occurred. The route through which the current has flowed is most important. Conduction of electrical current through the mediastinum may cause myocardial damage and associated local tissue destruction. Arrhythmias may occur immediately and up to 24 hours post injury, therefore continuous electrocardiogram (ECG) monitoring is required in all electrical burns patients who have an ECG abnormality.

For these injuries, initial management is the same as for thermal burns. Adequate fluid resuscitation is important, as in all severe burns. This is especially important in electrical burns due to the destruction of deep-tissue regions and the possibility of developing rhabdomyolysis.

### Chemical burns

Chemicals will continue to cause damage while on the skin. Dry chemicals should be brushed off. The main goal in initial treatment is decontamination; remove all contact of the chemical from clothing and thoroughly irrigate the burns (6).

Damage to tissue will continue to occur until the agent is weakened by dilution or inactivated with a specific neutralising agent. The amount of damage to tissue is directly related to the strength and volume of the agent, as well as the manner and duration of contact with the skin, the extent of penetration and the mechanism of action. Similarly, a thorough history of the exposure must be established to ascertain possible damage.

### Severe burns

A severe burn injury requiring immediate transfer to a MTS includes any burn greater than 20% TBSA, high-voltage electrical injury burns and any inhalation burns. A patient who has suffered a severe burn injury should be assessed and managed as a major trauma patient; polytrauma may co-exist, especially when there is a significant mechanism of injury.

All patients with severe burns must receive a rapid and systematic primary and secondary survey. The main goal is to ensure optimum resuscitation in the emergency setting as well as activation of the retrieval network, with timely transfer to an appropriate burns facility. For non-severe burns injuries, refer to the *Victorian state burns clinical practice guidelines* for management and to ascertain whether a non-immediate transfer to a specialist facility is required.

## 4. Early activation

Emergency medical services should notify the receiving hospital that a trauma patient is on their way. This information may be crucial to the management of the severely injured patient and can allow for communication to vital members of the response team as well as time to prepare the department for the patient's arrival.

The following sequence of actions should take place upon initial notification:

1. Gather vital information from the notifier using the IMIST mnemonic (7, 8)
  - I** Identification: Who and what is your role? Patient identifiers – name, age, sex.
  - M** Mechanism: Presenting problem, how it happened.
  - I** Injuries: specific injuries that have been found or potential to exist.
  - S** Signs: vital signs, such as HR, RR, BP, Temp, BGL, GCS, etc.
  - T** Treatment and Trends: treatment administered and patient's response to treatment, trends in vital signs.
2. Set up the trauma bay to receive the patient, including equipment checks, documentation, medications, and resuscitation equipment.

3. Activate the trauma team and available support departments (medical imaging, pathology). In small health service settings this may only consist of a clinician and a nurse. Additional staff may be gathered from wards or on call. It may be necessary to utilise the skills of all available resources including emergency response personnel in the initial trauma management.
4. Designation of roles and specific tasks to staff can help to maintain a structured approach based on teamwork. Ensure clear communication between all parties involved in managing the trauma. Use closed-loop communication, which ensures accuracy in information shared between response staff. Repeat instructions, make eye contact, and provide feedback. Misinterpreted information may lead to adverse events.
5. Ensure all staff involved in patient care are wearing gloves, aprons, and eye protection. Personal protective equipment is vital in the care of trauma patients.

If it is anticipated that transfer to a major trauma service will be required, early retrieval activation is essential, phone ARV on 1300 368 661.

- Early retrieval activation ensures access to critical care advice and a more effective and prompt retrieval response.
- Early activation and timely critical care transfer can significantly improve clinical outcomes for the patient (9).

If you are undecided, call the ARV coordinator, who can provide expert guidance and advice over the phone or via teleconference, and link to MTS as required.

## 5. Primary survey

The primary survey is the initial assessment and management of a trauma patient.

Use a systematic approach based on **<C> ABCDE** (10, 11) to assess and treat an acutely injured patient. The goal is to manage any life-threatening conditions and identify any emergent concerns, especially in a burns patient who may present with other multisystem injuries.

- Catastrophic haemorrhage
- Airway with in-line spinal immobilisation
- Breathing
- Circulation
- Disability (neurological)
- Exposure and environment

### Catastrophic Haemorrhage

#### *Assess for catastrophic haemorrhage*

- Identify any large volume external blood loss.
- Provide immediate management as required, consider; direct pressure, haemostatic dressings and tourniquets.

