

Trauma Clinical Guideline Major Burn Resuscitation

The Trauma Medical Directors and Program Managers Workgroup is an open forum for designated trauma services in Washington State to share ideas and concerns about providing trauma care. The workgroup meets regularly to encourage communication among services, and to share best practices and information to improve quality of care. On occasion, at the request of the Emergency Medical Services and Trauma Care Steering Committee, the group discusses the value of specific clinical management guidelines for trauma care.

The Washington State Department of Health distributes this guideline on behalf of the Emergency Medical Services and Trauma Care Steering Committee to assist trauma care services with developing their trauma patient care guidelines. Toward this goal, the workgroup has categorized the type of guideline, the sponsoring organization, how it was developed, and whether it has been tested or validated. The intent of this information is to assist physicians in evaluating the content of this guideline and its potential benefits for their practice or any particular patient.

The Department of Health does not mandate the use of this guideline. The department recognizes the varying resources of different services, and approaches that work for one trauma service may not be suitable for others. The decision to use this guideline depends on the independent medical judgment of the physician. We recommend trauma services and physicians who choose to use this guideline consult with the department regularly for any updates to its content. The department appreciates receiving any information regarding practitioners' experience with this guideline. Please direct comments to 360-236-2874.

This is a trauma assessment and management guideline. It was adapted from professional literature. The workgroup reviewed the guideline, sought input from trauma care physicians throughout Washington State, and used that input to make changes. Both the Emergency Medical Services and Trauma Care Steering Committee and the Department of Health Office of Community Health Systems endorsed the guideline. This guideline has not been tested or validated.

Washington State Department of Health
Office of Community Health Systems
111 Israel Road S.E.
Olympia, WA 98504-7853
Phone 360-236-2800



The Problem

According to the American Burn Association (ABA), in 2015 there were nearly 500,000 burn injuries in the United States requiring medical treatment. Of those, 40,000 required hospitalization, which includes 30,000 admissions to a specialized burn center. The majority of burns (69 percent) occur in the home. The most common mechanisms of injury are from thermal-related causes such as fire or flames, scalding, and contact with hot objects. Most burns occur during cooking. Intoxication is a contributing factor in many instances. Scalding burns account for 90 percent of all burn related injuries in children.

Burn injuries can be significant, and result in lifelong effects for patients and their families. These significant burns result in loss of function, disfigurement, scarring, and psychological-related issues such as post-traumatic stress disorder (PTSD). The care necessary to heal these wounds can be very lengthy and complex, resulting in additional personal and financial burdens for the patient and family. It is estimated that the cost for caring for complex burn-related injuries can reach millions of dollars. The importance of burn injury prevention cannot be overstated.

Many communities do not have a nearby burn center. It is safe to say many patients will receive their initial care in emergency departments (ED) whose personnel may be inexperienced caring for complex burn injuries. Following the recommendations of this guideline can aid in the initial care of the burn patient.

Assessment

Assessing the trauma patient with burn injuries can be very challenging. Burns result from a variety of mechanisms, which can cause more severe underlying injuries. Significant burn injuries can also be very distracting and result in missed injuries upon initial assessment. To ensure injuries are identified appropriately, a systematic approach should be taken when assessing these patients. This systematic approach should follow the advanced trauma life support (ATLS) process, which includes the primary and secondary survey.

The primary assessment should begin with stopping the burning process and ensuring all sources of heat have been removed, which may include clothing and jewelry. If chemicals are present, the area should be brushed off (dry chemical) and then flushed with tepid water. All clothing should be removed to assess injuries, and to facilitate determining the burn severity and total body surface area (TBSA) burned. Once exposed, the patient should be covered with a clean dry sheet. Interventions should be in place to prevent hypothermia.

Airway and breathing should be assessed immediately. Caution should be taken if the patient has signs of inhalation injury and is in respiratory distress. Signs of inhalation injury may include severe burns to the face and neck, carbonaceous sputum, hoarseness, air hunger, and/or history of enclosed space fire. If these symptoms are present the trauma team should provide 100 percent oxygen, control airway, and assess the need for a definitive airway.

