

Consensus Statement

Clinical Practice Guideline for Burn Injuries

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EVIDENCE CONSIDERED IN REACHING THE CONSENSUS STATEMENT:

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PREAMBLE:

This consensus statement summarizes recommendations for the care of trauma patients who have suffered a burn injury either as an isolated injury or as part of a complex of injuries. Recommendations are based on current best practice and is adapted from medical literature. It is recognized that the geography, population, and availability of specialized services in New Brunswick provide a unique context to be considered in any overall recommendations for the care of burn patients.

SCOPE:

The statement outlines the preferred guidance for adult and pediatric patients who have experienced a major burn injury which includes:

- Prehospital guidance
- Emergency/resuscitative care
- Transfer criteria
- Destination guidance
- Initial burn care including those that do not require admission but may require specialist referral

Surgical burn management, intensive care management and radiation burns are outside the scope of this document.

BACKGROUND:

1. A burn injury occurs "...when some or all of the cells in the skin or other tissues are destroyed by heat, electrical discharge, friction, chemicals, or radiation. Burns are acute wounds caused by an isolated, non-recurring insult, and healing ideally progresses rapidly through an orderly series of steps".
2. Advanced Trauma Life Support (ATLS) principles will guide the initial assessment and resuscitation of the burn injured patient using the mnemonic ABCDE in a systematic approach.
3. Burn injury distinguishes itself from all other trauma by its unprecedented inflammatory response during the initial 24-48 hours. Myocardial depression and increased capillary permeability result in rapid and extensive fluid shifts and the depletion of intravascular volume.
4. It is of critical importance to trigger early activation of the Toll-Free Trauma Referral System in all patients assessed as having a major burn or other NBTP approved criteria for potential burn transfer (refer to page 9). When required, assistance in determining total body surface area (TBSA), fluid resuscitation parameters and evaluation of correct pathway to specialized burn care management may be initiated.
5. Burn injuries are less frequent than other forms of trauma, however burns can have life altering consequences for both the injured person and the family. Initial clinical interventions in burn care are linked to patient outcomes. Supporting clinicians in the management of traumatic burn injury is essential. Evidence demonstrates that the early emergency care received by the major burn patient has a significant impact on morbidity and mortality. Guidance for pre-hospital personnel and rural trauma teams frequently involved in the early care of burn injury is essential as they are a key part of the burns team.
6. Early detection and adequate management of inhalation-related injury is important. Inhalation injuries occur in approximately one-third of major burn injuries and are related to significant morbidity and mortality. Airway protection in patients at risk of upper airway obstruction is critical.
7. Breathing may be compromised due to hypoxia, carbon monoxide poisoning, smoke inhalation injury, circumferential full thickness burn eschar or thoracic trauma not related to the burn.

8. Accurate assessment of the circumstances and cause of the burn, burn size and depth and timely and appropriate intervention is crucial to the early care of the burn injured patient.
9. Severe pediatric burn injuries have a higher mortality than a similar burn in a nonelderly adult. Physiological and psychological differences in the pediatric population require the clinician to understand the differences in the management of the burn injury.
10. The complex pathophysiology of severe burns necessitates specialized care by multidisciplinary medical and surgical teams. Referral to specialized burn care is imperative in major burn trauma.
11. Early and appropriate fluid resuscitation is essential to acute burn management and is aimed at avoiding burn shock. Second and third-degree burns involving >20% TBSA in adults and >15% in children require dedicated burn shock fluid resuscitation. Mortality is increased if resuscitation is delayed greater than 2 hours following a burn injury.
12. Over and under fluid resuscitation must be avoided as they have been determined to impact morbidity and mortality.
13. Hypothermia can have detrimental effects on any trauma patient. Normothermia has been shown to improve survival.
14. Assessment and management of pain in the burn injured patient is important and requires appropriate and judicious treatment.

