

# JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE



## BURN CARE

Addresses burn injury assessment, resuscitation, wound care, and specific scenarios including chemical and electrical injuries. Reviews considerations for the definitive care of local national patients, including pediatric patients, who are unable to be evacuated from theater.

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## TABLE OF CONTENTS

|   |    |
|---|----|
| INTRODUCTION.....   | 4  |
| EPIDEMIOLOGY OF MILITARY BURN INJURY.....                                 | 5  |
| POINT OF INJURY .....   | 6  |
| Initial Burn Survey .....   | 7  |
| ACUTE RESUSCITATION.....  | 8  |
| Assessment and Documentation/Support Tools .....                          | 8  |
| Alternative Strategy: Plasma .....  | 9  |
| Alternative Strategy: Enteral Resuscitation.....                          | 10 |
| Persistent Oliguria And Hypotension .....                                 | 11 |
| SPECIAL CONSIDERATIONS .....  | 11 |
| Antimicrobial Prophylaxis.....  | 12 |
| Inhalation Injury .....   | 12 |
| Ophthalmic Injury.....  | 13 |
| Lines and Tubes .....   | 13 |
| Gastrointestinal Prophylaxis.....   | 13 |
| Circumferential Burns, Escharotomy, & Extremity Compartment Syndrome..... | 13 |
| WOUND CARE .....  | 16 |
| GUIDELINES FOR PATIENTS WHO CANNOT BE EVACUATED.....                      | 16 |
| Triage Principles .....   | 17 |
| Considerations for Pediatric Patients.....                                | 18 |
| PERFORMANCE IMPROVEMENT (PI) MONITORING .....                             | 19 |

|   |    |
|---|----|
| REFERENCES.....   | 20 |
| APPENDIX A: PHYSICIAN'S ORDER SET.....  | 22 |
| APPENDIX B: ADULT LUND BROWDER BURN ESTIMATE & DIAGRAM.....                               | 26 |
| APPENDIX C: PEDIATRIC LUND BROWDER BURN ESTIMATE & DIAGRAM.....                           | 28 |
| APPENDIX D: BURN RESUSCITATION PROTOCOL, WORKSHEET & FLOW SHEET .....                     | 30 |
| APPENDIX E: ESCHAROTOMY FIGURE.....   | 37 |
| APPENDIX F: BURN EXCISION AND GRAFTING.....   | 39 |
| APPENDIX G: ENTERAL RESUSCUTATION FOR ADULTS <sup>1</sup> .....                           | 41 |
| APPENDIX H: WOUND CARE SUPPLY LIST FOR PERCENTAGE OF CASUALTIES WITH >50% TBSA BURNS..... | 42 |
| APPENDIX I: THE BURN NAVIGATOR.....   | 43 |
| APPENDIX J: CLASS VIII MEDICAL MATERIEL.....  | 44 |
| APPENDIX K: TELEMEDICINE / TELECONSULTATION .....   | 46 |
| APPENDIX L: INFORMATION REGARDING OFF-LABEL USES IN CPGS.....                             | 47 |

## SUMMARY OF CHANGES

- Enteral Resuscitation Protocol
- Removed references to 5% Sulfamylon aqueous solution, as it is no longer manufactured.

# BURN CARE

Burns are a global public health problem, accounting for an estimated 180 000 deaths annually. Non-fatal burns are a leading cause of morbidity.

**Call USAIR Burn Unit for assistance:** DSN 312-429-2876 (429-BURN), Comm: 210-916-2876 / 210-222-2876



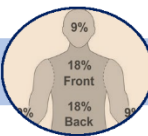
## POINT OF INJURY

- ✓ Stop the burning process
- ✓ TCCC First
  - Hemorrhage
  - Airway
  - Pneumothorax
  - Brush/rinse dirt & chemicals
- ✓ Survey & cover injuries
- ✓ Evacuate



## INITIAL SURVEY

- ✓ 1<sup>st</sup> & 2<sup>nd</sup> trauma surveys
- ✓ Protect airway. Use >8ETT for bronch/pulm toilet.
- ✓ Intubate if:
  - Comatose
  - Inhalation injury
  - Facial burns
  - >40% TBSA
- ✓ Keep the patient warm



## ACUTE RESUSCITATION

- ✓ 5-15% of casualties will have burn injuries; this number is expected to be higher in LSCO
- ✓ Calculate % TBSA burn using Rule of 9s & Lund-Browder Chart. IF >20% TBSA acute resuscitation with DD 3019 Form
- ✓ LR/Plasmalyte A
- ✓ Burn Navigator (>40kg)
- OR
- ✓ Rule of 10s: 10ml/hr x % TBSA. For patient > 80kgs-add 100 ml/hr for each 10kg over 80kg
- ✓ Foley catheter: UOP goal: 30-50ml/hr & titrate up or down 20-25% current rate to get to goal
- ✓ 250 ml/kg x24 hrs risks ABD Compartment Syndrome



## WOUND CARE

- ✓ Cleanse
  - ✓ Tetanus?
  - ✓ Sterile gauze with 5% Sulfamylon OR
  - ✓ Silver-impregnated nylon covered with moistened sterile gauze
  - ✓ Escharotomy for circumferential full thickness burns
- Tips**
- ✓ Secure catheters: Suture venous/arterial catheters to prevent dislodgment
  - ✓ Umbilical ties for ETT/OG & NG/DH tubes
  - ✓ GI prophylaxis > 20% TBSA burn

- Definitive airway prior to transport: GCS <8; >40% TBSA burn; facial burns; inhalation injury
- DD 3019 Resuscitation form completed for >20% TBSA burn
- Debridement (cleansing) of wounds with surgical antiseptic to remove blisters and debris and application of topical antimicrobial occurs within 24hrs of injury
- Escharotomy performed for circumferential burns



Clinical tips based on the Burn Care Clinical Practice Guideline published by the Joint Trauma System.