Burn injuries less than 15 percent TBSA in children and 20 percent TBSA in adults do not require intravenous (IV) fluids and may be resuscitated with oral hydration. However, burns greater than 15 percent TBSA in children and greater than 20 percent TBSA in adults result in an

inflammatory process with the loss of intravascular fluid into the interstitial space. For that reason it may be necessary to provide IV fluid resuscitation.

Many interventions for burn-related injuries will be based on the mechanism of burn (thermal, chemical, electrical, and radiation), burn severity, TBSA burned, and the circumstances of injury.

Mechanism:

- Thermal
- Chemical
- Electrical
- Radiation

Severity:

- First-degree (superficial partial thickness): Skin is red, dry and painful.
**do not include in TBSA calculation.*
- Second-degree (partial thickness): Skin is red, blistered, weepy, swollen, and painful.
- Third-degree (full thickness): Skin is whitish, brown, charred, with minimal to no pain in burned area.

TBSA:

The TBSA burned is initially calculated using the Rule of Nines ([Figure 1.](#)) which provides a rapid assessment to begin treatment. This rule can be applied to both adults and pediatrics. If burns are scattered in small areas the Rule of Palms ([Figure 2.](#)) may be used, which estimates 1 percent TBSA burned based on the size of the patient's hand, including fingers. If time allows, a more thorough estimate of the burned area can be calculated using the Modified Lund and Browder chart ([Figure 3.](#)).

Circumstances of Injury:

An assessment regarding the circumstances of injury is a vital component to ensure appropriate interventions are in place to promote healing and wellness. The patient's social support network should be assessed to determine available resources during recovery.

Non-accidental trauma (NAT) occurs in approximately 25 percent of admitted burn center pediatric patients. It may be difficult to determine abuse from non-abuse. High-risk intentional burn injuries are from scalds to the buttocks, perineum, bilateral lower extremities, feet, unilateral limbs, multiple contacts burns, and those with clearly demarcated edges. If burn injuries with these characteristics are present in children and vulnerable populations the provider should be suspicious of possible abuse. In some cases where NAT may be the cause of the injury, special interventions and consultations may be required.

Interventions

Initial interventions should be directed toward performing any actions associated with the primary survey (airway, breathing, circulation, disability, and exposure and warmth).

Oxygen should be applied based on the patient's condition. Intubation may be necessary for burns involving the airway and facial area.

Once the TBSA burned is calculated, initial fluid resuscitation should begin. It is vital to perform an accurate assessment and determination of TBSA burned. It is not uncommon for inaccurate TBSA burned estimates to result in over- or under-resuscitation, increasing morbidity and mortality.

Fluid resuscitation requirements should be based on the ABA adjusted fluid rate recommendations as noted in the table below. The IV fluid of choice is lactated ringers (LR) with the addition of dextrose (D5LR) for infants and children under 30 kilograms (KG). Fluid volume and titration rate is based on urinary output and physiological response. Start fluid resuscitation based on the overall calculated fluid volume by infusing half of the total volume in the first eight hours from the time of injury. Infuse the second half over the remaining eight hours (16 hours total) titrating the rate as needed.

Category	Age and weight	Adjusted fluid rate
Flame or scald	Adults and older children (≥14 years old)	2 ml LR x kg x % TBSA
	Children (<14 years old)	3 ml LR x kg x % TBSA
	Infants and young children (≤30kg)	3 ml LR x kg x % TBSA Plus D ₅ LR maintenance rate
Electrical injury	All ages	4 ml LR x kg x % TBSA

The initial total fluid volume is calculated by multiplying 2-4 milliliters (ml) LR by the weight of the patient in kilograms (kg) by the percent of TBSA burned.

Assessment of proper burn fluid resuscitation is based on urinary output. Each burn patient undergoing IV fluid resuscitation should receive a urinary catheter with urimeter. This will allow for precise monitoring of hourly urinary output. Adult urinary output should be 0.5ml/kg/hr and pediatric patients 1ml/kg/hr. If oliguria is present reassess hemodynamic status and check for other injuries. Increase fluid rate with caution and consult with the burn center.

Pain management should be a priority following the initial assessment. IV pain medications in the form of narcotics should be used with caution and given in small frequent doses as opposed to single large doses. Hypovolemic burn patients are at risk of the side effects associated with narcotic medications and should receive frequent monitoring of vital signs.