RECOMMENDATIONS:

AIRWAY MAINTENANCE WITH RESTRICTION OF CERVICAL SPINE MOTION

- Airway assessment is a critical first step in assessing the burn patient.
- Advanced airway management may be required for those who present with acute respiratory distress.
- In the absence of acute respiratory distress early consultation with the Trauma Control Physician (TCP) for any of the following is recommended prior to intubation:
 - **Respiratory distress**
 - **Stridor**
 - **Accessory muscle use**
 - **Extensive and deep facial burns**
 - **Upper airway trauma**
 - **Altered mentation**
 - **Hypoxia/hypercarbia**
 - **Hemodynamic instability**
 - **Inability to clear secretions or respiratory fatigue**
 - **Suspected inhalation injury, history of being burned in an enclosed space**
 - **Swelling on laryngoscopy**

BREATHING & VENTILATION

- The administration of oxygen at 15L/min via non-rebreather mask is recommended at first point of care.
- The continued assessment and monitoring of breathing includes:
 - Auscultation of bilateral breath sounds.
 - Monitoring respiratory rate, rhythm and depth.
 - Circumferential chest or neck burns and /or chest trauma may compromise airway and oxygenation.
 - The application of pulse oximeter-Caution must be exercised when interpreting oxygenation in the patient with potential carbon monoxide poisoning.
 - High index of suspicion for carbon monoxide exposure for persons burned in an enclosed area.

CIRCULATION WITH HEMORRHAGE CONTROL

Current American Burn Life Support (ABLS) guidelines provide revised resuscitation formulas. Initial fluid management for all major burns based on age along with reduced fluid volumes at time of secondary survey are notable changes.

- Total Body Surface Area burn percentage is determined by adding up only those body areas with 2nd and 3rd degree burn.
- Adults with >20% and children with >15% TBSA burn require burn fluid resuscitation.
- Two large bore peripheral IV access sites are recommended; peripheral access through burned skin is acceptable if needed to achieve IV access.
- Intraosseous (IO) or central line insertion is recommended if unable to obtain peripheral intravenous access.
- Lactated Ringer's (warmed) is the preferred crystalloid used in the initial fluid resuscitation.
- Refer to local hospital policy if administering blood or blood products for other injuries sustained.
- A urinary catheter is required to monitor the effectiveness of fluid resuscitation.
- Over and under resuscitation must be avoided by the continuous assessment of the hourly urine output and other physiologic parameters such as heart rate and blood pressure.

INITIAL FLUID RATE AS A STARTING POINT

Based on the patient's age and prior to calculating the exact TBSA, following are the pre-hospital and early emergency care initial fluid rate for major burns (>15-20% as above).

AGE	FLUID RATE
≤ 5 years of age	125 mL Lactated Ringers (LR) per hour
6-13 years old	250 mL LR per hour
14 years and older	500 mL LR per hour

ADJUSTED FLUID RATE

- During the secondary survey, the patient's weight in kg is confirmed and the TBSA burn is determined. The ABLIS 2015 Fluid Resuscitation Calculations are used to calculate the ADJUSTED FLUID RATE.

Adult thermal & chemical burns	<i>2 mL LR x patient's body weight in kg x % second and third-degree burns, with half of the 24-hour total (mL) infused over the first 8 hours post burn.</i>
Pediatric (13 years & under)	<i>3 mL LR x patient's body weight in kg x % second and third-degree burns, with half of the 24-hour total (mL) infused over the first 8-hour post burn.</i>
Adults with electrical injury	<i>4 mL LR x patient's body weight in kg x % second and third-degree burns, with half of the 24-hour total (mL) infused over the first 8-hour post burn.</i>
Pediatric patient with electrical injury	<i>4 mL LR x patient's body weight in kg x % second and third-degree burns, with half of the 24-hour total (mL) infused over the first 8-hour post burn.</i>

PEDIATRIC MAINTENANCE FLUID RATES (≤30 kg)

- Blood glucose should be closely monitored due to limited glycogen stores in young children.
- Children ≤30 kg require maintenance fluids in addition to resuscitation fluid.** The fluid of choice is D5W Lactated Ringers or D5W-Normal Saline if necessary and is calculated and infused using the "4-2-1" formula.

