Clinical Guideline

BURNS – CRITICAL CARE MANAGEMENT OF CHILDREN

SETTING
Paediatric Intensive Care Unit (PICU), Theatre, High Dependancy Unit (HDU), Bristol Royal Hospital for Children (BRHC)

FOR STAFF
All staff who provide direct patient care in the above settings

PATIENTS
All children with over 20% Total Body Surface Area (TBSA) burn or who require PICU

GUIDANCE

This guidance is for all staff who care for patients with burns of more than 20% Total Body Surface Area (TBSA) or who require paediatric intensive care and HDU care in University Hospitals Bristol NHS Foundation Trust (UH Bristol). It is the result of multidisciplinary discussion, evidence and expert views. The Burn Care Operational Delivery Network has provided input on a number of areas.

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WHO TO CONTACT

1. Plastics and Burns registrar – radiopage via switchboard
2. Burns bleep holder – bleep 6780
3. Burns consultant on call – via switchboard
4. Anaesthetic consultant on call – voip 27888 (until 1800, then via switchboard until 0800)
5. Ward 33 – ext. 27900

EXECUTIVE SUMMARY

This guideline has been drawn up in line with current evidence and expert views of the UH Bristol professional multi-disciplinary clinical teams involved in the care of children with burns. Representatives from each discipline were invited to regular meetings to develop the guideline. A final draft was circulated with three weeks for comments to the wider teams.

Below is a summary of information enclosed in the guideline for reference. Please refer to the full guideline for detail.

- **Patients with burns have multi-system issues and require multidisciplinary input at all times. Decision-making is a team responsibility. The family is part of the team.**
- Correct surgical and critical care management within the first 24 hours is key to good outcomes.
- Early/immediate surgery on admission for assessment and early management is vital.
- Debridement of tissue unlikely to heal within 14 – 21 days should be undertaken within the first 48 hours. This will require a consultant burn surgical team, experienced anaesthesia (often two consultants), the availability of blood, a warmed theatre and experienced scrub and ODA personnel. This should be discussed with theatre and critical care on the patient’s admission.
- Fluid management is complex and should be reviewed 2 hourly in the first 48 hours. Fluid overload is more common then hypovolaemia. Low urine outputs are common and likely due to an increased ADH response. Early signs of fluid overload include a new oxygen requirement, increased work of
breathing and hyponatraemia. If this is confirmed, use of diuretics should be considered by the consultant team.

- Intubation and positive pressure ventilation increases mortality and morbidity in patients with burns. Patients should be maintained unintubated, or extubated as early as possible. Frequent trips to theatre are not a reason to maintain intubation and ventilation.

- Prophylactic antibiotics are not required. The early suspicion of sepsis is essential. A pyrexia >39°C should be fully investigated including cultures, FBC, CRP and a formal wound assessment with consultant teams advised. A pyrexia of >39°C requires active cooling. **A diagnosis of toxic shock syndrome (TSS) must always be considered.**

- Early and continuous enteral feeding is vital. TPN is discouraged and institution requires senior team decision-making.

- Early psychological input is important for the whole family.

- Consider safeguarding issues from admission.

### 1. ADMISSION CRITERIA

**From BRHC Emergency Department (ED) /Theatre/Other Trusts/Scene:**

<table>
<thead>
<tr>
<th>Ward</th>
<th>HDU(33A)</th>
<th>PICU</th>
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<tbody>
<tr>
<td>TBSA &lt;10% and uncomplicated</td>
<td>• TBSA 10-20%</td>
<td>• TBSA &gt;20% and &lt; 30% warrants case by case discussion with PICU</td>
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<td></td>
<td>• TBSA 20-30% =&gt; case by case discussion with PICU</td>
<td>• TBSA &gt;30%</td>
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<td>• Daily HDU-consultant to PICU-consultant update</td>
<td>• All patients, independent of TBSA, who require any organ support</td>
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<td>• Early PICU consultation if worried about clinical condition</td>
<td>o Respiratory support (other than NRBM O₂)</td>
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<td>o Temperature &gt;38.9°C</td>
<td>o Cardiovascular support (inotropes etc.)</td>
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<td>o Decreased GCS</td>
<td>o Renal support (for instance for rhabdomyolysis, etc.)</td>
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<td>o Any oxygen requirement</td>
<td>o Other forms of organ support (see RAG-rating-information, Appendix 5.)</td>
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<td>• All patients who need close observation should have a discussion with PICU to decide best place for patient at night</td>
<td>• All patients with:</td>
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<td>o Electrical injury</td>
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<td>o Smoke inhalation</td>
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### 2. CLINICAL PRIORITIES FOR THE FIRST 48HRS [POST BURN DAY 0-2]:

**Referral:** As soon as the referral is received, a joint advice call should occur between: referring clinician, BRHC burn surgeon, BRHC PICU consultant and BRHC on call consultant anaesthetist. Theatre should be informed. The plan must agree on: airway management, intravenous access, fluid protocol (see below), early wound management, any safeguarding concerns and confirm transport and reception arrangements. An easy way to do this is to ring WATCh switchboard ((0300 0300789)) and ask them to patch the relevant clinicians in to a conference call.

*This is a request for Burns specialist advice, not a transport referral; WATCh would only transport these patients in extraordinary circumstances due to their time-critical nature.*
An ‘as soon as possible’ direct transfer using the referring teams is best unless the child has significant cardiopulmonary instability.

**BRHC ED ‘eyeball’ assessment:** Environment must be warmed before patient arrives. Receiving team (consultants in Burns, ED, PIC, Anaesthesia or their delegates) should make a single assessment of burn wound following a full primary survey to exclude/manage life threatening injuries. Patient ID bracelet, cross match samples, immediate physiological stability, emergency pain relief, and handover from the transfer team are the only activities for ED; unless there are non-burn injuries in which case the relevant specialist team must be involved at the outset and priorities agreed. The aim should be to transfer to theatre within 30 minutes of arrival to ED. The secondary survey can occur in theatre.

**Theatre management:** Theatre must be pre-warmed. Other injuries requiring emergency surgery must be treated. The first theatre visit will include a full burn assessment of depth, size and special areas. Bronchoscopic airway assessment, escharotomies or catheterisation must occur if indicated. Venous/arterial access sufficient for the patient’s next 48 hours of care must be secured including a change to any line believed to have been put in in “dirty” conditions. CVP lines should be avoided unless essential. Arterial access is useful in all patients with burns >20% TBSA. An NG tube must be placed; if the expertise is available an NJ tube should be sited. Beware of excess fluid administration; be guided by urine output (UO) and – more importantly – blood gases. Expect a reduced urine output and low normal blood pressure. Please insert an insufflon.

Endpoint: All wounds dressed, core temp >37°C, adequate analgesia, urine output >0.5ml/kg/hr.

**Airway:** Unless there has been direct thermal injury to the airway, patients should not remain intubated after the first theatre visit. Intubation increases their mortality from infection; the associated sedation exacerbates hypotension and encourages excess fluid administration and vasoconstrictor use; this will later make them ventilator-dependent, potentially deepen the burn and encourage graft loss. An incorrect early decision becomes progressively harder to undo.

Patients who are extubatable, should be extubated in theatre by the anaesthetist. NPA and NIV may be useful adjuncts. If this is not possible, the reason should be clearly documented in the medical notes. Airway burn, next scheduled theatre visit within 4 hours, pre-injury major behavioural problems, oxygen requirement above 50% would be good reasons to consider maintaining intubation but this is a consultant team decision. Facial burns in isolation do not necessarily constitute a good reason for remaining intubated.

For patients who must remain intubated, a cuffed ETT should be considered. Do not cut the ETT as facial swelling will peak over 12 – 72 hours. ARDS and ventilation difficulties are common in patients with burns who are ventilated and can be better managed with a cuffed ETT. **Early extubation should be considered at all times.**

**Airway Securing Options:** Standard adhesive tapes (‘Melbourne Strapping’) may be used if facial burns NOT present. Cotton ties may be used for initial stabilisation when facial burns are present. **Do not rely on adhesive tapes in patients with burned faces.** Discuss with ENT and burns team for other methods:

- Nasal intubation
- Interdental wiring
- Fixation to maxilla or mandible
- Fixation to tubing looped around the palate or nasal septum
- Tracheostomy – recent studies have proven that tracheostomy is safe and may improve patient comfort.

**First 48 hours’ critical care:**

- Keep child 30° head-up to minimise airway oedema.
• Do not seek to normalise HR (it will be 30 – 50% above the normal maximum for age) – though extreme tachycardias indicate either hypovolaemia, concealed haemorrhage from injury, or inadequate analgesia and must be addressed. All patients will be vasodilated; relative hypotension is common especially in ventilated patients, and should not be treated with fluid unless there is evidence of end-organ hypoperfusion (see below). **Parameters for BP should be agreed between consultant teams on admission.** Urine output may be low due to ADH response to burn. If it is <0.5 mls/kg/hr and all else including U&Es and ABGs are normal – **do not** prescribe extra fluid. Too much fluid can deepen the burn injury and result in prolonged ventilation. If fluid is prescribed it needs to be a consultant decision.

• A temp of 38 – 38.9°C is normal, but outside this range needs urgent correction and investigation for sepsis/TSS. **Temperatures >39°C should be notified to the burn and PIC consultant urgently** and active cooling started (see hyperpyrexia section).