JTS CPGs:

[HTTPS://JTS.HEALTH.MIL/INDEX.CFM/PI\\_CPGS/CPGS](https://jts.health.mil/index.cfm/pi_cpgs/cpgs)

## INTRODUCTION

Although burns sustained during military operations (whether combat and non-combat in nature) constitute a relatively small percentage (5%-15%) of injuries, they have an outsized impact on all involved. Burns are painful and potentially debilitating injuries. Even burns to a small surface area can be incapacitating for the casualty. Burns also significantly strain the resources of deployed military medical units.

Optimal treatment of burn injuries includes management of the physiologic changes related to the burn but also of any associated traumatic injuries. Resuscitation of the burn casualty is generally the most challenging aspect of care during the first 24 hours. The challenge is further augmented if the patient has other injuries, such that priorities for burn resuscitation may conflict with those for mechanical trauma care. An example of this dilemma is the casualty with both traumatic brain injury and extensive burns, in which large-volume fluid resuscitation for burn shock places the patient at risk of worsening cerebral edema. Such combined injuries are unusual in civilian practice but are more common on the battlefield.

The battlefield continuum of care requires frequent casualty movement. This presents a unique challenge to burn care and demands prudent judgment. The need to get casualties off the battlefield and to facilities with more resources must be balanced with the real possibility of deterioration of unstable patients during flight. The future operating environment with delayed evacuation will have additional challenges and may require more burn casualties to remain in the area of operations. Optimal care requires a concerted effort on the part of all providers along this continuum – **documentation is essential in burn management, especially resuscitation documentation. Both over resuscitation and under resuscitation can be lethal in burn casualties.**

The goal of this Clinical Practice Guideline (CPG) is to provide guidance and recommendations for care of burn casualties in the deployed or austere settings. During recent U.S. Central Command operations, U.S. Service Members with burns were rapidly evacuated out of theater. This is ideal given the extensive resources needed to manage large burns; however, the trauma system must communicate effectively when it comes to resuscitation. In 2006, burn patients from Iraq were massively over resuscitated along the continuum of care – this resulted in deaths from survivable burn wounds. The Burn Care CPG was one of the very first JTS CPGs to address this problem and the burn resuscitation flowsheet is an essential element of care to ensure burn casualties are not over resuscitated as they transfer back to the U.S. Army Institute of Surgical Research (USAISR) Burn Center. In the future, rapid transport may not be possible, so every military provider must be knowledgeable in initial burn care resuscitation and management. Host national casualties with burns who cannot be evacuated require a large number of resources and expertise in burn care. The operational environment influences how these casualties are managed and multiple factors (resources, expertise, availability of rehabilitation, nutritional support, prolonged ICU care, and multiple trips to the operating room) must all be considered.

**NOTE: If caring for a burn casualty, contact the USAISR Burn Center as soon as possible.** Early consultation will facilitate coordination of care to include possible activation of the Burn Flight Team to assist with movement back to the continental U.S. (CONUS). **Inability to contact the Burn Center should not delay the evacuation process. Contact the Theater Patient Movement Requirements Center as soon as possible to coordinate aeromedical evacuation.**

1. Contact USAISR Burn Center ASAP  
DSN number: 312-429-2876  
Commercial: 210-916-2876 or 210-222-2876
2. Contact Theater Patient Movement Requirements Center (TPMRC) ASAP to coordinate evacuation
  - TPMRC - Americas (NORTHCOM & SOUTHCOM), 618-817-4200
  - TPMRC - East (EUCOM, AFRICOM, CENTCOM), DSN 314-480-8040
  - TPMRC - West (INDOPACOM), DSN 315-448-1062
3. Do not delay evacuation process
4. Email for non-urgent consults/concerns [usarmy.jbsa.medcom-aisr.list.armyburncenter@health.mil](mailto:usarmy.jbsa.medcom-aisr.list.armyburncenter@health.mil)

## BURN INJURY IN DEPLOYED ENVIRONMENT: CLINICAL PEARLS

1. Stop the burning process and address bleeding and airway compromise (Tactical Combat Casualty Care).
  - a. Do not be distracted by the burn injury. Always look for other injuries.
2. Prevent hypothermia. Burn patients are much more susceptible to hypothermia, which can exacerbate the coagulopathy of trauma.
3. Secure the airway (intubate) for patients with:
  - a. >40% TBSA burns if they cannot be closely monitored in an ICU setting.
  - b. >40% burn and patient being transferred who will be in the en route care environment.
  - c. Significant facial or oropharyngeal burns.
  - d. Respiratory distress from inhalation injury.
  - e. Any concern for airway obstruction.
4. Start resuscitation based on the ISR Rule of 10s for adults only. Adjust infusion rate (up or down) to achieve an hourly urine output of 30-50 ml/h, or 0.5-1 ml/kg/h in children.
5. Always use the JTS Burn Resuscitation Flowsheet; fluid creep (over-resuscitation) can occur along the continuum of care without accurate documentation of fluid input and output. Document all interventions and fluids given.
6. When at all possible, transport casualties to an MTF that has burn care capabilities.
7. Wound care starts at the first level of care. There are multiple options for wound care depending on the depth and location of the burn.
8. U.S. military and DoD beneficiaries do not undergo definitive burn care in the theater of operations in the current military trauma system.
9. Call USAISR Burn Center early and often for consultation and Burn Flight Team activation.