4-2-1 Formula
4 mL/kg per hour for the 1st 10 kg body weight
+ 2 mL/kg per hour for the 2nd 10kg body weight
+ 1 mL/kg per hour for each additional kg over 20 kilograms

MONITORING OF URINE OUTPUT

Urinary output parameters: urine volumes less than or greater than these parameters require adjustments in fluid resuscitation rates. Consultation recommended with TCP.

Age/weight	Hourly urine output
Adult	30-50 mL/hour
Children > 30kg	0.5mL/kg/hour up to maximum of 50mL/hr
Child ≤ 30kg	1 mL/kg/hour
Adults & Children > 30kg – electrical injury with myoglobinuria	75-100mL/hour until urine clears
Children ≤ 30 kg – electrical injury with myoglobinuria	1-1.5 mL/kg/hour until urine clears

BURN SIZE ESTIMATION

- Accurate TBSA calculation only occurs in the Secondary Survey and is not needed in the initial fluid management of major burns.
- Accurate TBSA calculation can be difficult in the early burn setting even for experienced providers. Digital photo documentation and consultation with a burn care provider through the Toll-Free Trauma Referral System will facilitate TBSA calculation and communication with team members.

To estimate size of the body surface area burned there are three methods widely accepted and used:

- **Rule of Nines:** Calculated based on partial and full thickness burn areas. The adult body is divided into anatomical surface areas of 9% or multiples of 9%. Refer to Appendix A.
- **Lund-Browder Chart:** Provides more accurate method of burn size calculation and is the preferred method of calculation for the pediatric patient. Refer to Appendix B & C.
- **Palmar method:** uses palmar surface of the patients' **palm and fingers** which represents 1% of the TBSA burned. This method is preferred when calculating patchy and non-continuous burn areas. Refer to Appendix D.

DISABILITY (NEUROLOGIC EVALUATION)

- Establish level of consciousness and assess pupillary response.
- Examination of the cornea should be completed with facial burns.
- Isolated burn trauma does not affect mentation or level of consciousness. It is prudent to suspect other issues such as head injury, inhalation injury, hemorrhage, toxic ingestion, etc. when altered mentation is present.

EXPOSURE AND ENVIRONMENTAL CONTROL

- **Stop the burning process!**
- Remove all clothing, shoes, diaper, jewelry and body piercing(s).
- Contact lenses should be removed with or without facial burns before the onset of facial and periorbital edema.
- Active rewarming is recommended for all moderate to severe burn injuries.
- Infuse warmed fluids (Lactated Ringers).
- Apply Bair Hugger or warm blankets.
- Complete baseline trauma bloodwork and carboxyhemoglobin
- Maintenance of normothermia is more important than dressing application in the acute phase of care.
- There is no role for dressing application in the ED prior to consultation with a burn care provider.

UNIQUE BURN INJURIES-SPECIAL CONSIDERATIONS

Electrical injuries

- Determine type of electricity: High voltage ≥ 1000 V or low voltage < 1000 V and direct or alternating current (DC or AC).
- Remain vigilant for associated injuries with high voltage contact – the tetanic contraction of muscles or an unprotected fall (even from standing height) is sufficient to produce bony fracture including C-spine.
- At risk for cardiac arrhythmias - 12 Lead ECG and 24 hr cardiac monitoring is indicated (high voltage).
- Internal damage exceeds that seen from contact points on the skin – muscle swelling and breakdown may cause compartment syndrome and rhabdomyolysis – increase frequency of compartment checks and follow increased urine output guidelines.

Chemical Burns

- Personal protective equipment is essential prior to contact with patient.
- Remove all clothing, footwear and jewelry.
- Brush all powdered chemical from skin and initiate continuous irrigation with water.
- Large body surface area-avoid hypothermia use warm water and keep environment warm.
- Identify causative agent via Poison Control centre (1-902-470-8161) or Safety Data Sheets to identify any potential toxicities after initial intervention has begun.