• Analgesia must be maximised. Usually a standard opioid infusion/PCA/NCA is adequate in non-ventilated patients in the first 24 hours. Fentanyl tends to be better tolerated than morphine. If this is not adequate, use ketamine in preference to midazolam as an additional infusion; it is safer in non-ventilated patients and will support the BP in those that are intubated. Dexmedetomidine may have an evolving role. Gabapentin should be started within the first 48 hrs.

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• Parameters for BP should be agreed between consultant teams on admission. Urine output may be low due to ADH response to burn. If it is <0.5 mls/kg/hr and all else including U&Es and ABGs are normal – **do not** prescribe extra fluid. Too much fluid can deepen the burn injury and result in prolonged ventilation. If fluid is prescribed it needs to be a consultant decision.

• Vasopressors (e.g. noradrenaline, metaraminol) will extend or deepen the burn injury and encourage graft loss. They should be avoided if at all possible. Inotropes (e.g. dopamine, dobutamine) are not usually necessary in the first 24 hours when everything else is done correctly. If the patient requires inotropes or vasopressors then septic shock is the common underlying problem. **BP targets should be agreed twice daily with consultant teams.**

• Nutritional requirements for a ventilated child will be reduced until the child is doing their own work of breathing. Over-feeding a fully ventilated and sedated child is highly likely to exacerbate hyperglycaemia and prolong time to extubation. The dietitian will assess requirements according to the Penn-State Equation before using the Hildreth Equation once the child has been extubated. However, the PICU bedside feeding protocol below outlines the correct guidance to establish feeding and it is highly unlikely that within the first 48 hours a child with severe burns following these protocols will receive excessive calories.

• Propranolol (see hypermetabolism below) should be started enterally within the first 24 hours at a low dose and titrated as per [guideline](U:\Shared Info\Clinical Information\Enteral feeding\Guidelines\NJT guidelines\Revised NJ guidelines PICU.docx). Oxandrolone should be started when enteral feeding is fully established (see same guideline).

• Clexane should be started on day 1 via an insufflon which should be changed regularly

• Ventilation:
  - Pulmonary complications of burns and inhalation: airway obstruction and pulmonary oedema (0 – 24 hours), ARDS (24 – 72 hours) or pneumonia (days to weeks).
  - Standard PICU lung-protection strategies, and weaning programmes apply.
  - HFOV and iNO can be used in refractory hypoxaemia.
  - **Aim to maintain extubated if at all possible.**
Nebulised acetyl-cysteine, heparin and salbutamol should be considered in confirmed inhalation injury (confirmation by bronchoscopy).

- **Extubation should be actively planned for from admission. Return to theatre or facial burns are not a contra-indication for weaning and extubation.**
  - Where the safety of extubation is of concern it should take place in theatre.
  - NIV can be used to support patients who are struggling post extubation. This is not contraindicated but may be difficult in patients with facial burns.

- The following are among the indications for immediate PIC, anaesthesia and burn consultant review (extraordinary measures may be required; always consider missed injury):
  - Airway symptoms – tachypnoea, stridor;
  - Respiratory deterioration (increase in oxygen requirement of >10%), rising CO₂;
  - Inadequate pain control (including need for muscle relaxants in ventilated patients);
  - UO <0.5ml/kg or >2mls/kg/hr for 2 hours;
  - Temp <37°C or >39°C;
  - Significant hypotension (parameters agreed twice daily) despite 1 x 5mls/kg fluid bolus, or consideration of commencing inotropes.

- **Inotropes are not to be started before discussion with PIC and burns consultant team.**

- Following these principles is not easy and requires meticulous medical and nursing attention. Please seek advise from the burns team; they can offer practical help and expertise. Failures at this stage make the patient’s journey riskier and more difficult to manage.

- **Any safeguarding concerns regarding the injury should be considered at this time and throughout the child’s stay and the appropriate protocols followed.**

- All burns patients & their families have access to the Clinical Psychology service (Psychological Health service) in PICU, HDU(33A) & 33B for advice and support in relation to the impact of the injury.

### 3. COMMUNICATION

Good communication within the burns multi-disciplinary team and other involved specialists is vital to ensure a well-managed, co-ordinated approach to patient/family care. This is facilitated by:

- Minimum twice daily multi-disciplinary ward rounds. These will occur at 0800 – 08.30 hrs and 16.30 – 17.00 hrs and always be attended by the P2 consultant on duty, the burns consultant and the burns anaesthetist.
- Weekly (Mondays 12.00pm) Burns multi-disciplinary meetings attended by the PIC Burns liaison consultant or if not available the P2 consultant of the day.
- Microbiology ward rounds daily at 11.00hrs on PIC and HDU and at MDT.
- Theatre meeting at the start of care organised through the co-ordinator for the day, starred anaesthetist and burns anaesthetist (ext. 27888) to plan theatre trips.

Additional meetings/briefings between various disciplines/staff teams e.g. theatres and therapy will also likely be required. These can be planned and co-ordinated through Ann Miller (complex care co-ordinator) on ext. 27806 (mob 07785 956271).

**Communication priorities on admission:**

- Inform locality social care (via out of hours service if necessary) of this life-changing, life-threatening injury with long term implications. Advise if any non-accidental injury is suspected.
- Inform GP +/- Health Visitor (if under 5 years old) of admission (Monday – Friday).
- Inform Hospital Safeguarding of this patient if not already known (Monday – Friday).
All burns patients and their families have access to the Clinical Psychology service (Psychological Health service) in PICU, HDU (33A) and the burns ward (33B) for advice and support in relation to the impact of the injury in the short, medium and longer term.

4. PREPARATION FOR BURNS SURGERY

This section will provide guidance for the peri-operative care of burns patients on PICU and HDU. Appendix 3 has a theatre checklist encompassing these points.

A. Preparation for going to theatre (one hour before theatre)

- Pre warm patient – 2 x bair huggers top and bottom of child to a central temperature above 38°C. Have pre-cut, pre-warmed pieces of gamgee available for the transfer to theatre.
- CXM blood for theatre – 2 units (transfusion x 22579).
- D/W consultant anaesthetist – if patient listed for debridement +/- grafting, order Octaplas (1 unit = 200ml), to be ready in theatre. It takes 20 minutes to defrost. To find out the name of the consultant who will be responsible ring the starred anaesthetic consultant on x 27888.
- Do an arterial blood gas to check and document Hb, Na+, K+, Ca++ prior to theatre.
- Ensure the full set of blood results from 0600 (FBC, Coag, U and Es, LFTs, renal profile, CRP) are available to view by consultant anaesthetist.
- If the feed is nasojejunal (NJT) do not stop - this will be continued during theatre. Please make sure there is a sufficient volume to last the duration of surgery.
- If the feed is nasogastric (NGT), the feed should be switched off and NGT aspirated 6 hours before theatre, and left on free drainage. The patient should have a nasojejunal tube placed in theatre ASAP, please have a suitable NJT available to accompany the child to theatre. This will be brided in place, labelled, and its position radiologically confirmed and documented in the notes.
- Please ensure that the child’s carers/parents are available for consent and face to face discussion with burn surgical and anaesthetic consultants.
- Please have available new lines, insufflon, urinary catheter to change in theatre, old peripheral cannulae will be removed (over 3 days old). Central lines will be avoided if possible due to infection risk. Cannulae may be sutured in place if through burnt/healing skin.
- Please inform the consultant anaesthetist if any drugs due in theatre – e.g. antibiotics, and the timing of the last dose of paracetamol.
- Please complete a surgical care plan.
- PICU/HDU should ensure the coordination of other surgical specialities involved e.g. ophthalmology and general surgery (separate consent will be required).
- Coordination of other allied healthcare professionals should also be planned – burns physio and OT – castings, chest physio – sputum sample M, C and S – please provide a sputum trap to go with the patient to theatre and an ICE label.

B. Preparation for return from theatre (1 hour pre return from theatre to PICU)

- Theatre team will ring at least 20 minutes to give warning of return to the PICU/HDU.
- Ensure room is warmed to at least 28°C. Have 2 bair huggers ready for both top and bottom halves of patient.
- There will be a consultant anaesthetist to consultant intensivist face to face handover in the bedspace.
- A green PICU/HDU handover sheet with written guidance for parameters and tasks will have been completed in theatre.
- Ensure there is a sign above the patient’s bed stating “NO SUXAMETHONIUM”.

Version 1.1 Oct 2018 - To Oct 2019 Author(s) Dr Amber Young, Dr Natasha Clarke, Dr Adrian Upex, Burns MDT
Extended until September 2020
• Know where the difficult airway equipment is in case reintubation is required. Ensure the correct size facemask, guedel airway, ETT and bougie are easily to hand in the child’s room.

• Avoid giving large volumes of fluid post op, it is more likely that the patient will require off-loading with small doses of IV frusemide (0.25 – 0.5mg/kg). If blood products are required these MUST be administered through a ‘hotline’ IV giving set. Expect the child to be peripherally shut down with a prolonged CRT and poor base deficit post-op due to a post-cleaning toxæmia. If this lasts more than a few hours or the child is getting worse – discuss with PIC and burn consultant.

• Fluid management still requires senior attention and similar priorities to earlier care. If hypernatraemic then enteral water can be added. Serum sodium must be closely monitored at least 4 hourly with formal lab U&Es as well as ABGs.

• If the child has undergone significant grafting they will have increased analgesia requirements. See pain management guidance.