Wound care other than a dry sheet or blanket is usually unnecessary if the patient is transported within 12 hours of injury. If there is a transport delay, it may be necessary to apply a thin layer of silver sulfadiazine to open areas and cover them with a dry sterile dressing. Do not delay transfer to do wound care. Wound care questions can be directed to the burn center.

The extremities and trunk should be assessed for circumferential burns. If present, extremities should be elevated to the level of the heart with frequent distal neurovascular checks. If circumferential burns are present on the trunk, frequent assessment of breathing is recommended

to include peak airway pressures and monitoring of end-tidal carbon dioxide (ETCO₂). All concerns related to circumferential burns or the development of compartment syndrome should be immediately communicated to the burn center. If breathing is compromised or compartment syndrome develops, an escharotomy may be necessary and an immediate surgical consult obtained.

Diagnostics

Initial measurements of arterial blood gas (ABG) and carboxyhemoglobin (COHb) should be obtained in circumstances where there is a risk of airway burns, inhalation injuries, or trunk circumferential burns.

Large burns can have a number of effects on organ systems resulting in organ dysfunction. General laboratory studies such as complete blood count (CBC), chemistry, and clotting factors should be obtained.

High-voltage electrical burns may result in cardiac dysrhythmia and skeletal muscle damage, which may be difficult to assess. To aid in the diagnosis, a 12-lead electrocardiogram (ECG) should be performed along with an assessment of cardiac enzymes. A urinalysis should be obtained to aid in the diagnosis of rhabdomyolysis and myoglobinuria.

Special Circumstances

High-voltage electrical burns create some unique considerations. The electrical insult can result in cardiac dysrhythmias, which would require immediate management. In cases of cardiac dysrhythmia, follow the advanced cardiac life support (ACLS) treatment guidelines. Some electrical burns may include small cutaneous burns with underlying tissue damage resulting in myoglobin being released into circulation (Rhabdomyolysis) causing kidney damage. This is often evident by dark-colored urine and should be aggressively treated with intravenous fluids and medications. Electrical burns affecting the extremities can cause compartment syndrome and should receive frequent neurovascular assessments. The affected extremity should be elevated at the level of the heart and a surgical consult obtained.

Chemical burns have the potential to harm care providers and any nearby patients. Measures should be taken to protect staff members by using personal protective equipment, including gloves, gown, and face mask. Dry chemicals should be initially brushed off, followed by flushing with liberal amounts of water. It may be necessary to use a decontamination shower in some cases. Following decontamination, a patient history should be obtained to identify the chemical name, type (acid or alkali), concentration, and volume.

Hydrofluoric acid (industrial use and glass etching) burns can precipitate calcium loss, resulting in hypocalcemia. Management of these burns should include monitoring calcium levels and applying calcium gluconate gel to exposed skin.

Cyanide poisoning can result from the burning of household materials, especially plastics. The inhalation of cyanide gas leads to cyanide toxicity. Cyanide toxicity symptoms include headache, dizziness, nausea, bitter almond smell, tachycardia, confusion, convulsions, cardiac arrhythmias, and death. For patients in a closed-space fire who are unresponsive or in shock

treatment should include supporting vital functions and the rapid administration of hydroxocobalamin ([Cyanokit](#)).

If the chemical is unknown or for expert consultation, consider contacting the Washington Poison Center at 1-800-222-1222.

Burn Center Referral

The following ABA criteria includes burn injuries that should result in the patient's referral to a designated burn center. Contact your nearest burn center for its individual referral criteria.

- Partial thickness burns greater than 10 percent TBSA
- Burns that involve the face, hands, feet, genitalia, perineum, or major joints
- Third-degree burns in any age group
- Electrical burns, including lightning
- Chemical burns
- Inhalation injuries
- Burn injury in a patient with preexisting medical conditions
- Any patient with burns and concomitant trauma
- Burned children in hospitals without qualified personnel or equipment
- Burn injury in patient who will require special social, emotional, or rehabilitative interventions.

Burn physicians are available for consultation at **Harborview Medical Center 1-888-731-4791**. In southwest Washington consider contacting **Legacy Oregon Burn Center 1-888-598-4232**.