### Airway with cervical spine protection

The patient's airway is at significant risk in severe burns injuries, especially where there is involvement of facial or inhalation injuries. It is important to quickly identify those who may require intubation. Intubation can become increasingly difficult as swelling progresses in the first few hours following an injury, especially once fluid resuscitation has commenced. Early airway management is essential as signs of impending airway obstruction may not be immediately obvious.

#### *Assess for airway stability*

- Attempt to elicit a response from the patient.
- Look for signs of airway obstruction (use of accessory muscles, paradoxical chest movements, see-saw respirations).
- Listen for any upper-airway noises, breath sounds. Are they absent, diminished, or noisy?
- Assess for displaced dentures, especially in the older persons cohort.

#### *Assess for inhalation injury*

Early intubation is indicated with inhalation injuries. Suspect an inhalation injury if there has been any history of (12):

- exposure to fire and smoke in an enclosed setting,
- hoarseness or change in voice,
- harsh cough,
- stridor,
- burns to the face,
- head and neck swelling,
- singed nasal hair, eyebrows or eyelashes,
- or soot in the saliva, sputum, nose or mouth.

#### *Assess for an inflamed oropharynx.*

- Secure the airway if necessary (treat airway obstruction as a **medical emergency**)
- Standard indications for intubation should be followed including but not limited to shortness of breath, wheezing, stridor, hoarseness, combativeness, or a decreased level of consciousness (12).
- Contact should be made with the major burns service as soon as is safely feasible to discuss the events surrounding the burn and the need for intubation.

#### *Attempt simple airway manoeuvres if required*

- Open the airway using a chin lift and jaw thrust whilst avoiding neck extension to protect the C-spine.
- Suction the airway if excessive secretions are noted or if the patient is unable to clear their airway independently.
- Insert an oropharyngeal airway (OPA) if required.

**Caution:** Nasopharyngeal airways (NPA) should not routinely be inserted in patients with a head injury in whom a base of skull fracture has not been excluded (13). In the setting of airway obstruction, or failure to oxygenate, then an NPA can be inserted if delay to definitive airway management.

#### *Maintain full spinal precautions if indicated*

- Suspect spinal injuries in all polytrauma patients. Ensure cervical collar, head blocks and in-line immobilisation is maintained throughout patient care.

### Breathing and ventilation

- Assessing for adequate ventilatory effort is essential.
- Administer high flow oxygen and record the oxygen saturation (SpO<sub>2</sub>).

#### *Administer high flow 100% (15 L/min) of humidified oxygen*

- Assume carbon monoxide poisoning in patients who sustain burns in an enclosed area. Carbon monoxide preferentially binds to haemoglobin, leading to falsely reassuring oxygen saturation levels. Oxygen administration is pivotal, regardless of the oxygen saturation recording.

#### *Assess the chest*

- Be mindful that thoracic injuries may have also occurred
- Count the patient's respiration rate and note the depth and adequacy of their breathing.
- Auscultate the chest for breath sounds and assess for any wheeze, stridor, or decreased air entry. Circumferential burns to the chest may inhibit chest wall expansion and make ventilation difficult; consider an escharotomy (see *Early Management* below).

### Circulation with haemorrhage control

#### *Assess circulation and perfusion*

- Check the heart rate and blood pressure
- Inspect for any signs of external haemorrhage and apply direct pressure to any wounds.
- Insert two large-bore peripheral intravenous (IV) cannulas, preferably through non-burnt tissue. If access is difficult, consider central or intraosseous insertion if the equipment/skills are available.
- Commence fluid resuscitation as indicated for burns greater than 20% TBSA in adults.
- Review the unburnt skin colour and check the temperature and capillary refill.
- Monitor the circulation of the peripheries and trunk, especially distal to the burn wound if circumferential burns are present. Elevation of the affected limb will assist in managing swelling. Poor perfusion may indicate the need to perform an escharotomy.

### Disability: neurological status

#### *Assess level of consciousness*

- Complete an AVPU assessment (Alert, responds to Voice, responds to Pain, Unresponsive) A more detailed neurological assessment using the GCS will be performed in the secondary survey.

- Inadequate oxygenation as well as inhalation of smoke and toxins may lead to a decreased level of consciousness.
- Check pupillary response

#### *Test blood sugar levels*

- Ensure that any alterations in level of consciousness are not related to a metabolic cause.

#### Exposure/environmental control

- Remove the patient's clothing and any jewellery in order to prevent any further heat injury and to be able to fully assess all areas of the body.
- In suspected chemical burns, clothing may remain contaminated. Inappropriate handling may expose the patient to further injury as well as the care provider. Wear appropriate PPE.
- It is important to minimise heat loss for severe burns patients due to the risk of hypothermia secondary to the loss of skin integrity. It is important to monitor the patient's temperature and keep them in a warm environment.