• Meticulous care should be taken when positioning children post extensive grafting in order to avoid shearing the grafts. Chest physiotherapy should be adapted initially if the chest wall has been grafted. Long periods of sitting should be avoided if the buttocks/lower torso have been grafted. Discuss positioning with the consultant burn surgeon.

• If the child has very loose stools and is intubated, a bowel management system may have been placed during theatre to prevent graft soiling and infection. These need careful observation to avoid bowel wall necrosis from balloon pressure inside the bowel lumen. They are not specifically designed for children.

• All children with significant burn injury should be on prophylactic enoxaparin (Clexane) as per Low molecular weight heparin guideline. At handover, the timing of the next dose will be communicated by consultant anaesthetist, and documented on the green handover sheet.

• There should be a clear plan of the next theatre visit. The family should be informed of theatre findings and actions and planned further management by the burns and PIC consultants.

5. BURN SURGERY

The aim of burns surgery is to ensure that any dead skin is removed if it is not likely to heal spontaneously within 2 – 3 weeks. Where non-viable skin is removed, it will need to be replaced. Ideally, this is done with the patient’s own skin (autograft) at the earliest opportunity to reduce ongoing inflammation and risk of infection.

For larger burns, surgery is undertaken in a planned and staged manner. This may entail taking the patient back to theatre every two days for further skin grafting or changes of dressing. The surgical team returning the team to PICU will give a face-to-face handover and write written notes to include: amount of skin removed/grafted/still needing removal; plans for post-operative extremity elevation, physiotherapy, splintage and thromboprophylaxis; fragile areas beneath dressings that should be avoided during all manipulation; feeding plan; antibiotic plan and who to contact if there are any concerns.

For more detailed information, please refer to Appendix 2 - Acute Burn Surgery

6. VENTILATION AND INHALATION INJURY

Mechanisms of injury

• Asphyxia – tissue hypoxia from breathing low FiO₂, inhalation of carbon monoxide +/- cyanide;
• Direct thermal damage;
• Pulmonary irritation due to inhaled chemicals and particles;
• Systemic Inflammatory Response Syndrome (SIRS).
History and examination suspicious for injury

- Exposure to smoke in an enclosed space, especially if for more than 10 minutes;
- Reduced consciousness at any time or ongoing confusion;
- Dysphagia, dysphonia, stridor, hoarseness or cough;
- Visible burns to face, lips, tongue, mouth, pharynx or nasal mucosa;
- Soot in sputum, nose and mouth;
- Central facial burns – not absolute indication;
- Dyspnoea;
- Wheeze or other evidence of bronchospasm;
- Clinical hypoxaemia (SpO2 <94% in air, arterial pO2 <8kPa);
- Carboxyhaemoglobin levels >15%.

Beware! The symptoms and signs of smoke inhalation can get worse over the first 36 hours following injury. Reassess frequently.

Indications for intubation – one or more of the following:

- Impending airway obstruction, stridor, intraoral or intranasal oedema;
- Respiratory distress – increased work of breathing etc;
- Symptoms of carbon monoxide poisoning including decreased level of consciousness, nausea, confusion, ataxia or convulsions.
- If in doubt, discuss with consultant burns/PIC re intubation. Do not cut the ETT.

Baseline investigations

- Blood: ABGs, FBC, clotting, U&E’s, carbon monoxide levels, cyanide levels;
- CXR;
- Bronchoscopy.

Treatment – patients NOT requiring intubation:

- High flow humidified oxygen until COHb <5% and pO2 >96%;
- Chest physio assessment;
- Nebulised salbutamol;
- Sputum culture.

Treatment – patients requiring intubation:

- 100% O2 until COHb <5%.
- Full warm air humidification.
- Continue with lavage in 10ml aliquots, with bagging and suction, hourly (if tolerated) until sputum is clear of soot.
- Send first sputum sample for culture; daily sputum bacterial surveillance.
- Antibiotic therapy should be discussed with Microbiology and burns team and should not be given prophylactically.
- Regular physiotherapy started early.
- Bronchodilators: Salbutamol 4 to 6 hourly, Ipratropium 6 hourly. Consider nebulised n-acetyl cysteine 20% (2 – 3mls every 4 hours). Note that N-acetyl cysteine can sometimes cause bronchospasm so stop if bronchospasm is worsening.
• Consider nebulised heparin.

Specific therapies

• In the event of suspected cyanide poisoning, consider specific antidotes only after discussion with the consultant in charge; the Cyanokit® is kept within the Emergency Department.
• Consider CVVH in cases of severe persistent metabolic acidosis.
• Hyperbaric oxygen therapy remains controversial and is not currently recommended.

There is increasing evidence that prolonged ventilation is associated with poorer outcomes and that intubation may sometimes be unnecessary. Always consider the necessity for intubation and extubate at the earliest opportunity.

7. THERAPY

Refer to respiratory physio if patient:

• Has suspected/known inhalation injury.
• Has been intubated and ventilated.
• Has pre-existing respiratory problems.
• Has other respiratory problems as a result of the burn.
• Develops a chest infection or collapse with difficulty clearing secretions.

Burns therapy:

• All patients to be referred and assessed by burns therapist within 24 hours (excluding bank holidays and weekends).
• Burns therapist to document therapy plan clearly in medical notes.
• Splint precautions/regime to be clearly documented in medical notes.
• Positioning advice to be provided to the PICU nursing staff (photos to be provided of correct positioning).
• Patient to be reviewed by burns therapist on a regular basis (excluding bank holidays and weekends).
• Burns therapist to liaise with MDT including respiratory physio with regards to precautions from grafted areas.

8. HYPERMETABOLISM AND HYPERPYREXIA

Hypermetabolism

Burn injuries of more than 20% TBSA result in a hypermetabolic response, characterised by:

• hyperdynamic circulation;
• increased body temperature;
• catabolism and inefficient energy substrate cycling.

This is mediated by acute phase response cytokines and increased secretion of catecholamines, glucocorticoids, and glucagon. Protein is preferentially used as the main body substrate. Without treatment, the patient will have muscle wastage, delayed mobilisation, impaired rehabilitation and immune-compromise, increasing the risk of sepsis. Cardiac output and heart rate can often increase by 150 – 200%. This can last well into the rehabilitative stage. The patient will also typically have a hyperglycaemic insulin resistant state and often require insulin supplementation especially during episodes of sepsis.
Treatment relies upon early excision of deep burns, nursing in a thermoneutral environment, B-blockers and oxandrolone.

**Hyperpyrexia**

- **Defined as** a temperature above 39°C.
- **Requires immediate treatment to avoid seizure activity and multiorgan failure.**
- Children with major burn injury often become hyperthermic, a core temp up to 38.5°C can be considered normal, due to SIRS. Even a short period of very high temperature can cause significant morbidity (temperatures 41.6 - 42°C can cause irreversible cell injury in periods as short as 45 minutes). The gut is vulnerable to ischaemia secondary to shunting at such high temperatures, in severe cases multiorgan failure and DIC develop.

**Management of Hyperpyrexia (Core temp >39°C):**

1. Full septic screen, check CK and U&Es;
2. Antipyretics – give paracetamol;
3. Open gamgee dressings, remove hand dressings (discuss with consultant burns surgeon prior);
4. Consider ice packs to axilla and groin;
5. Consider reduction in room temp if periperal temperature warm (<2°C core – peripheral gradient);
6. Refrigerate NG/NJ flushes and feed prior to use;
7. Consider bladder washouts;
8. **STOP cooling when core temp is < 38.5°C.**

**Commence CVVH if:**

- Core temp 40°C for > 6 hours or;
- Core temp 41°C for > 2 hours.

**9. INFECTION**

Burns patients are vulnerable to infection due to the loss of the protective skin layer, immunosuppression secondary to major trauma, the presence of invasive lines and long hospital stays. Protective isolation in a single cubicle is essential; ideally a cubicle with positive pressure external ventilation and an adjacent ante-room.

Stringent infection control precautions cannot be over emphasised for these patients and this may extend to parents/carers/visitors in some cases. All clinical staff should wear aprons and gloves, be naked below the elbow and follow hospital standards for hand-washing.

The diagnosis of infection +/- sepsis in the major burns patient is extremely difficult due to the systemic inflammatory response which obscures the usual clinical indicators and blood markers of infection. The signs of sepsis are identical to those for systemic inflammation except for the presence of bacteria. Diagnostic criteria rely on a high index of suspicion. The presence of pyrexia, changes in white blood count and CRP alone, may indicate either state.\(^76,79,80\) Enteral feeding intolerance is more helpful, as is glucose instability.\(^81\) Evidence is mixed for the use of procalcitonin as a biomarker of sepsis in patients with burns.\(^82\)

If there are signs of sepsis in patients with burns, blood cultures, wound swabs, FBC (including a WBC differential), CRP and urgent assessment of the burn wound are essential. Broad-spectrum antibiotics must be started until cultures can give definitive results. Toxic shock syndrome, usually secondary to the TSST1 toxin of *S. Aureus*, should always be considered in the child with signs of sepsis after burn injury.\(^83,84\)
especially within the first week after injury. Diagnosis is by exclusion and should be considered in all children with a burn and a temperature of >39°C. A low lymphocyte count and serum Na⁺ are common. Specific management requires anti-Staphylococcal antibiotic treatment and wound cleaning. However, management must also include anti-toxin treatment with intravenous immunoglobulin (IVIG) or fresh frozen plasma (FFP). FFP is obtained from adults and thus contains the anti-TSST toxin which is depleted in children of less than four years of age. It is more commonly used than IVIG in the treatment of TSS although the evidence for its use is limited⁸⁵. Prophylactic intravenous antibiotics are contraindicated in burns patients due to the increasing concern of antibiotic resistance. However the administration of peri-operative antibiotics is more supported as cover for transient bacteraemias post wound cleansing/debridement.