## EPIDEMIOLOGY OF MILITARY BURN INJURY

Military burn injury occurs during both routine global operations and during combat. The epidemiology of burn injury is largely dependent on the operational environment and is commonly associated with combat involving armored vehicles and war at sea. Accidental injuries involving chemicals, electricity, and the handling of explosives or burning waste can also occur during routine military operations.<sup>1-3</sup> A DoD Trauma Registry (DoDTR) analysis from 2003 through 2014 found that primary burn injury accounted for 5% of all non-battle injuries (NBI) during Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF).<sup>4</sup> An analysis of 196 extended submarine patrols in the late 1990's found that burn injury accounted for 5.6% of medical events and injuries typically occurring in mechanical (e.g., engine rooms and trash disposal areas) and food preparation areas; 3.2% were categorized as electrical injuries occurring in mechanical areas.<sup>5</sup> A 50-year analysis (1970-2020) of all documented mishaps during U.S. naval operations found that fire, burn, and electrical injuries decreased over time. There were 103 different mishap events resulting in 923 burn and/or smoke inhalation casualties with an associated 13% mortality. During the 50 years, reported electrical injuries were rare (32 casualties), but highly lethal (90.6% mortality).<sup>6</sup> A 70-year analysis (1950-2020) of 27 major fires that occurred on U.S. Navy capital ships (including aircraft carriers and large amphibious warships) found an overall mortality of 23%. In those fires impacting more than 5% of the crew, the associated mortality was 29%.<sup>7</sup>

During OIF/OEF ground combat operations, primary burn injury accounted for 2.4% of all Battle Injuries (BI).<sup>4</sup> An analysis of the Expeditionary Medical Encounter Database from 2001 through 2018 identified 2507 deployed service members who sustained and survived a total 5551 burns. Of these, 86% were BI and 14% NBI. Most occurred from some type of blast injury (82%) with 9% inhalation injury and 29% traumatic brain injury rates of all deployed burn injury survivors;

65% occurred during a mounted posture and 23% while dismounted. In this cohort of survivors, most burns were relatively small with 92% involving <20% total body surface area (TBSA) and 85% <10% TBSA. The head and neck sustained burns in 34% and the upper extremity in 39%, most of which (19%) occurred in the hand.<sup>8</sup> A separate analysis of the DoDTR from 2011 through 2017 found that burns accounted for 13.61% of the total number of battle injuries sustained during combat. In this cohort, most burns were also relatively small, with 11.52% <20% TBSA and 1.23% >20% TBSA.<sup>1</sup>

During war at sea, burn injuries are common when combatant vessels are attacked. Comprehensive analyses of surviving U.S. naval casualties from lost warships during World War II demonstrate a burn injury rates of 22-26%. After Kamikaze attacks, the burn injury rate was 30% among survivors.<sup>9,10</sup> During the 1982 Falklands war, characterized by a significant naval warfare component, as many as 21% of battle casualties sustained burn injury and 12% of total casualties suffered inhalation injury. The 1988 Exocet missile attack on the USS Stark and the 2000 water-borne improvised explosive device attack on the USS Cole resulted in a 15.5% burn injury rate and a 10.3% inhalation injury rate among survivors.<sup>3</sup>

It is also important to note that burn injuries during war on land or sea generally do not occur in isolation, and combined burn and traumatic injuries are associated with higher mortality rates and a greater likelihood for concomitant inhalation injury.<sup>8, 11</sup>

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## POINT OF INJURY

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1. In the field, INTERRUPT THE BURNING PROCESS and **address any life-threatening bleeding, airway compromise, or tension pneumothorax in accordance with Tactical Combat Casualty Care (TCCC) guidelines**. Burn casualties may have additional traumatic injuries which are more life-threatening in the short term and require immediate attention.
2. Rinse off dirt and any contaminating chemicals, including hydrocarbon fuels, with clean water. Dry chemicals should be brushed off before irrigation. Once a survey of injuries is performed, cover the patient with blankets to prevent hypothermia.
3. Evacuate the casualty as soon as possible. Tactical considerations and distance may require prolonged casualty care in which resuscitation is begun under pre-hospital conditions.

1. **All burn victims are trauma patients first. Evaluate and treat initially according to TCCC and Advanced Trauma Life Support (ATLS) guidelines.**
2. **Avoid becoming distracted by the burns.**
3. **Perform rapid airway assessment. Intubate if:**
  - GCS < 8
  - Deep neck/facial burns
  - Signs/sx of Inhalational injury
  - >40% TBSA
4. **Use Size 8 ETT for intubation**



## INITIAL BURN SURVEY

All burn victims are trauma patients first and should be treated and initially evaluated according to TCCC/ATLS guidelines. Perform primary and secondary surveys as for any trauma patient. Below are some examples of burn severity.

**Figure 1. Examples of Burns**

### Superficial - First Degree



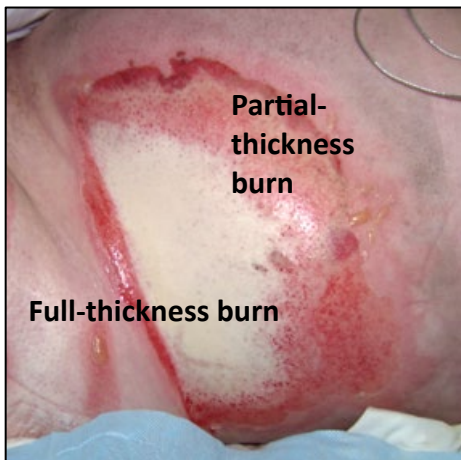
- Epidermal layer of skin
- Painful, red, blanch with pressure

### Superficial Partial Thickness - Second Degree



- Epidermis and dermis
- Sometimes blisters
- Painful, red, blanch with pressure

### Deep Partial Thickness - Second Degree



- Deeper dermis damaging hair follicles
- Blister formation
- Dry, mottled patches, white, do not blanch.

### Full Thickness - Third Degree



- Destroy all layers of the dermis injuring underlying subcutaneous tissue
- No sensation
- Dry, eschar, leathery
- May involve muscle and/or bone

Acute injuries found in the primary and secondary survey should be addressed in accordance with standard trauma protocols. In evaluating a patient for non-burn trauma, **avoid becoming distracted by the burns.**

Perform a rapid airway assessment and obtain a definitive airway if needed. Immediate intubation may not be necessary in less severely burned casualties, thereby allowing time to complete the primary survey and prepare for controlled intubation.