Cold Injuries

- Transport to safe environment before attempts at rewarming are initiated as partial rewarming and refreezing can be harmful.
- Remove damp clothing and apply warm blankets.
- Provide hot fluids by mouth if patient alert and able to drink—no contraindications/other injuries.
- Affected areas are rewarmed by immersion in gently circulating water at a constant 40-42°C for 15-30 minutes.
- If no circulating water baths available- place limb in clean bucket with warm water running in.
- Fingers may be immersed in sterile bowl in hand washing sink with warm running water with cooled water allowed to trickle out.
- Feet/ legs: if patient able and accompanied - a shower stall with warm running water.
- Do not rub or massage areas. Excessive dry heat can cause a burn injury.
- The extremity should be elevated once rewarmed.
- Rewarming can be very painful- assess and provide adequate analgesia. Oral Ibuprofen may be used and may limit injury by blocking prostaglandin production.

Tar and Asphalt burn

- Irrigate with cool water until product is completely cooled – *Attention:* this differs from guidance for other causes of burn.
- After cooling, next goal is to emulsify the tar with petrolatum based ointment (e.g. Vaseline or Polysporin).
- DO NOT peel tar off – emulsification for tar removal often requires several days.
- Underlying burn is often deep due to the initial temperatures – follow consultation criteria and be suspicious of likely deep burn hidden by the tar product.

CONSULTATION CRITERIA

Burn injured patients should be assessed by the local plastics service if present or available. Consultation through the Toll-Free Trauma Referral System is recommended for the following:

- Partial-thickness burns (second degree) > 10% TBSA
- Critical anatomic area burns: face, hands, feet, genitalia, perineum or major joints
- Third degree burns any age group
- Inhalation injury
- Electrical including lightening injury
- Chemical burns
- Pediatric patient with any significant burn
- Burn injury in patients with pre-existing medical diagnoses/illnesses that could complicate management, prolong recovery, or affect mortality (e.g. diabetes, renal failure)
- Burns and concomitant trauma in which the burn poses the greatest risk of morbidity and mortality
- Burn injury in patients who will require special social, emotional, or rehabilitative care
- Suspected non-accidental injury

BURN CARE CAPACITY:

- **Level 1 & Level 2:** Consult with Plastic Surgeon on call. If transfer may be required, contact Toll Free Trauma Line.
- **Level 3:** When on call, the local Plastics service should be consulted upon initial assessment.
- Early contact with the Toll-Free Trauma Line is encouraged when it is determined the facility's capacity for care is exceeded or when local plastic surgeon is not on call.
- **Level 5:** facilities are strongly encouraged to contact the Toll-Free Trauma Line in patients assessed as having any of the previously noted criteria.
- The TCP will determine the most appropriate destination for pediatric patients. Pediatric patients whose care exceeds that available in New Brunswick will be transferred to the IWK.

FIELD TRAUMA TRIAGE GUIDELINES (FTTG):

- FTTG should continue to reflect preferential transport to Level III, II and I designated centres for burn trauma.

COMMUNICATION:

- Advice shared between emergency physicians, consulting plastic surgeons, and other consulting physician specialist should be documented and readily available to health care providers within the patient's circle of care.

- **Digital images:** the secure transfer of digital images that facilitates the sharing of information on degree, depth and complexity of the burn injury with the TCP and/or plastic surgeon is an important component of contemporary burn care management and is strongly advised.

PAIN MANAGEMENT

- Ongoing pain assessment is essential to the management of the major burn patient.
- When needed, opiate pain control is delivered via the intravenous route in major burns. Small increments of **intravenous** analgesics should be initiated as early as possible.
- Intubated patients who require frequent dosing- consider infusion to provide consistent pain relief.
- Opiate IM injections **should not be** given in burns > 10% TBSA due to peripheral shutdown which will delay drug absorption and impede effective pain relief. IV or IO administration is recommended.
- The Richmond Agitation Sedation Scale (RASS) may also serve to guide analgesic/sedation to avoid unnecessary over sedation.
- Anxiety may increase the perception of pain; use of anxiolytics may be beneficial but should be used judiciously and only after the completion of the secondary survey and discussion with the TCP or plastic surgeon.
- Oral analgesia may be administered to patients with superficial burns (i.e. sunburn).
- In patients being discharged with follow up on an outpatient basis, provide pain management advice.