Prevention

Over the past two decades, the number of burn-related injuries has decreased substantially because of increased public awareness and improved safety of consumer products. To help sustain the decline in burn injuries, trauma programs should periodically educate staff members on the need to educate patients regarding fire safety and preventing burns. The Centers for Disease Control (CDC) has [online resources](#) that may be helpful.

Supporting References

The following online burn resources are provided by UW Medicine/ Harborview Burn Center. For patients who do not meet transfer criteria but will require follow-up burn care, please consult the online video series regarding wound care and stretching.

[UW Medicine Burn Education Videos](#)

[UW Medicine Burn Stabilization Protocol](#)

[UW Medicine/Harborview Burn Center Referral](#)

[Cyanokit Training Presentation](#)

[Cyanokit Administration Guide](#)

Reference

- American Burn Association - Advanced Burn Life Support Course Provider Manual. Chicago - American Burn Association (2016).
- American Burn Association Referral Criteria. (n.d.). Retrieved December 13, 2016, from <http://www.ameriburn.org/BurnCenterReferralCriteria.pdf>
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- Goverman, J., Bittner, E. A., Friedstat, J. S., Moore, M., Nozari, A., Ibrahim, A. E., & ... Fagan, S. P. (2015). Discrepancy in Initial Pediatric Burn Estimates and Its Impact on Fluid Resuscitation. *Journal Of Burn Care & Research*, 36(5), 574-579. doi:10.1097/BCR.000000000000185
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Figure 1. Rule of Nines

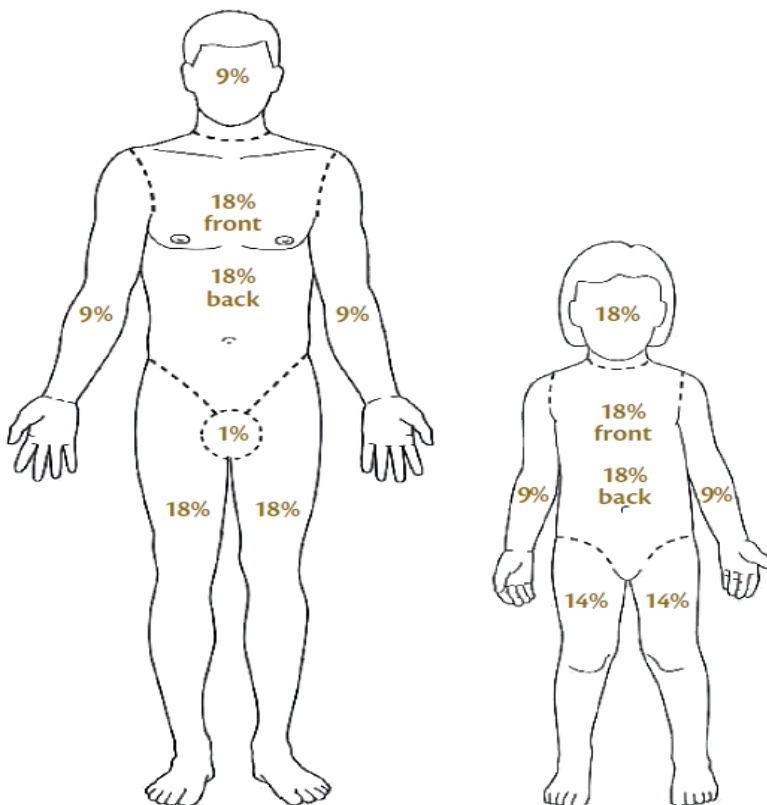


Figure 2. Rule of Palm



The palm and fingers equals one percent TBSA. Used to estimate small scattered burns.

Figure 3.