## 6. Secondary survey

The secondary survey is only to be performed once the primary survey has been completed and any life-threatening injuries have been managed. If during the examination any deterioration is detected, reassess the primary survey from the beginning.

eFAST point of care ultrasound and chest and pelvic x-rays may be performed as part of the early assessment of a major trauma patient, when required, available and the patient condition allows.

#### History

Taking an adequate history from the patient, bystanders or emergency personnel of the events surrounding the injury can assist with predicting other damage that may have occurred (14). Emphasis should be placed on understanding the mechanism, initial level of consciousness and any concurrent injuries noted. Note any history of drugs or alcohol prior to and at the time of injury.

Use the AMPLE acronym to assist with gathering pertinent information (14, 15):

- A** Allergies
- M** Medication
- P** Past medical history including tetanus status
- L** Last meal
- E** Events leading to injury

## Head-to-toe examination

During this examination, any injuries detected should be accurately documented and any required treatment should occur, such as covering wounds, managing non-life-threatening bleeding and splinting fractures.

### *Measuring burns*

- Assessing burn depth and calculating the percentage of the total body surface area burnt is important during the head-to-toe examination. This will allow fluid resuscitation requirements to be calculated and the severity of the injury to be determined to assess if transfer to a specialist facility is required.
- The extent of the burn is measured as the percentage of total body surface area (TBSA). It is important to accurately document the location and area of the burn. The recommended tool for assisting in calculating this in adults is the Wallace rule of nines chart. While examining the patient it is helpful to have another staff member documenting the location and extent of the injuries as they are called out by the assessing clinician.
- Refer to Appendix 1: Burn depth characteristics.
- Refer to Appendix 2: Rule of nines (adult).

## Head and face

- Inspect the face and scalp. Look for any lacerations and bruising as well as mastoid or periorbital bruising, which is indicative of a base of skull fracture. Gently palpate for any depressions or irregularities in the skull. Check the eyelashes and eyebrows for singeing.
- Look in the eyes for any burn injury, foreign body, subconjunctival haemorrhage, hyphaema, irregular iris, penetrating injury or contact lenses.
- Assess the ears for any signs of cerebrospinal fluid leak, bleeding, or blood behind the tympanic membrane.
- Check the nose for any deformities, bleeding, nasal septal haematoma, cerebrospinal fluid leak or presence of any soot/ash as well as singeing of nasal hairs.
- Look in the mouth for any lacerations to the gums, lips, tongue, or palate. Note any swelling, which may indicate inhalation injury. Inspect the teeth, noting if any are loose, fractured or missing.
- Test eye movements, pupillary reflexes, vision, and hearing.
- Palpate the bony margins of the orbit, maxilla, nose, and jaw.
- Inspect the jaw for any pain or trismus.

## Neck

- The cervical collar should be opened if in-situ, the head supported with manual in-line stabilisation and the neck inspected.
- Gently palpate the cervical vertebrae. Note any cervical spine pain, tenderness, or deformity.
- Check the soft tissues for burns, bruising, pain, and tenderness.
- Complete the neck examination by observing the neck veins for distension and palpating the trachea and the carotid pulse. Note any tracheal deviation or crepitus.

- The patient will need to be log rolled to complete the full examination. This can be combined with the back examination.

### Chest

- Inspect the chest, observing movements. Look for any burns, bruising, lacerations, penetrating injury, or tenderness.
- Identify any concerns regarding circumferential chest burns or other significant chest burns injury.
- Auscultate the lung fields; note any percussion, lack of breath sounds or adventitious sounds.
- Check the heart sounds: apex beat and the presence and quality of heart sounds.

### Abdomen

- Inspect the abdomen.
- Check the pelvis. Burns patients may be involved in multi trauma and can also have significant internal injuries.

### Limbs

- Note any inequalities with limb response to stimulation and document these findings.
- Inspect all the limbs and joints.
- In electrical burns, look for any entry and exit wounds as well as signs indicating the development of compartment syndrome. These may be found centrally, not just on the limbs (check the head and chest).
- Examine the sensory and motor function of any nerve roots or peripheral nerves that may have been injured.
- Assess for circumferential burns that may constrict blood flow to all limbs or digits. Assess colour, warmth, movement, sensation and capillary refill distally.

### Back

- Log roll the patient. Maintain in-line stabilisation throughout. Inspect the entire length of the back and buttocks noting any burns or other injuries.
- Palpate the spine for any tenderness or steps between the vertebrae.
- Digital rectal examination should be performed only if a spinal injury is suspected. Note any loss of tone.