WOUND CARE MANAGEMENT

- Cooling a burn using tap water up to 30 minutes for burns $\leq 5\%$ TBSA is acceptable.
- The risk of hypothermia and delay in transfer for a larger burn outweighs any benefit and is not recommended and may increase patient mortality.
- Prior to transfer the patient must be kept warm and dry. Cover with dry sterile sheets (e.g. Medline sterile $\frac{3}{4}$ drape) otherwise, use clean dry sheets and rewarm in accordance with exposure/environment recommendations.
- Patients being transferred for definitive care **should not** have any ointments or creams applied.
- Burn injuries are considered tetanus prone-tetanus prophylaxis should be provided when applicable.
- There are no indications for prophylactic antibiotics in burns.
- Burn care and appropriate dressing for burn patients not meeting criteria for transfer and able to be discharged and consulted by plastics later should be guided by local plastics or consulting plastic surgeon via the Toll-Free Trauma Referral System.

CLINICAL MANAGEMENT ISSUES

- A major burn may present practical clinical management issues rarely encountered otherwise. Examples of this include securing critical lines or endotracheal tube in the presence of surrounding burned tissue.
- In all cases, securing these lines and tubes takes precedence over dressings to the surrounding skin.
- In the case of the endotracheal tube, trach ties are acceptable even with burned facial skin.
- With respect to peripheral and central lines through burned tissue (only when necessary), it is prudent to suture secure these as standard taping and adhesives are often ineffective on burned tissue, particularly if wet.
- Standard sterile technique and precautions are appropriate as with any patient. No special barriers need to be placed between facial skin and a non-rebreather mask in the acute phase of management.

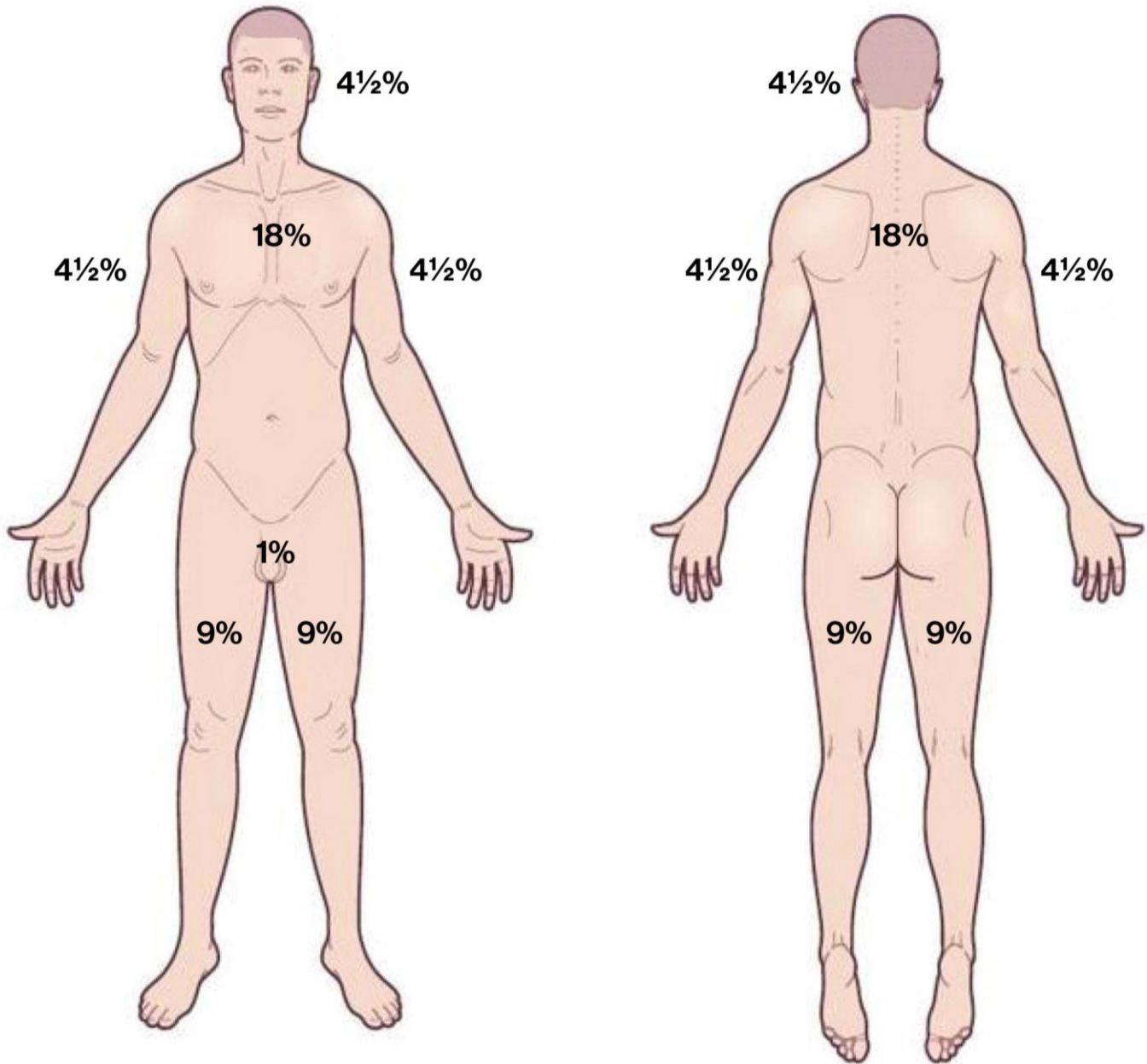
GRADE LEVEL OF EVIDENCE:

Grade B Practice Recommendations

Generally, clinicians should follow a recommendation but should remain alert to new information and sensitive to patient preferences.

Appendix A

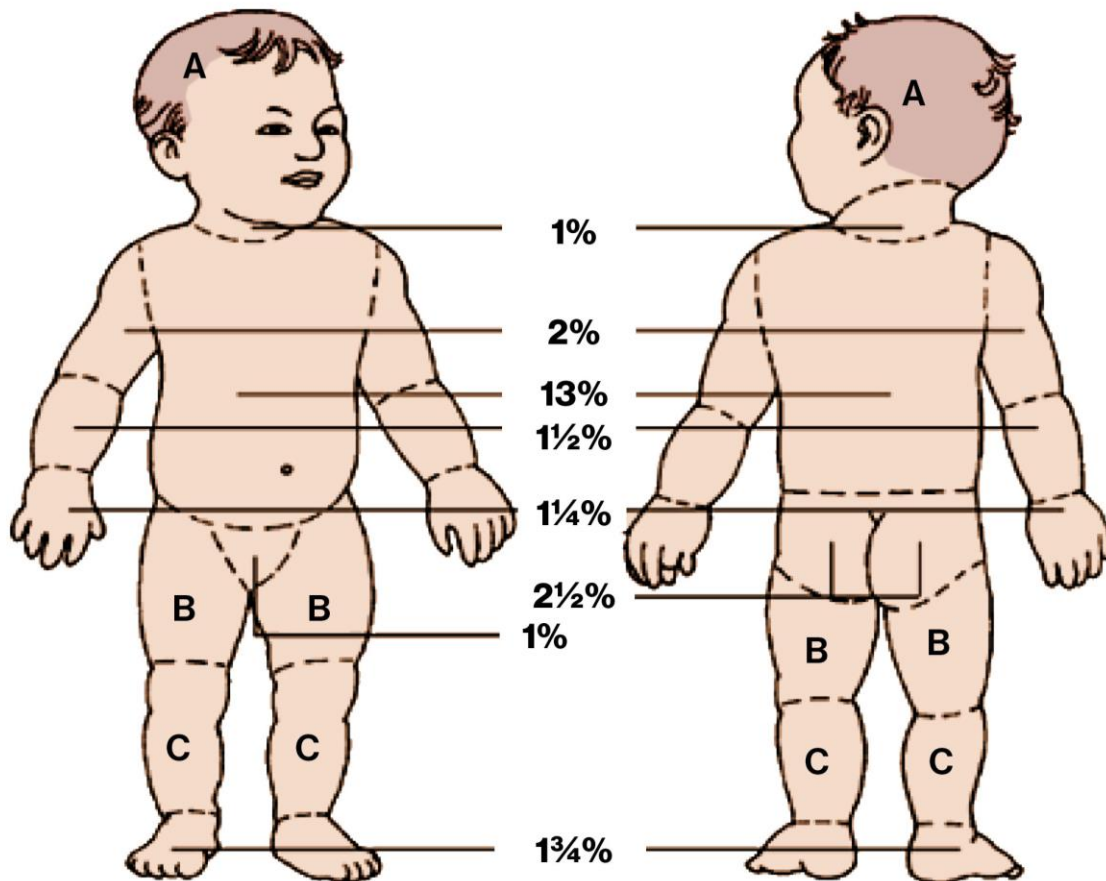
RULE OF NINES (Adults)



