Bottom Line Recommendations: Summary of Pediatric Emergency Care Information for Healthcare Providers

Pediatric Thermal Burns

Burns are a leading cause of unintentional injury and death in children, with the vast majority of cases occurring in the home.[1] Regardless of the burn depth or extent, these injuries can have significant long-term functional, aesthetic and psychological consequences for the child.

Pediatric Considerations

- Relatively thinner skin results in deeper burns at any given temperature.
- Larger skin surface area to body mass ratio predisposes to greater fluid and heat loss.
- Larger head to body ratio results in different distribution of Total Body Surface Area (TBSA) calculation compared to adults.
- Smaller and shorter airway results in earlier onset of upper airway obstruction secondary to inhalational burn-related edema.
- Higher metabolic rate causes increased oxygen and glucose demand, respiratory rate and insensible fluid losses.
- Burns without clear explanation or an explanation that does not match the pattern of injury are concerning for maltreatment. Refer to TREKK's Suspected Physical Child Abuse Bottom Line Recommendations. Patterns that may raise concern for an inflicted burn include:
    - Immersion-patterned scald burns (e.g., stocking and/or glove distribution, symmetrically burned buttocks and/or genitals).
    - Patterned contact burns (well-demarcated burns mirroring a hot object (e.g., cigarette, iron, lighter or hair dryer).

Emergency Department Management

Management of associated airway, breathing and/or circulatory emergencies must always be prioritized before wound care of the burn injury. Refer to TREKK's Multisystem Trauma Algorithm for further information.

AIRWAY AND BREATHING

- Assess for stridor, hoarseness and respiratory distress. If black sputum, singed nose hairs or facial swelling are present, prepare all necessary pediatric airway equipment and have a low threshold for early intubation. Direct visualization of the airway can help confirm inhalational injury.
- Administer 100% oxygen if concern for burns resulting from flash or flame in a closed space. Consider co-oximetry testing to assess for carbon monoxide exposure and treat accordingly.
- Administer hydroxocobalamin (Cyanokit™) if concern for cyanide poisoning (e.g., exposure to fire burning plastics, wools, silks and other natural/synthetic polymers).
- Protect the cervical spine with spinal motion restriction if any concern for associated head or neck trauma.
- Elevate the head of the bed to help decrease edema if significant head or neck burns are present.
- If the patient requires intubation, do not trim endotracheal tube length as swelling of face and airway may lead to accidental extubation.
- Widespread full thickness burns to the thorax may require escharotomy to allow for ventilation. Do not attempt this procedure without sufficient experience and/or expert guidance.

CIRCULATION

- Elevate any limbs with significant burns to help decrease edema.
- Check for signs of impaired perfusion and consider the need for escharotomy for circumferential burns to the extremities. Do not attempt this procedure without sufficient experience and/or expert guidance.

FIRST AID

- Remove any restrictive clothing or jewelry as soon as possible before tissue edema worsens.
- If technically feasible, place the affected site under cool running water for 20 minutes as soon as possible after injury. This is beneficial even when there is a delay of up to 3 hours post-injury.
    - If running water is not feasible, apply wet towels or gauze to cool wounds. This is less desirable as the towels/gauze require frequent changing and may contribute to hypothermia if left on too long.
    - NEVER use ice as it may cause secondary tissue injury.

- After cooling, apply plastic cling wrap to burn wounds (avoiding head and neck) to decrease pain and prevent heat loss, water evaporation and contamination.[2] The plastic cling should be applied lengthwise, NOT circumferentially. If plastic wrap is not available, use sterile green towels.
- Provide tetanus booster if last tetanus immunization was more than 5 years prior or is unknown.

PAIN MANAGEMENT

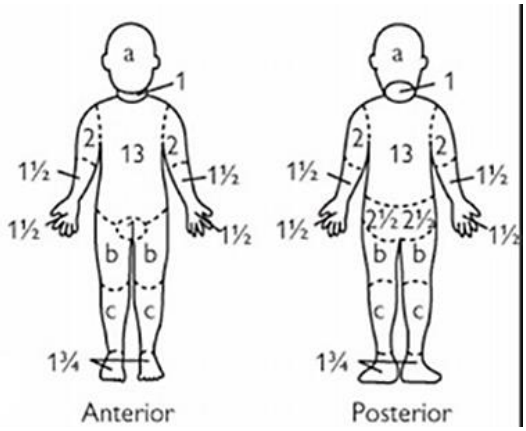
- Refer to TREKK's Pain Treatment Bottom Line Recommendations.
- Use a validated pain scale to monitor effectiveness of analgesia (e.g., FLACC, FPS-Revised).
- Use acetaminophen and/or ibuprofen for mild pain. Moderate to severe pain will require stronger analgesia (e.g., fentanyl IN/IV).
- Use distraction techniques and procedural sedation to facilitate wound care.
- Use procedural sedation for any burn debridement expected to cause moderate to severe pain. Refer to TREKK's Procedural Sedation Bottom Line Recommendations.

HYPOTHERMIA

- Monitor body temperature closely and keep the treatment room warm.
- Keep the child warm using blankets and avoid repeated exposure of the burn wounds.