### Buttocks and perineum

- Look for any burn injury.

### Genitalia

- Inspect for burn injury, lacerations or bruising.

The priorities for further investigation and treatment may now be considered and a plan for definitive care established.

## 7. Planning and communication

For a trauma team to run effectively there must be an identifiable leader who will direct the resuscitation, assess the priorities and make critical decisions (16, 17). Clear communication between the trauma team members is vital, as is ensuring that local senior staff are aware and can provide additional support if required.

Once the initial assessment and resuscitation is underway, it is important to plan the next steps in immediate management. Priorities for care must be based on sound clinical judgement, patient presentation, and response to therapies. Awareness of limitations in resources as well as training in the emergency field is vital. If escalation of care to senior staff is warranted, then do so early in the patient care episode. Do not wait until the patient deteriorates to ask for assistance.

Frontline clinical staff should initiate contact with ARV early in the patient care pathway or, more importantly as soon as it is identified that the patient meets the inter-hospital trauma transfer criteria or may have sustained injuries beyond the clinical skill set of the emergency department or urgent care service. ARV can be contacted at any time throughout the patient care episode to offer clinical advice and specialist consultation as well as expedite the retrieval process.

ARV coordinators can facilitate a three-way conversation between the referring health service, specialist clinical resources and an ARV consultant to discuss the best, timely management of the patient.

### Indications for ARV consultation and / or transfer to a major trauma service

#### *Specific Burns Injury*

- Burns > 20% TBSA (Adult)
- Suspected respiratory tract burns
- High voltage (>1000 volts) burn injury
- Burns > 10% TBSA (Paediatric)

The decision of when to transfer an unstable patient should ideally be made by the transferring and receiving clinicians in collaboration with the retrieval service. Clear communication is crucial: the transmission of vital information allows receiving clinicians to mobilise needed resources while the inadvertent omission of such information can delay definitive care. Information should be conveyed in both verbal and written (via the patient record) form and should include the patient's identifying information, relevant medical history, pre-hospital management and emergency department evaluation and treatment (including procedures performed and imaging obtained).

It is important that additional communication with the ARV coordinator is initiated when there is:

1. Significant deterioration in:
  - Conscious state.
  - Blood pressure.

- Heart rate.
  - Respiratory status.
  - Oxygenation.
2. Major clinical developments such as significantly abnormal diagnostic tests or new clinical signs.
  3. The need for major interventions prior to the retrieval team arriving (for example, intubation or surgery). This will ensure the retrieval team is prepared; the patient receives the appropriate care enroute and is referred to the correct facility.

## 8. Early management

### Airway management

- If there is potential that the patient's airway may deteriorate due to an inhalation injury or oedema subsequent to fluid resuscitation, then intubation prior to retrieval should be discussed with ARV in conjunction with the MTS (12).
- Patients with suspected airway burns should be managed in the semi-recumbent / upright position where feasible (18).
- Bronchodilators such as salbutamol may be effective in the presence of bronchospasm.
- Frequent reassessment of the patient must take place as progressive swelling may cause further airway compromise. In an intubated patient, end-tidal carbon dioxide (ETCO<sub>2</sub>) monitoring (if available) should be used to assess respiratory status and adequacy of ventilation.
- Always have emergency airway equipment by the bedside.
- Consider escharotomy of the chest wall if necessary.

### Fluid resuscitation

- Effective fluid resuscitation is a cornerstone of modern burn care and has contributed significantly to reduced mortality and improved outcomes. Without rapid and effective intervention, hypovolaemia/shock will develop in severe burns cases.
- Begin fluid resuscitation with normal saline if the TBSA (for adults) is over 20%. Fluid requirements should be estimated using the Parkland formula and taken from the time of injury (18).
- $4 \text{ mL} \times \text{TBSA\%} \times \text{kg} = \text{___ mL/24 hours}$
- ½ total in the first 8 hours post injury
- ½ total in the next 16 hours post injury
- Consider the amount of fluid given since treatment commenced. This formula should be used as a guide; titrate treatment to response and to the desired urine output of 0.3-0.5 mL/kg/hr (18).
- It is important to maintain an accurate intake and output chart from the early stages of treatment in order to assess the effectiveness of fluid resuscitation. This will also assist retrieval staff with further management during transfer.