Indications for endotracheal intubation include coma or depressed mental status with Glasgow Coma Scale (GCS) <8, symptomatic inhalation injury, deep facial or neck burns, and burns of  $\geq 40\%$  TBSA.

**NOTE:** Edema after burns or inhalation injury causes supraglottic airway devices such as laryngeal mask airways to be ineffective.

- Use a large-bore endotracheal tube (ETT), especially if inhalation injury is suspected. Size 8 ETT or larger is preferred for adults. The larger ETT facilitates subsequent bronchoscopy and pulmonary toilet and decreases the risk of later airway occlusion due to casts comprised of blood, mucus, and debris.

### Secure ETT

- Use cotton umbilical ties around the neck but ensure it does not cut into the corner of the mouth.
- Consider use of stainless-steel wire secured around a pre-molar tooth prior to long-range transport, particularly in patients with extensive facial burns.
- Frequently reassess position of the ETT during the acute resuscitation period as edema waxes and wanes.
- Avoid use of adhesive tape to secure ETTs, as this is not a safe method in burn patients. Tape does not stick well to burn patients. Do not use tape to secure an ETT.

**Keep the patient warm.** Burns increase insensible heat loss. Burn casualties with injuries >20% TBSA are at high risk of hypothermia.

**NOTE:** Do not debride blisters until the patient has reached a facility with emergency medical or surgical capability. Cover burns with loose, dry gauze or a clean sheet.

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## ACUTE RESUSCITATION

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### ASSESSMENT AND DOCUMENTATION/SUPPORT TOOLS

Calculate the patient's initial burn size using the [Rule of Nines \(Appendix A\)](#). When wounds have been cleansed, re-calculate using the Lund-Browder chart ([Appendix B](#) and [Appendix C](#)). Superficial (1st degree) burns are NOT included in the estimation of burn size.

Superficial burns (1st degree) appear red, do not blister, and blanch readily. Partial-thickness burns (2nd degree) are moist and sensate, blister, and blanch. Full-thickness burns (3rd degree) appear leathery, dry, do not blanch, are insensate, and often contain thrombosed vessels.

If TBSA is 20% or greater, patients typically require acute fluid resuscitation for 24 to 48 hours postburn.

**NOTE:** In 10%-20% TBSA burns, maintenance IV fluids should be initiated, and urine output and other endpoints of resuscitation monitored closely. This is especially important in the setting of pre-existing dehydration, methamphetamine or alcohol intoxication, petroleum-based accelerants, concomitant electrical injury, or multisystem trauma as these may be associated with higher than anticipated fluid requirements.<sup>12,13</sup>

When performing fluid resuscitation, **place a Urinary Catheter** (with a calibrated urimeter chamber if available). Burns to the penis are not a contraindication to urinary catheter placement. Suprapubic bladder catheter placement is rarely required.

Hourly urine output (UOP) is the main index of resuscitation adequacy and assists with IV fluid adjustments. In adults, the goal is to achieve an hourly target UOP of 30-50 mL/hr (or 75-100 mL/hr for high-voltage electric injury).

Lactated Ringer's (LR) or PlasmaLyte A are the preferred resuscitation fluids. Normal saline should be avoided, if possible, but can be used if absolutely necessary. \*\*\*Polytrauma patients with a source of hemorrhage should receive whole blood or balanced component therapy until hemorrhage is controlled and the patient is no longer coagulopathic. (Refer to [JTS CPGs: Damage Control Resuscitation and Whole Blood Transfusion](#)).

For adults, initiate IV fluid resuscitation using the Rule of 10s:  $10 \text{ mL/hr} \times \%TBSA = \text{initial fluid resuscitation rate}$ .<sup>14</sup>

For patients weighing more than 80 kg, add 100 mL/hr to IV fluid rate for each 10 kg > 80 kg. Example: For a 100-kg patient with 50% TBSA, the initial rate is  $(10 \times 50) + 200 = 700 \text{ mL/hr}$ .

**For children,  $3 \times TBSA \times \text{body weight in kg}$  gives the volume for the first 24 hours.** One half is programmed for delivery during the first 8 hours. Further guidance for pediatric management is provided below.



Example: a 30-kg child with 50% TBSA will need an estimated  $30 \times 50 \times 3 = 4,500$  mL during the first 24 hours. Half of this is 2,250 mL, to be given over the first 8 hours. Thus, the initial hourly rate is  $2,250 \text{ mL} / 8 \text{ hrs} = 281 \text{ mL/hr}$ .

Use the [Burn Resuscitation Worksheet \(Appendix D\)](#) to assist initiation and documentation of fluid resuscitation.

If available, use the Burn Navigator for decision support.<sup>15</sup> At the top of every hour, follow the prompts and enter the intake and UOP values. The device will provide isotonic fluid rate recommendations for the next hour.

For guidance, see [Appendix I: Burn Navigator](#).

Both under- and over-resuscitation can result in serious morbidity and mortality. Patients who receive over 250 mL/kg in the first 24 hours are at increased risk for severe complications including abdominal and extremity compartment syndromes.

In the absence of overt hypotension (MAP < 65 mmHg), **avoid fluid boluses**, as rapid changes in infusion rates contribute to edema. Instead, adjust IV fluid rates based on urine output (see below).

## Colloid Rescue Recommendations

As early as 8-12 hours post-burn, if the following criteria are met, consider starting a colloid:

- Hourly IV fluid rate exceeds 1500 mL/hr.
- Projected 24-hour total fluid volume approaches 250 mL/kg.
- Other indications of significant hypovolemic shock despite IV fluid resuscitation.
- Evidence of compartment syndrome (such as bladder pressure > 20 mmHg).

For adults: administer 5% albumin based on Table 1.