The commencement of intravenous antibiotics is a joint decision between the burns consultant and critical care consultant. Positive wound culture swabs alone is not an indication for treatment.

See the Burns Toxic Shock Syndrome & Sepsis Guideline for more information.

10. FLUID MANAGEMENT

Follow the guideline: Fluid Management in Paediatric Burns.

Hartmanns is no longer widely available and Plasmalyte (+ 5% Dextrose in children under 10kg) is an acceptable alternative.

N.B. The electrolyte content and buffer within the two solutions is different.

Supplemental guidance for beyond the first 48 hours, is in the appendix of the guideline.

Nutrition guidelines:

Children admitted to the PICU should follow the PICU specific guidance to establish nutrition support: U:\Shared Info\Clinical Information\Burns\Policies and forumlarys\Nutritional Management on the PICU - Clinical Guideline.doc

The PICU have specific out of hours feeding protocols to establish and advance tolerance to enteral feeding until reviewed by the dietitian: U:\Shared Info\Clinical Information\PICU\Guidelines\PICU bedside feeding guidelines.doc.

Children admitted to the HDU should commence enteral feeding nutrition support according to: U:\Shared Info\Clinical Information\Burns\Policies and forumlarys\Nutritional Management - Paed Clinical Guideline.doc and supported with the appropriate out of hours screening chart until reviewed by the dietitian U:\Shared Info\Clinical Information\Burns\Policies and forumlarys\Nutrition Screening Flowchart.doc.doc
Background Management in PICU/HDU 33A (generally applies in >20% burn)

Good analgesia is essential to burns management and must be maintained throughout a long, complex hospital stay. If at any time this is not achieved, prompt Acute Pain Service review and administration of rescue analgesia is required. Adequate pain control will require the attendance of a burns anaesthetist or intensivist prepared to supervise strong rescue doses of analgesia, possibly using extraordinary doses of several different agents. For a child with a major burn to survive, it is important that they do not unnecessarily remain intubated and ventilated for any reason; and especially not because of fears that their analgesia will be inadequate when awake.

FENTANYL
First line analgesia in major burns should be with Fentanyl NCA/PCA/infusion. Midazolam or Ketamine infusions may be added for sedation (at least one must be used for intubated patients, but most children with major burns will benefit from this). In large burns, tolerance to all drugs will develop and sedation will require cycling and supplementation. Dexmedetomidine may have a useful role.

<table>
<thead>
<tr>
<th>Fentanyl for sedation of intubated patients</th>
<th>Check carefully which concentration of Fentanyl is in use; infusion prescribed initially at 5 – 10 micrograms/kg/hr undiluted (50 micrograms/mL) Fentanyl. Refer to the PICU Drug Sheet <a href="http://nww.swretrieval.nhs.uk/">http://nww.swretrieval.nhs.uk/</a>.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl for analgesia PCA/NCA/infusion</td>
<td>Refer to PCA/NCA guidelines. This should be a diluted concentration.</td>
</tr>
</tbody>
</table>

Patients with extensive burns whose analgesia is stable on high-concentration fentanyl while intubated on PICU may well require this dose to be continued after extubation to maintain adequate
analgesia. All staff on the PICU/HDU should be notified when this is the case, and the agreement with the charge nurse and duty consultant. Patients requiring this level of analgesia should not be managed outside PICU. Their analgesia throughout step-down to care on the ward must be overseen by the Acute Pain Team and PICU consultant. These children require a gradual wean from what are often extraordinary doses of opioids, and sudden reductions are likely to cause severe pain, agitation and withdrawal phenomena.

<table>
<thead>
<tr>
<th>KETAMINE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ketamine for analgesia with sedation</strong></td>
</tr>
<tr>
<td>Can be given by infusion at a starting dose of 50 – 200 micrograms/kg/hr</td>
</tr>
<tr>
<td><strong>Ketamine for analgesia with PCA/NCA</strong></td>
</tr>
<tr>
<td>Please refer to PCA/NCA guidelines.</td>
</tr>
</tbody>
</table>

This can be a useful additional analgesia in long-stay critical care patients and is a reasonable substitute for Midazolam infusion when the use of the latter becomes problematic. Under direct consultant supervision, IV boluses may be given for rescue analgesia.

<table>
<thead>
<tr>
<th>MIDAZOLAM for sedation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infusion concentrations and initial infusion rates are on the PICU Drug Sheet at:</td>
</tr>
</tbody>
</table>

**OTHER PARENTERAL OPTIONS** – Morphine/Oxycodone PCA/NCA for analgesia

These are 2nd line options in major burns; they may occasionally be helpful later in a patient’s admission, or in patients who respond poorly to Fentanyl despite dose increases. Please refer to PCA/NCA guidelines.

**However**, most patients who require IV Fentanyl during their early burn debridement/grafting/dressing management should be converted **directly to oral opiates** once these major interventions are over, so that all IV access can be removed.

<table>
<thead>
<tr>
<th>Oral opiates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please see section 1 of the paediatric acute pain guideline.</td>
</tr>
</tbody>
</table>
**CLONIDINE**

Clonidine is a useful sedative analgesic, but must be used with great care in burns patients as they are already extremely vasodilated. Even patients with a normal awake blood pressure are often profoundly hypotensive under the anaesthesia required for their theatre visits; and most patients by this stage will already be established on beta-blockers, adding clonidine will further exacerbate this and can be dangerous. **Consider** dexmedetomidine as an alternative on consultant advice.

Clonidine should be avoided altogether during the first 48 hours of a burn; if renal function is abnormal; if awake blood pressure is abnormal; if sepsis develops.

**Clonidine should be agreed between consultants in Critical Care and Burns Anaesthesia, and restriction to the following situations is suggested:**

<table>
<thead>
<tr>
<th>Bolus</th>
<th>Rescue analgesia given by a supervising consultant to an awake, haemodynamically stable patient in a dose of 1 – 4 micrograms/kg IV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning Regime</td>
<td>Prescription initiated by consultant intensivist to enable weaning of other sedative medications, again in the haemodynamically stable patient. Doses in the 6 hours prior to a theatre visit should be withheld unless approved by a consultant.</td>
</tr>
<tr>
<td>Infusion for Sedation</td>
<td>Prescription initiated and supervised by a consultant intensivist in a haemodynamically stable patient, where the other options listed above have proven inadequate.</td>
</tr>
</tbody>
</table>

**Chloral Hydrate** may be a necessary sedative adjunct, especially later in major burns course. However, the hazards of gastric ulceration, and sometimes unexpectedly prolonged duration of action, should limit its use in burns to consultant decision.

**Breakthrough/Procedural Pain Management:**

Procedural sedation must only take place in designated areas, with established monitoring, clinical backup and staff training. Please refer to the **Clinical Guidelines: Sedation in Children and Young People**. Their first non-theatre procedure should be supervised by a consultant paediatric anaesthetist or intensivist, to ensure adequate analgesia/sedation. Please refer to the guidelines for further options.

**12. NURSING**

Included below are the additional nursing care requirements for Burns patients over and above what is considered essential nursing care within a critical care setting. Essential nursing care in a paediatric critical care setting includes; eye care, mouth care, airway protection/suctioning, tracheostomy care, care of invasive devices, naso- and/or oral-gastric tube placement and care, urinary catheter care, bowel management/nappy care and maintaining skin integrity (turns/positioning) as key examples.