### Compartment Syndrome

- Circulation or breathing can be compromised due to increased pressure caused by the swelling in the tissue deep to the burn interfacing with the unyielding overlying burnt skin ('eschar') which acts like a tourniquet. Compartment syndrome can arise from three main causes in the burn patient:
  1. Formation of inelastic, circumferential eschars around burned limbs and the associated extravasation of fluids.
  2. Electrical conduction burns leading to muscle and nerve damage and cell death.
  3. Systemic inflammation and subsequent volume resuscitation in patients with intravascular volume depletion.
- The requirement for an escharotomy and/or fasciotomy usually presents within the first few hours of injury. This procedure may be necessary to relieve pressure if circulation is compromised (18).
- Indicators that a circumferential chest wound may require an escharotomy are where the chest wall movement is decreased or there are signs of any respiratory compromise.
- Signs that circulation is compromised, and a limb may require a fasciotomy are loss of circulation as evidenced by decreased capillary return, coolness, pallor, loss of palpable pulses and numbness. **Early elevation may prevent the need to perform the procedure.**
- Prior to performing an escharotomy, discussions with Victorian Burns Service clinicians should always take place.
- For detailed instructions on how to perform the above, please refer to the *escharotomy guide* in the downloadable resources section via the Trauma Victoria website.

### Analgesia

- Burns are painful due to the thermal injury itself as well as the inflammatory mediator response. IV analgesia administration is the most effective route in burns due to rapid absorption.
- Analgesia that is administered via the intramuscular, subcutaneous, and oral routes may be unreliably absorbed due to fluid shifts and gastrointestinal stasis. However, if IV access is unattainable, then these are optional routes for administration. Intranasal analgesia is often used in the prehospital setting; however, the effects of absorption are not clear in the setting of inhalation injury.
- Administer analgesia as per local protocols and titrate to effect. Consider prophylactic antiemetic administration, especially if retrieval and transfer is likely.
- Individualised multi-modal analgesic regimes using medications from different classes will assist significantly in burns pain management (19).

### Wound care

- **First aid:** Immediate cooling of burns with cool running tap water helps to reduce the severity of tissue damage and relieve pain. Burns cooled for 20 minutes show greater re-epithelisation than other time periods. Leave any clothing that is adhered to underlying skin and immediately cool wounds for 20 minutes with continuous running water if possible.

Patients with a large burn (TBSA > 10%) or children/older people should be observed for hypothermia and in such circumstances, cooling should be ceased. In circumstances

where running water is not available, apply wet towels or saline soaked gauze to affected areas and change frequently.

- **Dress:** If the patient is being transferred to the burns service within six hours, cover the wound with plastic cling film. It should be applied longitudinally (to allow for swelling) rather than circumferentially, which may have a tourniquet-like effect.

If none is available and/or the patient is unlikely to be transferred to the burns unit within six hours, cover with paraffin gauze / silver or non-adherent dressing. Once dressings are complete, elevate the affected limb if possible, to assist in minimising burn wound oedema. Place the patient on a burn sheet to absorb any exudate and to allow for minimal adhesion.

- It is important to document if the burns have been contaminated at time of injury or during care such as if the patient rolled in dirt at the time of injury or jumped into a dam to cool the burns.
- For detailed dressing instructions, refer to the *Victorian state burns clinical practice guidelines*.

### Minimise heat loss

- It is important to maintain normothermia. Ensure the patient does not lose any excess heat due to the loss of skin and the metabolic effect of the burn. Make sure the wounds are covered and air is not able to circulate around them.
- Use warmed IV fluids; cover the patient with extra warm blankets as well as keeping the room warm (a general guide is that if clinical staff are comfortable, it's likely to be too cold for a burns victim).
- If available, the use of a forced air-warming machine is encouraged. Ensure wound care is attended to prior to commencement. Avoid moist dressings when using a forced air-warming device due to evaporative cooling effects. Reassess the patient temperature at regular intervals while awaiting the retrieval team.

### In-dwelling catheter

- A urinary catheter should be inserted and urine output measured hourly. The desired urine output for adults is 0.5–1.0 mL/kg/hr (20).
- A urinalysis should also be performed to check for blood. Discoloured, brown urine in circumferential or electrical injuries may indicate myoglobinuria, a sign of rhabdomyolysis.

### Monitoring

- Monitoring of the heart rate, respiration rate, blood pressure, temperature and oxygen saturation should take place at 15/60 intervals or less if indicated. Monitor continuously via electronic monitoring if facilities are available. All monitoring should be maintained until the retrieval team arrives.
- A baseline ECG should be taken prior to transfer if time permits and facilities exist.

### Glasgow Coma Scale

- A focused neurological assessment using the GCS should be performed (see table below). This should include a description of the patient's level of consciousness as well

as assessments of pupillary size and reactivity, gross motor function, and sensation. Document the findings and reassess at frequent intervals.