**Table 1. Hourly infusion rate for 5% albumin for adults**

| Weight   | 30-49% TBSA | 50-69% TBSA | 70-100% TBSA |
|----------|-------------|-------------|--------------|
| <70 kg   | 30          | 70          | 110          |
| 70-90 kg | 40          | 80          | 140          |
| >90 kg   | 50          | 90          | 160          |

For children: give the colloid at the calculated maintenance rate (e.g., 4-2-1 rule), reducing the current isotonic infusion rate by an equal amount.

Continue the colloid infusion until the 48-hour mark. Typically, continue to adjust the crystalloid rate while keeping the colloid infusion constant.

**\*\* In trauma patients without burns, albumin resuscitation has been associated with a significantly higher mortality in patients with severe traumatic brain injury (TBI). If there is a concern for TBI, utilize an alternate colloid strategy with plasma as the first line.<sup>16,17</sup>**

## ALTERNATIVE STRATEGY: PLASMA

Plasma is likely a superior resuscitation fluid because of protective effects on the endothelial glycocalyx.<sup>18</sup> Additionally burn shock is a plasma deficit, so early plasma resuscitation will result in less fluid shifts. For burns larger than 20% TBSA, consider utilizing plasma early if available, in combination with balanced crystalloid, using one of the following formulas:<sup>19,20</sup>

- Original Brooke Formula: estimated plasma dose for the first 24 hours is 0.5 mL/kg/TBSA. Estimated crystalloid dose is 1.5 mL/kg/TBSA. Example: 100 kg with 50% TBSA: initial plasma rate is 156 mL/hr; initial crystalloid rate is 468 mL/hr.
- Evans Formula: estimated plasma infusion dose for the first 24 hours is 1 mL/kg/TBSA. Estimated crystalloid dose is the same.
- When using these formulas, it is recommended to adjust the crystalloid dose hourly while keeping the plasma dose constant.

## ALTERNATIVE STRATEGY: ENTERAL RESUSCITATION

Enteral resuscitation, also known as oral rehydration therapy, can be used in addition to or instead of IV fluids.<sup>21,22</sup> (See [Appendix G](#) for the Oral Resuscitation Protocol.) Such fluids can be consumed orally (ideal route) by an awake and alert patient. They can also be administered via a nasogastric tube, orogastric tube, or by proctoclysis (enema). If given enterally, the resuscitation solution must be administered to the stomach and not directly to the small bowel due to large volumes required for resuscitation. Reasons for avoiding enteral resuscitation include the following:

- Abdominal injuries
- Gastrointestinal intolerance (vomiting)
- Pressor use >15mcg/min of norepinephrine (with or without vasopressin)
- Burns >40% TBSA (will likely need IV fluid augmentation).

Enteral resuscitation must include fluids that have salt, sugar, and are isotonic. Fluids like Gatorade will result in severe hyponatremia. Patients undergoing enteral resuscitation should be monitored for gastric residuals or vomiting. Enteral resuscitation through an NG tube/enteral tube must ensure that the fluid is gastric and not small bowel.

## Titration and Goals of Fluid Resuscitation

Diligent fluid resuscitation in the first 24-48 hours prevents development of multiorgan failure in the setting of burn shock. This is why maintaining goals of resuscitation is essential in the care of a burn patient.

Urine Output:

1. 30-50 mL/hour in adults, or 0.5 to 1 mL/kg/hr in children
  - a. If UOP > 50 mL/hr, then decrease the IV fluid rate by 20%, wait two consecutive hours, and reassess.
  - b. If UOP < 30 mL/hr, then increase rate of IV fluids by 20%, wait two consecutive hours, and reassess.
2. 75-100 mL/hr for high-voltage electrical injury, or other conditions causing rhabdomyolysis.

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**Comment about alternate resuscitation strategies:** Ongoing research into both plasma resuscitation and enteral resuscitation is active. Some authors believe that both plasma and enteral resuscitation are superior to large volumes of crystalloid, however there is no level 1 evidence to support this. Large volume crystalloid does have a resuscitation morbidity, which is why the volume of crystalloid must be carefully monitored and endpoints of resuscitation monitored closely. As data from studies of both plasma and enteral resuscitation emerge, this CPG will be updated to reflect that data.

---

## Laboratory Considerations

UOP may not be a reliable indicator of adequate resuscitation in some patients. Monitor hematocrit and lactate (and/or base deficit) as well. Successful resuscitation is indicated by resolution of hemoconcentration (e.g., hematocrit > 30%) and normalization of lactate.

**Special considerations that increase fluid requirements in the first 24 hours:**

- |                         |                                  |
|-------------------------|----------------------------------|
| ▪ Hyperglycemia         | ▪ Mechanical ventilation         |
| ▪ Illicit substance use | ▪ Additional trauma              |
| ▪ Diuretics             | ▪ Preexisting dehydration        |
| ▪ Alcohol               | ▪ Sedation or general anesthesia |

**Indicators of completed resuscitation:**

- |  |   |
|--|---|
| ▪ Patient follows commands   | ▪ Minimal fluid requirement   |
| ▪ Restoration of hemodynamics with minimal vasopressor requirement | ▪ Resolution of metabolic acidosis  |
| ▪ Adequate UOP of 30-50 mL/hr                                      | ▪ Hematocrit low to normal range (no further evidence of hemoconcentration) |

If possible, measure bladder pressures every 4 hours in intubated patients if fluid resuscitation volumes during the first 24 hours are >200 mL/kg.<sup>5</sup> Ensure the patient is in the supine position and follow the manufacturer's instructions for commercial kits; otherwise, use between 25 and 50 ml, being consistent in whatever volume is used, for serial measurements using a transducer located at the level of the symphysis pubis. Sustained bladder pressure >12 mmHg indicates early intra-abdominal hypertension and adjuncts such as colloid fluid should be considered for ongoing resuscitation. If the measured pressure is >20 mmHg, the patient should be fully sedated and paralyzed, and the measurement repeated. Persistent bladder pressures >20 mmHg may indicate abdominal compartment syndrome. (See [Abdominal Compartment Syndrome](#) below.)