The Burns specific nursing requirements will be individualised according to patient need and these will likely change according to the patient’s clinical condition. Anticipation of these changes is a key nursing skill in the care of Burns patients and this can be developed over time.
<table>
<thead>
<tr>
<th>Activity of Daily Living</th>
<th>Burns specific requirements</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airway/ Breathing</td>
<td>Follow inhalation injury management strategies where applicable. Aim to wean and extubate asap (see above).</td>
<td>To promote self-ventilation and prevent ventilatory associated complications.</td>
</tr>
<tr>
<td></td>
<td>Nurse upright when possible.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Support proactive ventilator weaning/ early extubation whenever possible.</td>
<td></td>
</tr>
<tr>
<td>Eating/ Drinking</td>
<td>Prioritise enteral feeding as soon as possible – ideally NJ.</td>
<td>To moderate the hypermetabolic response, prevent the patient becoming catabolic, promote wound healing.</td>
</tr>
<tr>
<td></td>
<td>Progress to full feeds as soon as possible. Follow dietetic regime. Alert staff of any issues with enteral feeding.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monitor oral intake in addition to enteral feeds. Fluid restrictions may apply and a diuretic may be indicated.</td>
<td>To reduce the risk of fluid overload.</td>
</tr>
<tr>
<td></td>
<td>Maintain an accurate record of all input/ intake.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alert staff to signs of fluid overload; increasing $O_2$ requirement +/- oedema.</td>
<td></td>
</tr>
<tr>
<td>Elimination</td>
<td>Maintain an accurate record of all output, weigh incontinence sheets if possible to estimate insensible losses.</td>
<td>To reduce the risk of fluid overload/underload.</td>
</tr>
<tr>
<td></td>
<td>Accept urine output of 0.5mls – 1mls/kg/hr and alert staff if outside of this.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alert staff of any concerns with bowel motions.</td>
<td></td>
</tr>
<tr>
<td>Controlling Temperature</td>
<td>Maintain cubicle temperature above 28°C. (Note when returning from theatre 32°C maybe desirable for a short period until core temp is above 37°C).</td>
<td>To moderate the hypermetabolic response.</td>
</tr>
<tr>
<td></td>
<td>Maintain patient core temperature between 37°C – 38.5°C. Use bair hugger/radiant heaters if necessary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Consider monitoring toe-core temperature readings.</td>
<td>Hyperpyrexia and Sepsis management.</td>
</tr>
<tr>
<td></td>
<td>If patients temperature stays at 39°C then seek consultant review</td>
<td>Burns Paediatric Toxic Shock Syndrome and Sepsis</td>
</tr>
<tr>
<td></td>
<td>Monitor for signs and symptoms of infection/sepsis.</td>
<td></td>
</tr>
<tr>
<td>Maintaining a Safe environment</td>
<td>Nurse in protective isolation in a single cubicle. Ensure positive pressure ventilation is switched on (in PIC).</td>
<td>Infection prevention and control precautions.</td>
</tr>
<tr>
<td></td>
<td>Limit numbers of staff/ visitors entering the cubicle.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Securing lines/ tubes will likely be more challenging with extensive burns.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Encourage proactive invasive device change/removal.</td>
<td></td>
</tr>
<tr>
<td>Washing &amp; Dressing</td>
<td>Accept that this is likely to be limited due to extensive wounds/bandages.</td>
<td>To support burn wound healing and reduce the risk of infection.</td>
</tr>
<tr>
<td></td>
<td>Administer additional prescribed analgesia prior to wound care procedures.</td>
<td></td>
</tr>
</tbody>
</table>
**Communication**

- Ensure the child/family are fully informed and involved in their care as much as possible.
- Be the child/family advocate if necessary ensuring that their voice is being heard.
- Allow the child/family to express their fears and anxieties.
- Where necessary, act as the conduit for communication between the various specialists looking after the patient.

**Mobilisation**

- Follow splint and positioning regimen as per burns therapy instruction.
- Perform passive range of motion exercises as per burns therapy instruction where required to do so.
- Encourage mobilisation if able to do so.

**Play/Education**

- Employ a range of sensory/educational materials appropriate to age and stage of development.

**Sleeping**

- Alert PIC consultant if over- or under-sedated.
- Balance sensory stimulation/patient interventions with adequate rest time.
- Promote day/night routines.

**Death & dying**

- Provide comfort care appropriate to own role.
- Refer to appropriate personnel to provide religious rites/ceremonies according to the child/family’s religion.

**Expressing sexuality**

- Additional care requirements will be required for menstruating girls.
- Maintain privacy, dignity and chaperone staff where necessary.

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**Facial Burns:**

Twice daily cleansing of exposed wounds and regular application of yellow soft paraffin.

**Perineal Burns:**

Clean wounds and change pads immediately after soiling. Use a bowel management system if appropriate.

**Exudate control:**

Outer layer bandages/gauze may need changing in between theatre dressing changes.

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**Additional fluid** – if required in excess of predicted feed volume this should be given as flushes or enteral water boluses. If unable to provide additional water enterally IV fluids should be commenced. This requires consultant level discussion with PIC and Burns team regarding overall fluid status of the patient.

**Diarrhoea** – may be cause by osmotic effects from feed, but also the gut flora can be altered which can be exacerbated by antibiotics. If possible, a bowel management system should be investigated and the feed should not be stopped. At this point a hydrolysed formula may improve upper GI absorption and reduce the severity of diarrhoea. If profuse diarrhoea, hydration becomes paramount and the formula may need to be

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**Additional**

Version 1.1 Oct 2018 - To Oct 2019

Extended until September 2020

Author(s) Dr Amber Young, Dr Natasha Clarke, Dr Adrian Upex, Burns MDT
changed to an amino acid formula for a temporary period until the diarrhoea has improved. Failing this, IV fluids may be needed and consideration of alternative nutrition support explored further if chronic profuse diarrhoea continues.

13. PSYCHOLOGY

All patients with burn injuries and their families have access to the Clinical Psychology Service (Psychological Health Services) in PICU, HDU (33A) and the burns ward (33B) for advice and support in relation to the impact of the injury in the short, medium and longer term which includes outpatient care. The psychology service supports children, young people and their families in coping with the following commonly occurring reactions after a burn injury:

- Experiencing distressing memories of the injury.
- Coping with distressing or upsetting treatment.
- Difficulties in adjusting to the effects of the burn injury.
- Worries about scarring and treatment.
- Difficulties in coping with changes in appearance.
- Worries around returning to school.

In addition, the psychology service supports the patients' families in relation to:

- The child’s health, future development and social reintegration such as returning to school.
- Developing and maintaining healthy relationships with other children.
- Problems with their child’s behaviour.
- Feelings of guilt or responsibility about what has happened.
- The impact of the injury on relationships within the family.
- Concerns about surgery and scar management.
- Communication with the burns service.

14. REFERRALS/LIAISON WITH OTHER SPECIALISTS

These specialists should be involved from the outset by the Burns or PIC consultants, if there is an indication for their contributions.

- Microbiology
- Ophthalmology
- Oculoplastics
- ENT
- General Surgery
- Renal
- Orthopaedics

15. DISCHARGE FROM PIC AND/OR HDU

Discharge (step down) from PIC or HDU is a joint decision between the on-call critical care consultant and burns consultant. Bed availability must be known prior to discharge/step down.

The step down from PIC is to ward 33A HDU. The step down from HDU is either to a ward 33B cubicle or as an agreed managed transfer to a local hospital. The appropriate discharge stickers are to be used and filed in the notes as part of the handover process. Hospital transfers require more detailed handover notes +/-
photocopies of relevant notes to go with the patient. A health professional escort may be required for this transfer. Multi-disciplinary liaison in advance with respective discipline counterparts at the receiving hospital is essential for these patients (i.e.; doctor to doctor, nurse to nurse, therapist to therapist etc.).

All burns patients and their families have access to the Clinical Psychology Service (Psychological Health service) in PICU, HDU (33A) and the burns ward (33B) for advice and support in relation to the impact of the injury in the short, medium and longer term which includes outpatient care.

**RELATED DOCUMENTS**
- Burns Paediatric Toxic Shock Syndrome and Sepsis
- Clinical Psychology Service for Burns Patients
- Fluid Management in Paediatric Burns
- Burns inpatient MRSA Screening & Management Policy for Paediatric Burns
- Burns – Oxandrolone and Propranolol for Managing Post Burn Hypermetabolism for burns ≥ 20%
- Burns in Children – Children’s Emergency Department (CED) assessment and management
- Metaraminol/Phenylephrine in Post-Surgical patients on PICU & 33a Burns /Neuro HDU
- The Nutritional Management of Moderate to Severe Burns Guideline – *Needs to be ratified*
- Burn Pain Management in Paediatrics
- Families in the Paediatric Intensive Care Unit (PICU) Bristol Royal Hospital for Children
- Psychology support for families in the Paediatric Intensive Care Unit
- The management of Post Burn Itch in children

**AUTHORISING BODY**
- Paeds Burns Governance Group

**QUERIES**
In the first instance please contact the Burn Team on 0117 342 7910 or bleep the clinical nurse specialist on Bleep 6780.
## APPENDIX 1