Best response	Eye opening	Verbal response	Motor response
6			Obeys commands
5			Localises to painful stimuli
4	Opens eyes spontaneously	Confused, disoriented	Withdrawal to painful stimuli
3	Opens eyes in response to voice	Utters inappropriate words	Abnormal flexion to painful stimuli (decorticate response)
2	Opens eyes in response to painful stimuli	Incomprehensible sounds	Extension to painful stimuli (decerebrate response)
1	Does not open eyes	Makes no sounds	Makes no movements

### Pathology tests

- Pathology tests should be taken for FBC (full blood count), UEC (urea, electrolytes and creatinine) and glucose as well as a blood gases if available. In suspected carbon monoxide poisoning, test for CoHb levels. Consider taking a group and cross-match if the patient is involved in a trauma presentation with a high index of suspicion for further injuries.

### X-ray/FAST scan

- Consider further diagnostic imaging if available and indicated.
- Consider the need for eFAST (Extended Focused Assessment with Sonography in Trauma) if available and staff are trained in its use. FAST is used primarily to detect pericardial and intraperitoneal blood and it is more accurate than any physical examination finding for detecting intra-abdominal injury (21).
- In haemodynamically stable patients, eFAST can be delayed until the secondary survey and is ideally performed by a second operator while the remainder of the secondary survey is completed.



### Naso/orogastric tube (N/OGT)

- All patients should be kept nil orally in the initial post-resuscitation phase of injury. In severe burns, enteral feeding will begin upon transfer to the burns service (22). Discuss the necessity of this with ARV and the burns unit in the early stages of management.
- The potential for a base of skull fracture in polytrauma should be considered as a relative contraindication in the decision to insert an NGT. An OGT may be inserted following consultation and under direct visualisation.

### Tetanus immunisation

- Tetanus immunisation should be updated if necessary for any burns deeper than superficial thickness (18, 23). Tetanus immunoglobulin should be given to patients who have not received a complete primary immunisation.

### Antibiotics

- Routine IV antibiotic administration is not recommended in an initial uncomplicated burn injury (18, 19). There may be some benefit if the wound has been contaminated; discuss with ARV.

### Reassess

- The importance of frequent reassessment cannot be overemphasised. Patients should be re-evaluated at regular intervals as deterioration in a patient's clinical condition can be swift. This will be evident in their vital signs and level of consciousness. If in doubt, repeat the primary survey.

## 9. Retrieval and transfer

Urgent arrangements for transferring and retrieving severe burns injury patients should take place as soon as is possible. This includes:

- All burn inhalation injuries
- Burns to > 20% TBSA (Adults) and > 10% TBSA (Paediatrics)
- High-voltage electrical burns, including lightning injury.

It is important to note that an exhaustive clinical workup and interventions are not always necessary or appropriate prior to transfer. Stabilisation and ensuring life-threatening problems are addressed, as well as taking measures to prevent deterioration enroute, are essential aspects of early care. Delaying transfer to obtain laboratory results or imaging studies may simply delay access to definitive treatment.

Hospitals with specialist burns facilities should manage burns patients requiring critical care support. Currently in Victoria, burns specialist facilities are located at The Alfred and the Royal Children's Hospital.

In liaison with ARV clinicians, interventions to stabilise the patient prior to retrieval personnel arriving should be commenced. ARV will coordinate the retrieval and will evaluate the practicality and clinical needs involved in transferring the patient from the referring hospital. Once retrieval staff arrives on scene, be prepared to give a thorough handover. Retrieval staff

will assess the patient prior to transfer and may update care to ensure the patient is safe during transfer.

Adult Retrieval Victoria recommends a standardised recognised handover tool such as **ISBAR** or **IMIST-AMBO** to facilitate clarity and completeness amongst health professionals and patient safety (7).

Consultation about transferring non-urgent burns patients to a specialist facility should also take place where there is:






- Burns greater than 10% TBSA.
- Burns to special areas and full-thickness burns involving the face, eyes, ears, hands, feet, major joints or genitalia.
- Full-thickness burns greater than 5% TBSA.
- Electrical burns.
- Chemical burns.
- Circumferential burns of the limbs or chest.
- Burns with associated trauma.
- Burns in the very young or older people.
- Burn injury in patients with a pre-existing illness or disability that could adversely affect patient care and outcomes.
- Suspected non-accidental injury in children.
- Small area burns in patients with social problems, including children at risk.
- Burns occurring in pregnant women.
- Burn injuries that the referring unit is concerned about or are slow to heal.