Appendix B

Lund & Browder Chart

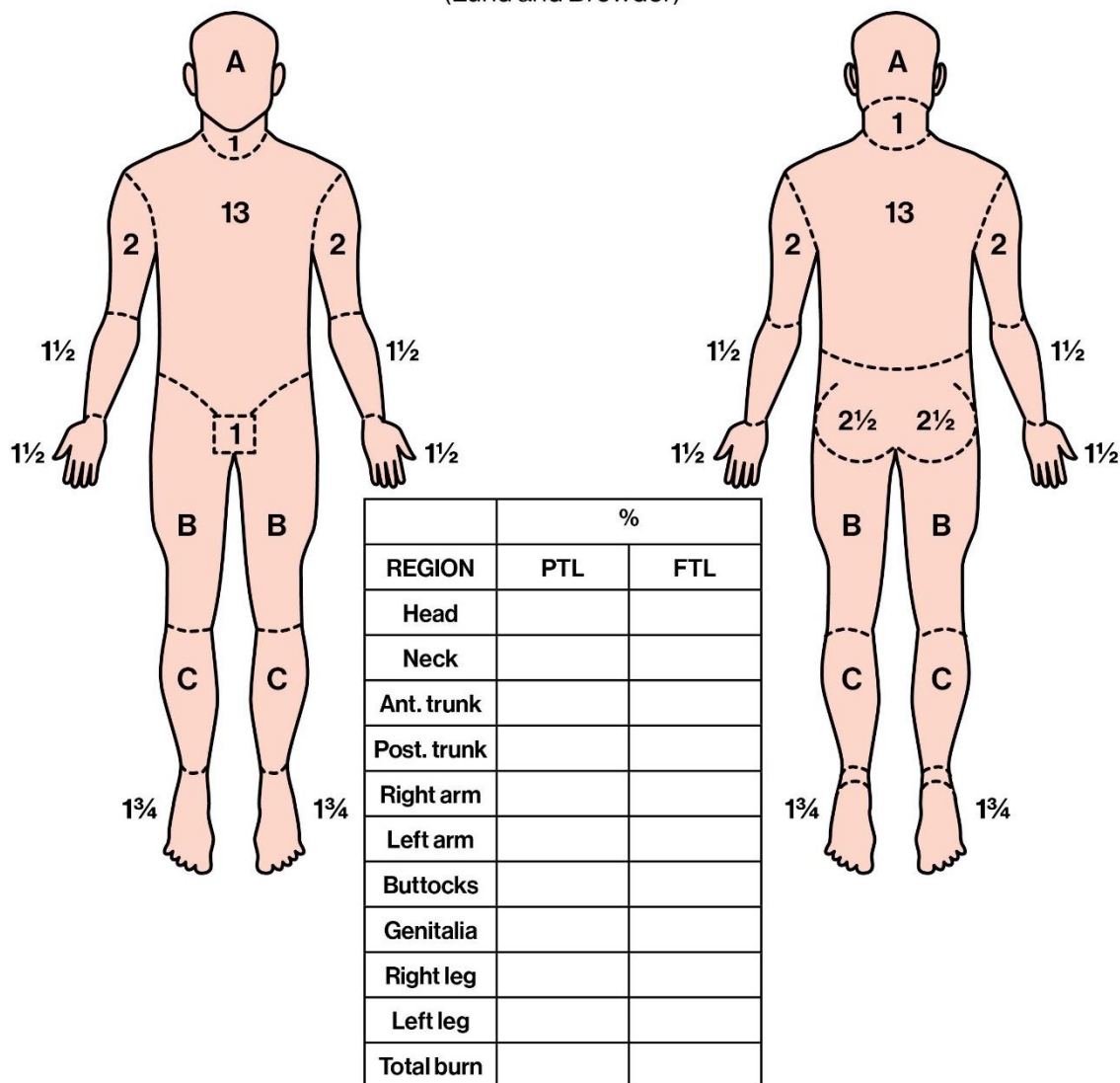
To determine the extent of an infant's or child's burns, use the Lund and Browder Chart shown here.