### Drug Information for Burns Patients

<table>
<thead>
<tr>
<th>Section</th>
<th>Information</th>
<th>Guide/Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analgesia/Sedation</td>
<td>Use fentanyl first line. Be aware of clonidine issues with blood pressure when using in conjunction with propranolol. Avoid NSAIDs as per pain guideline</td>
<td>See acute pain team guidelines and PICU sedation guideline: Paediatric Pain Service Acute Pain Management Sedation and Analgesia on PICU</td>
</tr>
<tr>
<td>Suxamethonium</td>
<td>Do not use in burns patients due to risk of fatal hyperkalaemia. It may be used within the first 24 hours after injury on consultant advice. Place a laminated sign above the bedspace instructing not to use suxamethonium</td>
<td></td>
</tr>
<tr>
<td>Fluids</td>
<td>Burns patients are an exclusion to the Trustwide paediatric fluids guideline. Use Plasmalyte.</td>
<td>See paediatric burns fluid guideline Burns – Fluid Management in Paediatric Burns</td>
</tr>
<tr>
<td>Ranitidine</td>
<td>To be started if patient is not receiving enteral feeds (this is outside of PICU normal practice)</td>
<td>Use electronic prescribing system for dosing or BNFC</td>
</tr>
<tr>
<td>Propranolol</td>
<td>Start day 1 for patients with &gt;20% burns unless contraindicated.</td>
<td>See guideline Burns – Oxandrolone and Propranolol for Managing Post Burn Hypermetabolism for Burns &gt;20%</td>
</tr>
<tr>
<td>Oxandrolone</td>
<td>Start when feeding established – discuss with dietician to ensure patient is receiving appropriate amounts of nitrogen before starting</td>
<td>See guideline Burns – Oxandrolone and Propranolol for Managing Post Burn Hypermetabolism for Burns &gt;20% Contact pharmacist for supply as soon as possible – liquid needs 2 – 3 working days to be prepared.</td>
</tr>
<tr>
<td>Enoxaparin prophylaxis</td>
<td>Start on day 1 for all patients after major debridement (check with surgical consultant). Must be part of post-theatre hand-over as to when to re-start**</td>
<td>See guideline Low Molecular Weight Heparin (LMWH) Therapy in Children and Neonates Monitoring of Anti Xa levels are NOT required.</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>Prophylactic antibiotics not used (particularly in inhalation injury). Peri-operative antibiotics at discretion of surgical consultant. Part of post-theatre handover**</td>
<td>See guideline Burns (Paediatric) : Toxic Shock Syndrome &amp; sepsis</td>
</tr>
<tr>
<td>IV Immunoglobulin</td>
<td>Sometimes indicated for toxic shock, although FFP is more commonly used.</td>
<td>See guideline Burns (Paediatric) : Toxic Shock Syndrome &amp; sepsis For obtaining IVIG contact the pharmacist. See guideline: HUMAN INTRAVENOUS IMMUNOGLOBULIN (PRIVIGEN 100MG/ML®)</td>
</tr>
<tr>
<td>Nebulised therapies</td>
<td>Used for inhalation injury.</td>
<td>Nebulised Heparin 5000 units diluted with 3mls 0.9% sodium chloride 4 hourly for 5 – 7 days (monitor daily and discontinue if APPT &gt;1.5) Nebulised 20% acetylcysteine solution, 3mls every 4 hours (may be irritant to airway and should be discontinued if bronchospasm develops). Alternate medication so patients receive 2 hourly treatments. Nebulised salbutamol 2.5-5 mg hourly if wheeze present.</td>
</tr>
<tr>
<td>Seravit</td>
<td>Please discuss with dietician</td>
<td></td>
</tr>
<tr>
<td>Peditrace/Additrace</td>
<td>Used to optimise vitamin intake and therefore healing in burns patients. Under 40kg: IV Peditrace 1ml/kg (max 15ml/day) in 100ml 5% glucose over 8 hours</td>
<td></td>
</tr>
</tbody>
</table>
As a regional burns centre, we deal with all sizes and depths of skin injury. Most of these will be secondary to major burns such as significant scald injuries or flame burns, but we also manage skin loss conditions such as Toxic Epidermal Necrolysis Syndrome (TENS). The latter group are managed by the guidelines or our dedicated skin loss protocol, but they present with many of the issues of a major burn.

At a fundamental level, major burn injuries present with loss of the barrier function of the skin and a mass of dead tissue that excites an inflammatory reaction. Combined, these factors increase the risk of infection, suppress the immune system, permit the loss of fluid and electrolytes from the skin, and engender a significant inflammatory drive that can affect every organ system. The correction of the skin derangement should lead to gradual improvement in systemic health.

At the core of modern burn surgery is the assessment of the depth and extent of the injury. As discussed elsewhere, the extent of the burn injury (percentage of total body surface area) will dictate the amount of fluid that is necessary to maintain adequate perfusion of tissues in the face of early leakage from the intravascular space and also, the likely metabolic needs in terms of nutritional supplementation. The depth of burn injury will dictate the need for surgery. Burns that progress beyond the upper part of the dermis of the skin require removal of all dead components as these drive the inflammatory process. Injuries beyond the depth of the upper dermis would otherwise take an unduly long time to heal by secondary intention and as a result, are associated with excessive scarring.

Consequently, modern, acute burns surgery pivots on the initial assessment of injury. The definitive assessment should be done in a dedicated theatre by a burns consultant but much of the preparation for this first surgical assessment is dependent on a first review of the burn within the Emergency Department setting. Preparation of the theatre and patient should entail:

- A full history of events to ensure that there is no ongoing risk to staff, e.g. as a result of residual chemical burn agents. Personal protection equipment is mandatory where any chemical injury is suspected.
- Keeping the patient warm in transit to theatre. Delays in transfer can lead to significant problems with hypothermia and then potentially, later blood loss due to coagulopathy.
- Warming of the theatre for anything other than small, well localised burns to at least 28°C. The thermostat needs to be elevated well in advance of the case as it can take an hour for the ambient temperature to rise adequately. For most cases, background heating can be supplemented by our radiant warmer and the strict application of warmed fluids to cleanse the surface of the burn.
- For burns of resuscitation size, the siting of a urinary catheter, the initiation of fluid resuscitation as per our protocol (see here) and the maintenance of a fluid balance chart.
- For more significant sized burns, the siting of an enteral feeding tube (see nutrition section).
- Baseline blood tests to include FBC, Urea and electrolytes, clotting and LFT’s. Blood should be sent to transfusion. The predicted extent of surgical excision should determine the transfusion...
requirements; small burns may require no more than a ‘group and save’ but larger burns may require a formal cross-match of packed cells and, for extensive burns, an additional request for FFP and/or platelets.

- Documentation of the estimated size of the burn on age-appropriate Lund and Browder charts supplemented with formal photography.

- A full discussion with the patient and relatives about the nature of any surgery, its alternatives, benefits and risks – this should be part of an ongoing consent process and the appropriate consent form (1 – 4) should be completed prior to theatre in all but the exceptionally rare situations of a life or limb saving procedure that necessitates immediate intervention.

- The availability of a dedicated theatre team that are familiar with the set up and process of burns surgery. This improves the efficiency of the case and has a direct effect on the time to completion in theatre.

- The availability of standard burns theatre equipment including, but not limited to: an electric or air dermatome and a range of guard widths for skin harvest; a meshing device to allow split thickness skin expansion; a high pressure fluid infiltration machine for the administration of adrenaline-containing fluids; our electric fluid warming devices; a range of epidermal (e.g. Biobrane® or Suprathel®) or dermal (e.g. Integra™ or Matriderm™) skin substitutes; a kit for keratinocyte lysis and spray (Recell™); a hydrosurgical debridement device (Versajet™); conventional instruments for tangential excision such as a Watson Knife and Gullian Knife; Histacryl glue and a range of sutures for graft application; aqueous iodine and chlorhexidine solutions.

The purpose of the acute burn surgery procedure is to stabilise the patient, assess the depth and extent of the burn, and deal with any devitalised skin. With good evidence, the trend of the last 30 years has been to remove any non-viable skin (deep dermal or full thickness injury) at the earliest opportunity and to seal the breach in the integument, either temporarily or ideally, permanently. Usually, debridement is undertaken surgically and in a staged manner to limit cooling and blood loss through the course of the theatre visit. There are now chemical means (Nexobrid®) to remove non-viable skin and it is hoped that this may form part of our armamentarium in the future. Currently, most debridement procedures entail sharply excising any non-viable tissue (tangential excision) with a Watson Knife to a healthy, bleeding plane. This tissue is often sent for microbiological culture. Tangential excision may be supplemented with the hydrosurgical device. A diathermy devices is used on the residual tissue to limit further blood loss. On limbs, a tourniquet may be used in theatre to allow a bloodless field while excision is undertaken. Throughout the excision procedure there is an ongoing discussion with the anaesthetist as to the physiological status of the patient and sometimes it is necessary to transfuse and warm pro-actively to permit an efficient procedure.

During the first trip to theatre for larger burns, the most emergent problems are prioritised and treated first. This may include: escharotomies to release a tight, constrictive burn to a limb that is limiting blood flow; fasciotomies to release tightness in a muscle compartment; excision and grafting of eyelids to prevent corneal exposure; excision of burn over potential sites of larger vascular access where the patient is predicted to need this for a prolonged duration; the equivalent procedure over the site of a planned tracheostomy. If an inhalation injury is suspected, the patient will be managed in accordance with the guidelines of our inhalation protocol and this may necessitate the siting of an early tracheostomy at the first theatre visit. Vascular lines that were sited in semi-sterile conditions prior to theatre are re-sited.

Where burned skin is clearly a full thickness injury, or close to it (‘deep dermal’), it is removed surgically before it creates a significant inflammatory injury in other body systems. The resulting defect is re-constituted, ideally immediately with a skin graft of the patient’s own skin (‘autograft’) or, if there are issues such as a paucity of donor sites for skin, a temporary dressing such as Biobrane™, allogeneic skin, other conventional dressings (e.g. Jelonet, Adaptic Touch), or a negative pressure dressing. The latter approach necessitates the patient to have further autografting or other reconstructive procedures to close the wound when the situation is more favourable. Typically, the patient returns to theatre every 2 – 3 days for a change of dressing, assessment and if needs be, further grafting. Any donor sites for autogenous skin are covered with a dressing that encourages epithelialization and are not disturbed, typically for 12 – 14 days. The donor site heals from local epidermal regeneration from residual elements.
When burned skin is clearly not deeply injured (‘superficial burn’ or a slightly deeper ‘superficial partial thickness burn’), the skin is cleaned and then left to regenerate naturally from residual epidermal elements. During this time, the area may be covered with a contact dressing such as Biobrane™, Mepilex Ag™, Jelonet™, Adaptic Touch™ or Telfa™. Outer dressings function to absorb exudate, provide an antibacterial milieu and physically pad the area. These may include Acticoat™, betadine-soaked gauze or Kerlix. All the dressings may be kept in place with an outer crepe bandage, Mexfix™ or Hypafix™ adhesive dressings or an elasticated tubular dressing. Again, superficial burns need regular dressing changes and for larger total body surface area injuries, this may necessitate a trip to theatre. Older children may tolerate dressing changes under sedation and analgesia as per our departmental protocol. If a superficial burn is not healed within 2 – 3 weeks, a senior opinion will determine whether healing would best be expedited with debridement and skin grafting.