The transfer of these patients will be assessed on a case-by-case basis and an appropriate transfer timeline will be given according to need.

Refer to Appendix 3: *Victorian state burns service transfer criteria*.

## 10. Appendix 1: Burn depth characteristics

<h1 style="margin: 0;">Burn Depth Characteristics</h1>	<b>CONTACT DETAILS</b>
	 <p>Alfred Hospital <b>03 9076 2000</b></p>
	 <p>Royal Children's Hospital PIPER <b>1300 13 76 50</b></p>

	Superficial Epidermal eg sunburn '1 <sup>st</sup> degree'	Superficial Dermal Thickness (partial) '2 <sup>nd</sup> degree'	Mid Dermal Thickness (partial) '2 <sup>nd</sup> degree'	Deep Dermal Thickness (partial) '2 <sup>nd</sup> degree'	Full Thickness '3 <sup>rd</sup> degree'
					
<b>PATHOLOGY</b>	Involves epidermis only	Involves epidermis and upper dermis, most adnexal structures intact	↔	Involves epidermis and significant part of dermis, only deeper adnexal structures intact	Epidermis, dermis and cell adnexal structures destroyed
<b>APPEARANCE</b>	Dry and red, blanches to pressure. No blisters.	Pale pink. Smaller blisters. Wound base blanches with pressure.	↔	Blotchy red or pale deeper dermis where blisters have ruptured	White waxy charred. No blisters. No capillary refill
<b>SENSATION</b>	Maybe painful	Increased sensation  Very painful and tender	↔	Decreased sensation	No sensation
<b>CIRCULATION</b>	Normal, increased	Hyperaemic  Rapid capillary refill.	↔	Sluggish capillary refill	Nil
<b>COLOUR</b>	Red, warm	Pink	↔	White/Pale pink/ Blotchy red	White/Charred/ Black
<b>BLISTERS</b>	None or (days) later or desquamation	Yes (within hours of injury)	↔	Early—usually large blisters which rupture rapidly and slough	Epidermis & dermis destroyed, no blistering
<b>HEALING TIME</b>	Within seven days	7-14 days	↔	Over 21 days	Does not heal spontaneously
<b>SCARRING</b>	No scar	Colour match defect. Low risk of hypertrophic scarring	↔	High risk (up to 80%) hypertrophic scarring	Wound contraction  Heals by secondary intention
↔ In the range between Superficial Dermal Thickness (partial) '2 <sup>nd</sup> degree' and Deep Dermal Thickness (partial) '2 <sup>nd</sup> degree'					


Last Updated: 09 May 2012

## 11. Appendix 2: Rule of nine (adult)

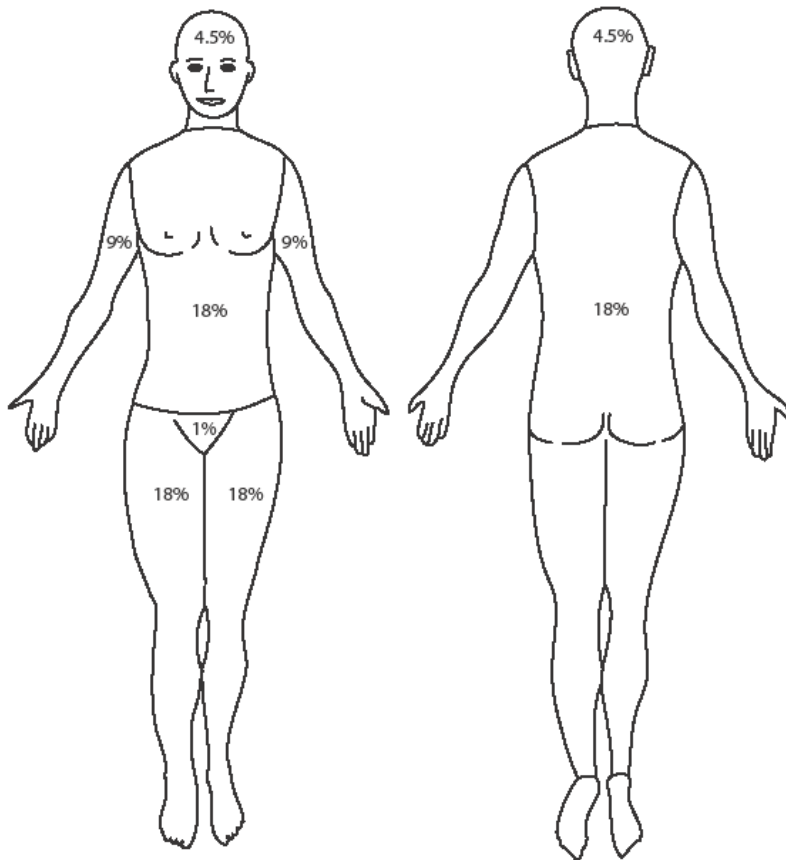
# Rule of Nine

## For Adults Only.

CONTACT DETAILS



Alfred Hospital  
03 9076 2000



TBSA %	
	%
Head	
Right arm	
Left arm	
Anterior Torso	
Back	
Right Leg	
Left Leg	
Genitalia	
TOTAL TBSA	