## PERSISTENT OLIGURIA AND HYPOTENSION

Clinically significant hypotension (mean arterial pressure, MAP < 65 mmHg) must be correlated with UOP and other indicators of resuscitation adequacy. Adequate end-organ perfusion as estimated by UOP 30-50 mL/hr generally requires a MAP > 65 mm Hg. Persistent oliguria and hypotension should trigger an assessment of the patient's hemodynamic status and intravascular volume. **Reassess for a possible missed injury or ongoing bleeding.** Monitor intravascular fluid status using all available technologies. **Consider early use of a colloid as discussed above as an adjunct.**

If hypotension persists, use vasopressin 0.04 units/min (do not titrate) followed by norepinephrine (titrate 2-20 mcg/min) if needed. Epinephrine may be used as an additional vasopressor in severe shock proven to be non-hemorrhagic.

If intravascular volume appears adequate, STOP increasing IV fluid rate even if oliguria persists. Consider this patient hemodynamically optimized and that the oliguria likely results from an established renal insult. Expect and tolerate some degree of renal dysfunction in large burns. Continued increases in IV fluid administration, despite optimal hemodynamic parameters, will only result in "resuscitation morbidity," which is often more detrimental than kidney injury.

If the patient exhibits catecholamine (vasopressor)-resistant shock, consider the following diagnoses:

- Missed injury and/or on-going blood loss.
- Acidemia. If pH < 7.20, adjust ventilator settings to target PCO<sub>2</sub> 30-35 mmHg. If, despite optimal ventilation, patient still has a pH < 7.2, consider administration of sodium bicarbonate.
- Adrenal insufficiency.<sup>6</sup>
- Hypocalcemia. Consider empirically administering calcium chloride (8-16 mg/kg IV) for refractory hypotension, especially in patients who have received a blood transfusion. If able to measure levels, maintain ionized calcium >= 1.2 mmol/L.

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## SPECIAL CONSIDERATIONS

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### Burn injury in deployed environment: non-clinical pearls

Documentation of resuscitation throughout the continuum of care is lifesaving.  
Providers must document resuscitation!

1. Communication with the USAISR Burn Center is essential, starting at the Role 2 level of care.
2. It is logistically challenging, yet important to maintain supplies for burn patients at the Role 3 (Theater Hospitalization) role of care. In large-scale combat operations, this will likely include maintenance of supplies for Role 2 capabilities.
3. Caring for host national patients with burns depends on the theater's current medical rules of eligibility. Host national patients with greater than 60% TBSA burns might be considered expectant according to medical, tactical, and operational environments.

## ANTIMICROBIAL PROPHYLAXIS

**Prophylactic systemic antibiotics are not indicated for burn injury in the absence of infection.** Penetrating wounds or open fractures should be treated with antibiotics according to respective guidelines. See the [Wound Care](#) section for discussion of topical antimicrobials.

- Administer tetanus prophylaxis as for any trauma patient.
- If **wound infection is diagnosed clinically** (e.g., burn-wound cellulitis, purulent drainage, marked changes in the color of the eschar, or ongoing conversion of partial thickness burns to full thickness burns), **direct empiric therapy against Gram-positive and Gram-negative bacteria is indicated based on known geographic susceptibilities.** If these data are unavailable, broad coverage with vancomycin for Gram positive organisms and a carbapenem (meropenem) or 4th generation cephalosporin (cefepime) for gram negative organisms is advised. If in the Role 1 environment and only have Ertapenem, that is acceptable.

## INHALATION INJURY

**Smoke inhalation injury** is mediated by inhaled toxic gases and carbonaceous particles (soot).

- Risk factors for inhalation injury include burns sustained in an enclosed space (structure, vehicle, or shipboard fires); extensive TBSA; flame burns of the face; and extremes of age.
- Inhalation injury is associated with a higher mortality, especially in burn wounds with >40% TBSA.
- Clinical signs include progressive voice changes, soot about the mouth and nares, dyspnea, and respiratory distress. Hypoxemia may be a late finding. (See [Initial Burn Survey](#) for airway management recommendations). If available, bronchoscopy should be used to confirm diagnosis, grade injury severity, and lavage for debris removal.
- Patients diagnosed with inhalation injury should receive aerosolized unfractionated heparin, 5000 units per ETT every 4 hours; mix heparin with albuterol, as heparin can induce bronchospasm.

**Carbon monoxide (CO) toxicity** include those exposed to smoke from burning hydrocarbons (e.g., vehicle or generator exhaust) or cellulose-containing materials (wood, paper, charcoal).

- Symptoms of CO toxicity include confusion, stupor, coma, seizures, and cardiac ischemia.
- Treatment: Administer 100% oxygen and measure carboxyhemoglobin levels via co-oximetry if available.

**Cyanide** is encountered in fires involving certain nitrogen-containing materials such as polyurethane. Initial symptoms include dizziness, headache, nausea, and anxiety.

- High-dose exposure causes rapid onset of coma, seizure, respiratory depression, hypotension, and tachycardia. Lactate levels > 8 mmol/L suggest cyanide toxicity.
- Treatment: Administer 100% oxygen via mechanical ventilation. Hydroxocobalamin (Cyanokit) is the preferred antidote; infuse 5 g IV over 7 minutes. It may be infused over 2-5 minutes in cases of cardiac arrest or severe hypotension and may be repeated if no clinical improvement. Cyanokit should be available at every Role 3 hospital, and at Role 2 hospitals as well if there is a high risk of managing burn casualties. Role 2 MTFs (including Role 2 capable combatant vessels) should be equipped with Cyanokits if evacuation to Role 3 MTFs is long or not permissive. Cyanokit typically causes dramatic red/violaceous coloration of skin, mucus membranes, and urine; it may also cause hypertension and acute kidney injury.