Some injuries may require a different approach. Evidently small full thickness burns are sometimes treated expectantly with flammazine cream that is showered off on a daily basis before being reapplied. Flammazine™ is also used for ear burns. Facial burns are often treated expectantly in the first instance with antiseptic cleaning and the application of a waterproofing barrier ointment such as paraffin. Perineal burns often necessitate an indwelling catheter if micturition is painful and topical ointment with a retaining outer dressing such as a large nappy. Gluteal and anal burns may require meticulous wound care to ensure that stool does not come into contact with the open wound. Limb burns may require elevation to reduce oedema and splintage to keep the joints in a functional position and limit the tendency to contractures. Such burns benefit from a passive range of movement in theatre with the physiotherapy team.

At the end of the first theatre trip, the patient usually leaves theatre with an operation note that indicates:

- Via a Lund and Browder chart, the total burned area and graphically, the regions within the burn that are: deep dermal/full thickness; superficial/superficial dermal; unburned; debrided; debrided and skin grafted. This should give an index of the extent of injury, the need for continued intervention, and the areas of the body that must be protected if grafts have been applied.
- The fluid management plan.
- The need for any antimicrobial treatment.
- The need for thromboprophylaxis.
- The likely blood deficit and instructions for replacement.
- Instructions for positioning of limbs.
- Analgesic recommendations.
- Instructions for feeding.
- Instructions on nursing including eye care (e.g. application of eye drops), facial toileting, positioning of torso and limbs, sites in which to avoid pressure or shear such as grafted burn, and recommendations for mobilisation.

Postoperative issues

A burns and plastic surgical registrar is always available to review a patient on PICU. If you cannot make contact with them through switchboard and there is an urgent issue, a burns consultant is available through switchboard at all times.

The patient is kept in a warm environment on PICU to blunt the hypermetabolic drive. This is achieved with elevation of the ambient temperature, warming blankets and occasionally, radiant warmers in the room. It is not uncommon for a transient pyrexia a few hours after burn surgery as a result of cleaning the area of injury, but this is self-limiting. A core temperature of 38°C is normal after a significant burn but above 38.9°C – and in combination with other clinical parameters and blood investigations – there may be a concern about overwarming or sepsis. Persistently pyrexia in combination with other features of sepsis should prompt a request for a rapid review by PICU and burn medical staff. A full septic screen should be instituted as per the burn infection protocol until an alternative source of pyrexia is identified.

Signs of local infection should prompt a medical review. For example, cellulitis beyond the level of the dressings should necessitate the reduction of dressings in a good light to permit full assessment. Microbiological advice and occasionally a theatre assessment may be mandated.
Displacement of dressings is not unusual, particularly on the thighs or shoulders. Ideally, the dressing should be re-sited in a sterile manner. If a member of the burn team is not available to give instruction on how to do this, a temporary non-adherent dressing can be applied (e.g. Jelonet or Adaptic Touch), followed by simple gauze padding and an outer crepe bandage.

‘Strike through’ of dressing or equivalent soiling of dressing with exudate, blood or iodine. This must be relayed to the surgical team. Repeated changes of wet dressings may not be recognised as a source of significant fluid loss. Excessive bleeding necessitates a rapid burns team review. As a temporising measure for excessive exudative losses or clear strike through of iodine, outer, wet dressings may be removed and re-padded with a gauze of Gamgee pad followed by a crepe bandage. Adequate analgesia must be administered prior to manipulating the dressing.

High analgesic requirements require input from the PICU team. An indication that increasing pain is isolated to one limb must prompt a rapid medical assessment for excessively tight dressings, compartment syndrome or deep vein thrombosis.

Electrical burns present with a unique set of problems. There can be both early and late complications affecting all body systems. These include arrhythmias, pulmonary compromise, bowel stasis, compartment syndrome, peripheral or cranial nerve palsies and cognitive impairment. In the early stages of significant electrical injury, continuous ECG monitoring may be prudent. If there has been a compartment syndrome, urinary myoglobin may be helpful in diagnosis and serial renal function test may help guide fluid administration.

**Elective burn surgery**

Elective burn surgery rarely requires PICU care post-operatively. Exceptions include major skin resurfacing where extensive skin grafts, with or without artificial dermis, has been applied at a mobile site such as the neck or face. These patients need every effort to be made to prevent hypertension and shear of their grafts and as such, they are occasionally kept intubated, ventilated and sedated for a couple of days until first graft inspection. Equally rarely, a free flap (microvascular tissue transfer) may have been used to cover a site of previous burn injury and in the post-operative phase, these patients require close observation of flap vascularity. There is a flap observation protocol. Such children typically are monitored on HDU.
## APPENDIX 3 – Pre-Theatre Checklist

### PREPARATION CHECKLIST FOR THEATRE TRIP BURNS

**Preparation for going to theatre**  
(1 hour before theatre)  

<table>
<thead>
<tr>
<th>Item</th>
<th>Responsible for Action</th>
<th>Name (Print)</th>
<th>Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre warm patient to 38 degrees</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CXM blood for theatre</td>
<td>PICU registrar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D/W consultant anaesthetian</td>
<td>PICU registrar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete an arterial blood gas check</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure a full set of blood results available</td>
<td>PICU registrar</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nasojejunal feed</strong> in situ check sufficient amount to last through theatre episode &amp; charging cable attached</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nasogastric feed</strong> - This should be switched off</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consent obtained from parents &amp; with the notes</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent face to face with anaesthetic consultant arranged</td>
<td>Anaesthetist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sufficient new lines, insuffion, urinary catheter available and sent with patient</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anaesthetist informed of any drugs due in theatre</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete a surgical care plan</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facilitate the coordination of other surgical specialities</td>
<td>PICU registrar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facilitate the coordination other allied healthcare professionals</td>
<td>PICU registrar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sputum trap with ICE label sent with patient</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Preparation for return from theatre**  
(1 hour pre return from theatre to PICU)  

<table>
<thead>
<tr>
<th>Item</th>
<th>Responsible for Action</th>
<th>Name (Print)</th>
<th>Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ward contacted giving warning of returning patient</td>
<td>Theatre staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room warmed to at least 32 degrees</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consultant anaesthetist to consultant intensivist face to face handover</td>
<td>Consultant team</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PICU/HDU green handover sheet completed and returned along with pink surgical operation note</td>
<td>Anaesthetist &amp; Surgeon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A “NO SUXAMETHONIUM” placed above patients bed</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficult airway trolley within easy access</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure the correct size facemask, guedel airway, ETT, bougie and C mac videolaryngoscope are easily to hand</td>
<td>Nursing staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timing of next dose clexane and paracetamol will be communicated and documented</td>
<td>Surgeon and Anaesthetist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clear plan for next theatre trip agreed and documented</td>
<td>Surgeon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family informed of findings, actions and planned further management</td>
<td>Surgeon &amp; Anaesthetist</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A. Ventilation and Inhalational Injuries

Current evidence suggests that mechanical ventilation of patients with burns, but without inhalational injury, is independently associated with poorer outcomes. This may be associated with a need to provide more intravenous fluid purely to maintain acceptable clinical endpoints in patients who are sedated and ventilated. Patients with facial burns, upper airway thermal trauma, or large burn area should be intubated and ventilated, if required, for transfer to definitive care at the burn service. However, extubation should then occur as early as possible. This should not be postponed because of a need for daily or alternate day surgery. This management will require careful monitoring of ventilator requirements and airway signs in a high care area. If extubation is not possible, consideration should be given to an early tracheostomy and weaning from sedative drugs and positive pressure ventilation.

Inhalational injury can occur in isolation or in combination with a cutaneous burn. The presence of inhalational injury is an independent risk factor for death after burn injury. Inhalational injury should be considered in all those who have been trapped with a fire within an enclosed area.

Pulmonary parenchymal injury: toxins typically cause a local inflammatory response and hypersecretion, which obstructs the airways causing alveolar collapse and hypoxaemia. The gold standard for diagnosis of inhalational injury is by fibre-optic bronchoscopy – although there is no classification system for severity. Clinical differentiation between direct chemical irritation of the lungs and the systemic inflammatory response to the cutaneous injury may also be difficult. Pulmonary parenchymal injury after inhalation is often be delayed and should be anticipated. Treatment is supportive and involves a lung-protective ventilation strategy, regular pulmonary toilet, respiratory physiotherapy, humidified oxygen, nebulised n-acetylcysteine (a powerful mucolytic) and nebulised heparin to decrease fibrin casts after inhalation injury. Early detection of bronchopulmonary injury with bronchoscopy is crucial to improve survival after inhalation injury. Inhalation injury substantially increases mortality and often requires endotracheal intubation. However, as intubation and ventilation will increase the incidence of nosocomial pneumonia, patients with inhalation injury should not be prophylactically intubated, nor should they receive prophylactic antibiotics.

B. Hypermetabolism

Management of the hypermetabolic response include pharmacological and non-pharmacological methods.