Estimated fluid (Parkland)

$4\text{mls} \times \text{TBSA}\% \times \text{Kg} = \text{mls}/24\text{hrs}$   
 1/2 total in 8 hours post injury  
 1/2 total in 16 hours post injury

Time of injury: \_\_\_\_\_ Time elapsed since burn: \_\_\_\_\_

Estimated fluid required: \_\_\_\_\_ mls Total fluid since burn: \_\_\_\_\_ mls

Use as a guide to estimate fluid requirements. Titrate fluid administration to achieve desired urine output



DEPTH LEGEND:

- Full Thickness
- Deep Dermal
- Mid Dermal
- Superficial Dermal
- X Circumferential

Last Updated: 09 May 2012



## 12. Appendix 3: Victorian state burns service transfer criteria

Victorian State Burns Service Transfer Criteria		CONTACT DETAILS
		 Alfred Hospital 03 9076 2000
		 Royal Children's Hospital PIPER 1300 13 76 50

People with the following injuries should also be transferred to the state burns services:

1. Burns with associated inhalation injury
2. Burns greater than 10% total body surface area
3. Burns to special areas – face, hands, major joints, feet and genitals
4. Full thickness burns greater than 5% total body surface area
5. Electrical burns
6. Chemical burns
7. Circumferential burns of limbs or chest
8. Burns with associated trauma
9. Burns in the very young or older people
10. Burn injury in patients with pre-existing illness or disability that could adversely affect patient care and outcomes
11. Suspected non-accidental injury in children
12. Burns in children under the age of 12 months
13. Small area burns - in patients with social problems, including children at risk
14. Burns occurring in pregnant women
15. Burn injuries which the referring unit is concerned about or are slow to heal.

Last Updated: 08 May 2012

### 13. Appendix 4: AGREE II Score sheet - Burns

Domain	Item	AGREE II Rating						
		1 <i>Strongly Disagree</i>	2	3	4	5	6	7 <i>Strongly Agree</i>
Scope and purpose	1. The overall objective(s) of the guideline is (are) specifically described.							X
	2. The health question(s) covered by the guideline is (are) specifically described.							X
	3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.							X
Stakeholder involvement	4. The guideline development group includes individuals from all the relevant professional groups.						X	
	5. The views and preferences of the target population (patients, public, etc.) have been sought.							X
	6. The target users of the guideline are clearly defined.							X
Rigor of development	7. Systematic methods were used to search for evidence.						X	
	8. The criteria for selecting the evidence are clearly described.						X	
	9. The strengths and limitations of the body of evidence are clearly described.						X	
	10. The methods for formulating the recommendations are clearly described.						X	
	11. The health benefits, side effects and risks have been considered in formulating the recommendations.						X	
	12. There is an explicit link between the recommendations and the supporting evidence.							X
	13. The guideline has been externally reviewed by experts prior to its publication.							X
Clarity of presentation	14. A procedure for updating the guideline is provided.							X
	15. The recommendations are specific and unambiguous.						X	
	16. The different options for management of the condition or health issue are clearly presented.							X
	17. Key recommendations are easily identifiable.							X

Domain	Item	AGREE II Rating						
		1 <i>Strongly Disagree</i>	2	3	4	5	6	7 <i>Strongly Agree</i>
Applicability	18. The guideline describes facilitators and barriers to its application.							X
	19. The guideline provides advice and/or tools on how the recommendations can be put into practice.							X
	20. The potential resource implications of applying the recommendations have been considered.							X
	21. The guideline presents monitoring and/ or auditing criteria.							X
Editorial independence	22. The views of the funding body have not influenced the content of the guideline.							X
	23. Competing interests of guideline development group members have been recorded and addressed.							X
Overall Guideline Assessment	1. Rate the overall quality of this guideline.	1 <i>Lowest possible quality</i>	2	3	4	5	6	7 <i>Highest possible quality</i>
Overall Guideline Assessment	2. I would recommend this guideline for use.	Yes X	Yes, with modifications			No		

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