MEASURING TOTAL BODY SURFACE AREA OF THE BURN

- Use Lund-Browder burn diagram below to more accurately calculate the TBSA affected.
- Alternatively, the size of a child's palmar surface (including fingers) represents approximately 1% TBSA.
- DO NOT include areas of skin with erythema only (e.g., superficial epidermal/1st degree burns) to the TBSA calculation.



Relative percentage of body surface area (% BSA) affected by growth

	Age				
Body Part	0 yr	1 yr	5 yr	10 yr	15 yr
a = ½ of head	9½	8½	6½	5½	4½
b = ½ of 1 thigh	2¾	3¼	4	4¼	2½
c = ½ of 1 lower leg	2½	2½	2¾	3	3¼

FLUID MANAGEMENT

- Use warmed Ringer's Lactate for fluid resuscitation to help prevent hyperchloremic metabolic acidosis and hypothermia. Avoid fluid boluses. Under or over fluid resuscitation can cause increased morbidity due to burn wound progression, acute respiratory distress syndrome and/or compartment syndrome.
- Use the **Parkland/Modified Brooke Formula** to estimate the fluid requirements for the first 24 hours for burn wounds **> 15% TBSA**. Refer to Burn Fluid Resuscitation ABA 2023 Recommendations
    - ≤12 years of age: 3 mL/kg body weight/%TBSA
    - ≥13 years of age: 2 mL/kg body weight/% TBSA
- Give this total fluid volume over 24 hours, with half of this volume given over the first 8 hours after injury and the second half given over the next 16 hours.
- For children aged 12 years and younger, or those at risk of hypoglycemia, a dextrose-containing fluid (e.g., D5RL) should be added to the Parkland/Modified Brooke Formula fluid estimate above as maintenance using the 4:2:1 rule.
- Adjust further fluid resuscitation based on perfusion including mentation, pulses, capillary refill, urine output and venous blood gas/pH.
    - Target urine output: ≤30 kg body weight: **1 mL/kg/hr**
      >30 kg body weight: **0.5 mL/kg/hr**

Fluid Management Example: 6 year old, 24 kg, 50% TBSA burn:

1. 3 mL x 24 kg x 50% TBSA = 3600 mL Ringer's Lactate (RL) resuscitation IV fluid required in first 24 hours. Give 1800 mL in first 8 hours at 225 mL/hr, followed by remaining 1800 mL at 112 mL/hr over next 16 hours.
2. For children ≤12 years, add D5RL maintenance IV fluid using 4:2:1 rule. For 24 kg child = 64 mL/hr D5RL in addition to RL resuscitation fluid in Step 1 (e.g., 225 mL/hr RL + 64 mL/hr D5RL in first 8 hours, 112 mL/hr RL + 64 mL/hr D5RL in next 16 hours).
3. Adjust RL rate to target urine output of 24 mL/hr (1 mL/kg/hr for child ≤30 kg).

WOUND DEBRIDEMENT

- Use sterile water-soaked 4x4 gauze pads to gently wipe/scrub the wound.
- Evidence regarding blister management is limited.[3] We recommend de-roofing and debriding any large blisters and/or those overlying joints. Thick blisters on the palms/soles may be left intact if the child can still make a fist/walk.

BURN DRESSINGS

- Use topical antimicrobial ointment (e.g., Polysporin®, Bacitracin) for small superficial burn wounds. Discontinue use within 1 week to avoid sensitivity reactions (rash).
- Clean facial burns with soap and water. Apply petroleum-based ointment (e.g., Vaseline™) twice daily.
- Whenever possible, apply long-term dressings (e.g., Mepitel®, Adaptic™ silicone, UrgoTul™ Ag, Durafiber™ Ag, Aquacel® Ag, Silvercel™) after wound cleaning and debridement. Alternatively, apply petroleum-based non-stick gauze however this option requires dressing changes every 2-3 days. For patients needing outpatient follow-up at Pediatric Referral/Burn Center, discuss preferred dressing choice with Burn Specialist.
- Avoid using silver sulfadiazine (e.g., Flamazine™, Silvadene™) due to impaired re-epithelization[4] and higher rates of infection.
- Large burn wounds that require emergent transfer to Pediatric Referral/Burn Centre should remain dressed with plastic wrap or sterile green towels. Definitive dressings will be applied at the Burn Center.

Disposition

- Discharge patient home if no Burn Centre referral criteria are met (see below), there are no concerns for maltreatment, burn dressings have been applied, pain is well controlled and discharge instructions regarding pain management at home, care of dressings and outpatient follow-up plans have been explained.
- Transfer to Pediatric Referral/Burn Centre if patient meets any of the following:
  - Full thickness/ 3rd degree burns
  - Partial thickness burns ≥ 10% TBSA
  - Circumferential burns
  - Concomitant trauma in which the burn injury poses the greatest risk of morbidity and mortality
  - All chemical injuries
  - All high voltage (≥1000V) electrical injuries including lighting injury
  - Inhalation injury and partial and/or full thickness burns ≥5% TBSA
  - Deep partial or full thickness burns involving the face, hands, genitalia, feet, perineum, or over any joints
  - Pre-existing medical disorders that could complicate burn management, prolong recovery or affect mortality
  - Concern for burn management challenges due to pain, dressings, rehabilitation, patient/caregiver needs, or concern for child maltreatment

Scan or click the QR code to learn more and to see a full list of references and development team members