RELATIVE PERCENTAGES OF AREAS AFFECTED BY GROWTH

	AT BIRTH	0 TO 1 YR	1 TO 4 YR	5 TO 9 YR	10 TO 15 YR	ADULT
A: Half of head	9½%	8½%	6½%	5½%	4½%	3½%
B: Half of thigh	2¾%	3¼%	4%	4¼%	4½%	4¾%
C: Half of leg	2½%	2½%	2¾%	3%	3¼%	3½%

Appendix C **Lund & Browder Chart** **% Total Body Surface Area Burn** Be clear and accurate, and do not include erythema (Lund and Browder)



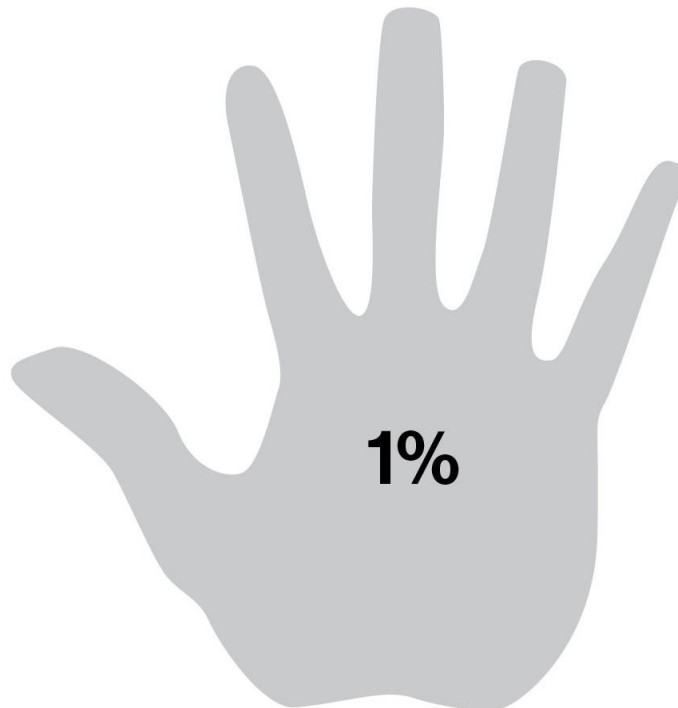
AREA	AT BIRTH	0 TO 1 YR	1 TO 4 YR	5 TO 9 YR	10 TO 15 YR	ADULT
A = 1/2 HALF OF HEAD	9 1/2%	8 1/2%	6 1/2%	5 1/2%	4 1/2%	3 1/2%
B = 1/2 HALF OF ONE THIGH	2 3/4%	3 1/4%	4%	4 1/4%	4 1/2%	4 3/4%
C = 1/2 HALF OF LEG	2 1/2%	2 1/2%	2 3/4%	3%	3 1/4%	3 1/2%

Appendix D

PALMAR METHOD ESTIMATE IRREGULARLY SCATTERED BURNS

PALM & FINGERS=1%

PALMAR METHOD FOR BURN SIZE CALCULATION



IMPLEMENTATION PLAN:

- To be determined