Non-pharmacological:
- Early wound excision and closure (see above)
- Early enteral nutritional support
- Environmental support: high ambient temperature and humidity to prevent heat loss

Early enteral feeding is essential in order to maintain calorific input and to protect the integrity of the bowel mucosa. Repeated operative procedures interrupt feeding regimens and early consideration of an NJ tube is important. Overly high calorie feed has been linked to increased mortality. Conversely, failure to meet nutritional requirements impairs wound healing and increases infection risk. Many formulae have been developed but most overestimate calorie requirement. A nutritionist/dietician are key members of the burn care multi-disciplinary team.

An increase in 'normal' core temperature to 38°C, is linked to the hypermetabolic response. Maintaining a warm, humid ambient temperature (28°C and 60% humidity respectively) prevents heat loss and ameliorates the hypermetabolic response by decreasing resting energy expenditure by up to 20%.

Pharmacological methods include beta-blockers and anabolic agents. Propranolol, starting at 1mg/kg, should be titrated to produce a decrease in heart rate by 20%. Propranolol reduces cardiac work, decreases hepatic steatosis, and reduces skeletal muscle catabolism. Oxandrolone, a non-virilising anabolic steroid, improves efficiency of protein synthesis and healing of the burn wound. Please refer to Burns –.
Oxandrolone and Propranolol for Managing Post Burn Hypermetabolism for burns ≥20%. This should be started when enteral feeding is established. Both should be maintained for at least one year after major burn injury.\textsuperscript{10} Burns of more than 20% TBSA result in stress, inflammatory and hypermetabolic responses which can last up to three years. An ebb phase starts immediately after injury with low cardiac output, decreased metabolic rate and impaired glucose tolerance and may present as shock. After three to five days, the flow or hyperdynamic phase occurs, consisting of increased heart rate, blood pressure, temperature and hypermetabolism and is associated with protein catabolism. Management of the hypermetabolic phase requires environmental temperature control, early surgery to remove dead tissue, early enteral feeding and pharmacological treatment.

Research supports the safety and effectiveness of drugs such as propranolol and oxandrolone in ameliorating this hypermetabolic response. Propranolol is a non-selective beta-blocker, and has undergone significant testing in patients with major burns. It has been shown to decrease heart rate, cardiac work, muscle catabolism and resting energy expenditure in children with severe burns.\textsuperscript{72} A more recent systematic review of 10 clinical trials concluded that propranolol was effective and safe for reduction of metabolic rate in patients with burns.\textsuperscript{46,73,74}

Results of smaller studies support a role of oxandrolone (a testosterone analogue) reducing muscle loss and hypermetabolism and increasing bone mineral density and promoting growth in children recovering from burns.\textsuperscript{46,73}

C. Fluid Management

The aim of fluid management is to replace fluid loss through evaporation and re-distribution secondary to the systemic inflammatory response syndrome (SIRS). This requires replacement fluid to ensure organ perfusion but prevention of fluid overload. Maintenance fluid should be prescribed on admission at 80% and converted to NJ feed as soon as is possible (see nutrition section).

Markers of hyper and hypovolaemia include:

- Clinical condition (CRT, HR, MAP)\textsuperscript{1}
- Urine output\textsuperscript{2}
- Base deficit and lactate
- Serum sodium and urea

Note: in children with burns >20% TBSA the heart rate will be elevated. This is therefore a poor marker of hypovolaemia. Children will also be on propranolol which will also affect heart rate utility.

- Urine output in children with burns >20% TBSA will be reduced because of the syndrome of SIADH. Lesser volumes of urine should therefore be expected. If urine output is 0.5mls/kg/hr and all other information is within normal limits (BD <-5, lactate normal, urea normal) this is acceptable.

Signs of Hypovolaemia

- Increased HR;
- Increased CRT (note: this may well be prolonged immediately post-operatively secondary to cytokine release);
- Decreased urine output;
- BD >-5;
- Lactate >2;
- Increased serum urea.

Management:

- Discuss with PIC/HDU consultant.
- Use small fluid bolus (5mls/kg) and re-assess.
• If >2 fluid boluses required within 6 hours, check HB, serum urea and blood gas and d/w surgical and PIC team.

**Signs of Hypervolaemia**

• New oxygen requirement
• Increased work of breathing
• Increased ventilator needs if ventilated
• Hyponatraemia, low serum urea
• Positive fluid balance

**Management:**

• Discuss with PIC consultant and burns surgeon
• Decrease resuscitation fluids by 25%
• Consider small (0.25mg/kg) frusemide and re-assess

**For children with burns >20% fluid management is key to good outcomes and frequent assessment including a formal clinical review (2 hrly minimum for first 48 hours), U&Es and blood gas analysis (6 hourly or more frequent).**


33. https://www.merseyburns.com

34. https://www.nice.org.uk/advice/mib58/chapter/Introduction


36. https://www.nice.org.uk/guidance/MTG2/chapter/1-Recommendations


40. Lund Browder charts


64. Mackie D. Inhalation injury or mechanical ventilation: which is the true killer in burn patients?. Burns 2013;39:1329-1330.
# APPENDIX 5 – RAG Rating

## Levels of Care for In-patient Children Admitted Under the Care of the Neurosurgical, Burns and Plastics and Spinal Medical Teams

**Bristol Royal Hospital for Children**

<table>
<thead>
<tr>
<th>Specialist Ward Care</th>
<th>High Dependency Care</th>
<th>Intensive Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Ward 3B/3B/3J)</td>
<td>(Ward 3EA Surgical HDU)</td>
<td>(PICU)</td>
</tr>
<tr>
<td>Nursing staff: patient ratio = 1:9</td>
<td>Nursing staff: patient ratio = 1:2</td>
<td>Nursing staff: patient ratio = 1:1</td>
</tr>
</tbody>
</table>

### Respiratory
- Established Tracheostomy
- Oxygen via mask or nasal cannula High Flow Support (i.e. Optiflow) at low flow rates up to the following: neonate 6L/min; infant 8L/min; 1-6 yrs 12L/min, >6 yrs 18L/min; and no more than 40% FiO2 (see HDU Care)
- Saturation monitoring
- Nasal Drains(s)
- Nasalised masks (except admixture or continuous – see HDU Care)

### Cardiovascular
- ECG monitoring
- Central venous line in situ
- Fluid bolus <20ml/kg in previous 6 hours

### Neurology
- Oral analgesia
- Oral sedation
- Analgesia via PCA & NCA pumps (in conjunction with pain teams)
- EEG (Video-Telemetry)

### Neurosurgery
- Established EVD
- ICP monitoring in neurologically stable patient with GCS 15
- GCS < 13/15 in neurology/neurosurgery patient under the direction of Senior Nurse/Consultant.
- Hourly neurological observation in stable patient.
- Externalised VP Shunt.

### Burn/Plastic
- Burn with surface area <15% in patient > 1 year of age or <10% in patient <1yr
- Dressing changes under oral sedation
- Skin loss condition <20% surface area if clinically stable
- Free flap post 72 hrs surgery

### Trauma
- Isolated Stable #

### Endocrine
- Unstable / newly diagnosed D1

### Burns/Plastic
- Suspected burn shock syndrome (see guidelines for diagnosis)
- Burns > 15% in 1 yr or > 10% in < 1 yr or any percentage where there is a clinical instability / concern
- Any facial burn where there is concern regarding potential loss of an an “M~20%”
- Skin loss condition >20% or clinically unstable
- Free flap (inc toe to hand) until flap / toe observations reduced to 2 hourly.

### Trauma
- Poly-trauma
- Multiple unstable if’s

### Respiratory
- Newly created tracheostomy after first tube change
- High Flow Support at flow rates up to the following: neonate 6L/min; infant 8L/min; 1-6 yrs 12L/min, >6 yrs 18L/min; and no more than 50% FiO2 (Higher flows may be used with HDU Care agreement)
- Non-invasive BiPAP / CPAP post Scoliosis correction
- Established long-term home ventilation (invasive or non-invasive)
- Pleural drain(s) post Scoliosis correction

### Cardiovascular
- Arterial pressure or Central venous pressure monitoring
- Fluid bolus >20ml/kg in previous 6 hours
- Intraosseous infusion of metaraminol (vasopressin)

### Neurology/Neurosurgery
- Hourly neurological observations for decreased level of consciousness (responds only to voice) GCS 3/4/5/6
- ICP monitoring in neurologically unstable patients/persistent ICP > 20mmHg for > 20mins
- Acute presentation of hydrocephalus / 70kPa VP Shunt / Insertion of new EVD
- Patient who has undergone a major neurological procedure / or has suffered major neurological insult
- Hourly spinal observations until clinically stable
- Continuous intravenous infusion of analgesia (under direction of Pain Team)
- Patient undergoing intravenous infusions of chemotherapy / anti-convulsants

### Burn
- Burns patient / patient with smoke inhalation requiring ventilation or cardio-vascular support

### Neurosurgery
- Requirement for Cerebral Perfusion Pressure monitoring eg. Acute Head Injury

### Neonates
- Continuous intravenous infusions of sedation
- Status epilepticus

**NB: If a child is cared for in an HDU area out-with their specialty e.g. a medical patient on the surgical HDU, the ‘RAG’ rating to be applied must relate to the specialty they are admitted under i.e. Ward 3D RAG rating for a bronchialtic child admitted to Ward 33a**

**BRHC HDU Operational Group: Ward 33 – Nov 2016**

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Version 1.1 Oct 2018 - To Oct 2019
Author(s) Dr Amber Young, Dr Natasha Clarke, Dr Adrian Upex, Burns MDT
Extended until September 2020