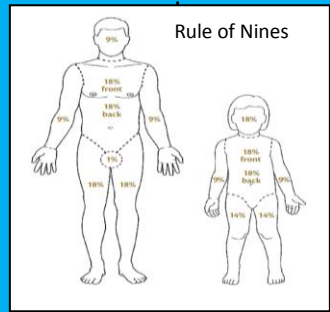
**Lund and Browder Chart
Percent of TBSA Burn**

Area	Birth – 1 year	1 – 4 Years	5 – 9 Years	10 – 14 Years	15 Years	Adult
Head	19	17	13	11	9	7
Neck	2	2	2	2	2	2
Anterior trunk	13	13	13	13	13	13
Posterior trunk	13	13	13	13	13	13
Right buttock	2.5	2.5	2.5	2.5	2.5	2.5
Left buttock	2.5	2.5	2.5	2.5	2.5	2.5
Genitalia	1	1	1	1	1	1
Right upper arm	4	4	4	4	4	4
Left upper arm	4	4	4	4	4	4
Right lower arm	3	3	3	3	3	3
Left lower arm	3	3	3	3	3	3
Right hand	2.5	2.5	2.5	2.5	2.5	2.5
Left hand	2.5	2.5	2.5	2.5	2.5	2.5
Right thigh	5.5	6.5	8	8.5	9	9.5
Left thigh	5.5	6.5	8	8.5	9	9.5
Right lower leg	5	5	5.5	6	6.5	7
Left lower leg	5	5	5.5	6	6.5	7
Right foot	3.5	3.5	3.5	3.5	3.5	3.5
Left foot	3.5	3.5	3.5	3.5	3.5	3.5
Total						

Burn Care Algorithm

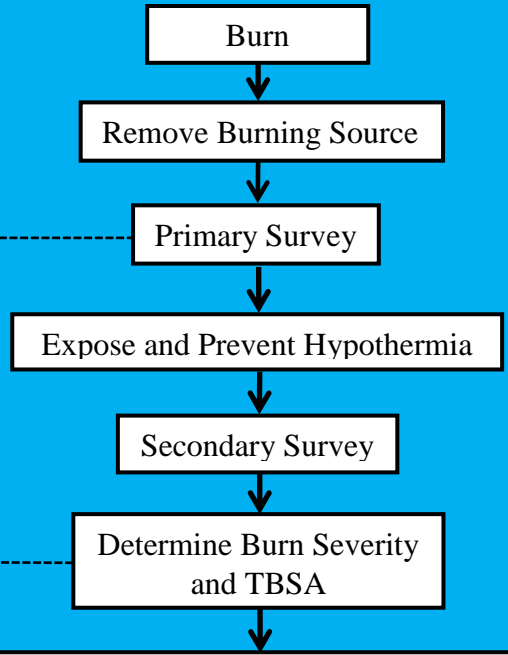
Severity:

- First degree (superficial partial thickness): Skin red, dry and painful. *do not include in TBSA.
- Second degree (partial thickness): Skin red, blistered, weepy, swollen, and painful.
- Third degree (full thickness): Skin whitish, brown, charred, with minimal to no pain.



Respiratory Distress

100% Oxygen
Prepare for Intubation



Harborview Burn Center 1-888-731-4791
Legacy Oregon Burn Center 1-888-598-4232

Prepare For Burn Center Transfer

- Burn Key Points**
- Protect caregivers
 - Remove clothing and jewelry
 - Hazmat concern, flush with tepid water
 - Avoid hypothermia
 - Use Rule of Nines to determine % TBSA
 - Obtain ABG and COHb if airway injury
 - Fluid resuscitation formula:
Adults and older children (>14 yo) **2ml/kg/TBSA**
Children (<14 yo) **3ml/kg/TBSA**
Infants/young children (≤30 kg) add D5LR
Electrical (all ages) **4ml/kg/TBSA**
Infuse total volume over 16 hours; ½ in first 8 hours; ½ in the remaining 8 hours
 - Titrate fluid based on UA output:
Adult 0.5ml/kg/hr
Ped 1ml/kg/hr
 - Avoid diuretics and fluid boluses
 - Slowly adjust fluid rate to increase UA output
 - [Cyanokit Administration Guide](#)
 - Poison Control for chemical burn consultation

- Burn Center Referral Criteria**
- Partial thickness burns > 10% TBSA
 - Burns involving the face, hands, feet, genitalia, perineum, or major joints
 - Third degree burns in any age group
 - Electrical burns, including lightning
 - Chemical burns
 - Inhalation injuries
 - Burn with preexisting medical conditions
 - Burns with concomitant trauma
 - Burned children in hospitals without qualified personnel or equipment
 - Burn injury requiring special social, emotional, or rehabilitative interventions