**Hydrogen fluoride (HF)** is a byproduct of standard fire-suppression systems. Exposure to HF may result in rapidly progressive or fatal respiratory failure despite minimal external evidence of injury. Symptoms include shortness of breath, cough, hypoxia, and hypocalcemia; there must be a high level of suspicion for HF inhalation.<sup>10</sup>

- Treatment of HF inhalation injury is primarily supportive.
- Telemetry monitoring and measure calcium levels. If hypocalcemia is present, administer IV calcium followed by nebulized calcium gluconate (1.5 ml of 10% calcium gluconate in 4.5 ml water) q4hr until normalization of serum calcium levels.
- Consider steroids if symptoms do not improve.

Refer to the [Inhalation Injury and Toxic Industrial Chemical Exposure CPG](#) for additional information.<sup>4</sup>

## OPHTHALMIC INJURY

- Every patient with facial burns should have a thorough eye exam, including Wood's lamp exam with fluorescein, when available. If available, consult an ophthalmologist for all patients with facial burns or corneal injury verified by Wood's lamp exam. Eye exams should be done early, before facial edema sets in.
- If no injury exists, lubricate the eyes of intubated patients every 2 hours with Lacri-lube.
- If a corneal injury is identified, use a Fox shield to cover the eyes and apply ophthalmic erythromycin ointment at least every 2 hours.
- If there is suspicion of an open globe injury, no drops or ointment should be applied, place a Fox eye shield, and refer to an ophthalmologist as soon as possible.
- If resuscitation exceeds 200 mL/kg/TBSA, and/or in the presence of full thickness periorbital burns, perform intraocular pressure measurement using a tonometer (and consult an Ophthalmologist); the patient may require urgent lateral canthotomy and cantholysis.
- Refer to [Eye Trauma: Initial Care CPG](#) for additional information.<sup>4</sup>

## LINES AND TUBES

- **Suture and/or staple all venous and arterial catheters in place**, as tape does not adhere to burned skin. **Do not circumferentially tape lines around extremities**; this may further impede circulation and cause limb ischemia as extremities swell during resuscitation.
- **Use umbilical ties to secure endotracheal, orogastric, nasogastric and Dobhoff tubes.** Note that ties around the ETT may occlude the balloon tubing if they are too tight, giving the appearance of a cuff leak as the balloon is not actually inflated.

## GASTROINTESTINAL PROPHYLAXIS

- Burn patients, regardless of age, are prone to nausea and vomiting as well as stress ulceration.
- Place orogastric or nasogastric tube in all intubated patients for gastric decompression during resuscitation and later for enteral nutrition.
- Administer IV proton pump inhibitor or similar agent to all patients with >20% TBSA burn injury.

## CIRCUMFERENTIAL BURNS, ESCHAROTOMY, & EXTREMITY COMPARTMENT SYNDROME

Escharotomy is normally performed for circumferential full thickness burns.

Check pulses (preferably using a Doppler flowmeter if available). If pulse is decreased or absent:

- Rule out hypovolemia.
- If not hypovolemic, perform escharotomies.

Escharotomy incises the skin only, not the fascia and is usually sufficient for limb ischemia caused by burns unless there is underlying muscle damage, over-resuscitation, or combined injury. **The requirement for escharotomy or fasciotomy usually presents in the first 48 hours following injury.** If the need for either procedure has not been identified within the first 24-48 hours, then circulation is likely to remain adequate without surgical intervention.

- A patient who required escharotomy or fasciotomy at a lower echelon of care should always have their extremity compartments reassessed upon arrival at the next echelon of care. Extension of the incision(s) may be required to restore circulation. This situation can occur if large IV fluid volumes are given during transport, compounding tissue edema. The threshold for escharotomy should be low in patients requiring transportation but must consider the ability to monitor.
- Absent Doppler signals or pulses that are diminishing on hourly exams should prompt immediate consultation with a burn surgeon and strong consideration of surgical decompression with escharotomies.
- **Repeat the vascular exam hourly.** If available, use a handheld Doppler flowmeter to assess the palmar arch and the radial, ulnar, dorsalis pedis, and posterior tibialis arteries. A triphasic signal in the above vessels is considered normal. Consider performing escharotomy early, based upon the vascular exam.



Elevation of the burned extremities (especially the upper extremities) above the level of the heart is required to decrease edema and prevent compartment syndrome.

## Escharotomy

### CLINICAL INDICATIONS:

Deep partial-thickness or full-thickness **circumferential** burns to arms or legs.

- This may mimic compartment syndrome or act like a tourniquet, reducing arterial circulation resulting in ischemia or necrosis of the limb.
- Pulses will feel diminished on exam even after elevation.

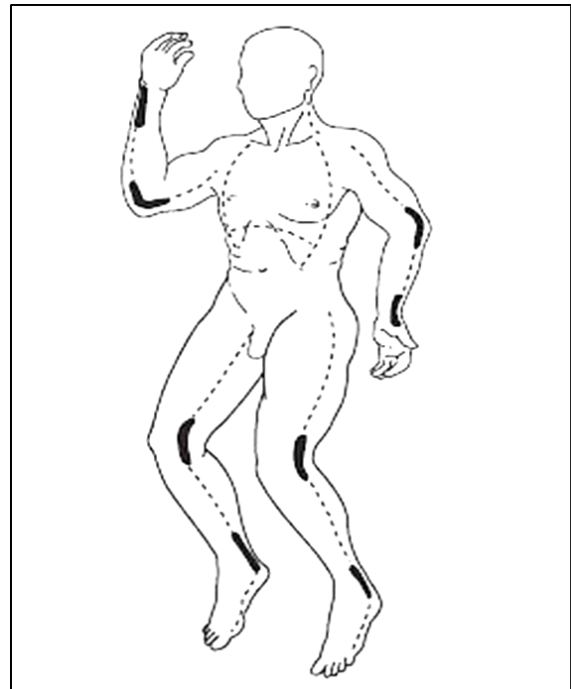
**Circumferential**, full thickness burns to the chest wall.

- This can result in restriction of chest wall expansion and decreased compliance causing difficulty oxygenating and ventilating of intubated patients.
- Clinical manifestations of chest wall restriction include rapid, shallow respirations; poor chest wall excursion; and severe agitation.

### CONTRAINDICATIONS: No contraindications

- Escharotomy is performed by incising circumferential full-thickness burns.
- Extend escharotomy incisions the entire length of the circumferential portion of full-thickness burn.
- The depth of the incision should be through the dermis into the subcutaneous fat. Carry incisions across involved joints (Figure 2).
- Although full thickness burn is insensate, this is a painful procedure, and patients will often require moderate sedation with benzodiazepines and IV narcotics.
- An escharotomy performed to the proper depth should not result in significant bleeding, especially if electrocautery is used. The bleeding that does occur can usually be controlled with electrocautery or topical hemostatics (i.e., Combat Gauze, Avitene). It may require suturing using a silk stitch.
- Upon completion of the escharotomy, reassess perfusion. If circulation is restored, the extremity should be dressed and elevated above the level of the heart. Continue to assess pulses hourly for at least 12-24 hours.

Figure 2: Escharotomy Incisions



## Fasciotomy

**Optimal fluid resuscitation and prompt escharotomy usually mitigates the need for fasciotomy.** Consider fasciotomy in the operating room (OR) if pulses remain undetectable after complete escharotomy.

Due to the frequency of extremity injuries seen among combat casualties, fasciotomies on burned extremities may be required for those with:

- delayed revascularization.
- hemorrhage requiring massive resuscitation.
- fractures, crush, or blast injuries.

Following escharotomy or fasciotomy, late bleeding may occur as circulation is restored. Examine the surgical site every few minutes for up to 30 minutes for signs of new bleeding, which is usually easily controlled with electrocautery.

Refer to [Acute Extremity Compartment Syndrome and the Role of Fasciotomy in Extremity War Wounds CPG](#) for additional information.<sup>23</sup>

## Abdominal Compartment Syndrome

Massive fluid replacement (> 250 mL/kg within 24 hours) is a risk factor for abdominal compartment syndrome (ACS), a clinical diagnosis which includes increased bladder pressure, increased airway pressure, oliguria, and hypotension.<sup>24,25</sup> Bladder pressure > 20 mmHg warrants consideration of therapeutic paracentesis which may provide partial relief. A bladder pressure > 30 mmHg, when measured accurately, is a serious finding that mandates immediate assessment and treatment.

Decompressive laparotomy, when performed for ACS in patients with massive burns, almost always indicates a nonsurvivable situation. The decision to pursue decompressive laparotomy must consider this fact.<sup>24</sup>

**PLEASE CALL THE BURN CENTER PRIOR TO PROCEDURE! Avoiding over resuscitation is key to avoiding ACS.**

If the patient requires a decompressive laparotomy, perform a standard midline incision followed by temporary abdominal closure. If the abdominal wall skin is burned, adhesive drapes for negative pressure wound dressings will not adhere to the skin edges. Use of Stomahesive paste or another barrier is recommended.

## Chemical Burns

1. Expose body surfaces, brush off dry chemicals, and copiously irrigate with clean water. Large volume (> 20 L) serial irrigations may be needed to thoroughly cleanse the skin of residual agents.
2. Do not attempt to neutralize any chemicals on the skin.
3. Use personal protective equipment to minimize exposure of medical personnel to chemical agents. Resuscitation strategy and goals for patients with chemical burns are the same as for thermal injuries.
4. **White phosphorus fragments ignite when exposed to air. Clothing may contain white phosphorus residue and should be removed.**
  - a. Fragments embedded in the skin and soft tissue should be irrigated out if possible or kept covered with soaking wet dressings. **Note that if the dressings dry the white phosphorus may ignite them.**
  - b. Urgently retrieve deeply embedded fragments in the OR.
  - c. Use a Wood's lamp to help locate the fragments. Monitor calcium levels closely and treat hypocalcemia with IV replacement.
  - d. Plan a second-look operation within the day to identify missed fragments.

Refer to [Inhalation Injury and Toxic Industrial Chemical Exposure CPG](#) for additional information.<sup>4</sup>

## Electric Injury

1. First responders should remove the patient from the electricity source while avoiding injury themselves.
2. In cases of cardiac arrest due to arrhythmia after electrical injury, follow advanced cardiac life support (ACLS) protocol and provide hemodynamic monitoring if spontaneous circulation returns.

### Special considerations for electrical injury:

- Extremity compartment syndrome: Particularly with high-voltage electric injury (> 1000 V), skin contact points (cutaneous burns) of limited extent can hide extensive soft-tissue damage. Observe the patient closely for clinical signs of compartment syndrome (refer to the Circumferential Burns section above), and the Extremity Compartment Syndrome or [Appendix E](#).
- Fasciotomy vs escharotomy: Fasciotomy is typically required for extremity compartment syndrome caused by electrical injury. Note that escharotomy, which relieves the tourniquet effect of circumferential burns, will not relieve elevated muscle compartment pressure due to myonecrosis associated with high-voltage electric injury.
- Rhabdomyolysis: Compartment syndrome and muscle injury may cause rhabdomyolysis, causing pigmenturia and acute kidney injury. Patients with clinically significant pigmenturia will have visibly red or brown urine. If available, monitor CK levels every 6 hours. Balancing crystalloid resuscitation to avoid renal failure without over resuscitation is a challenge in these patients.
- Increased fluid goals: Fluid resuscitation requirements are higher than those predicted for a similarly sized thermal burn. Isotonic fluid infusion should be adjusted to maintain UOP 75-100 mL/hr in adult patients with pigmenturia

until it resolves (urine returns to clear or light yellow). Urinalysis-based heme pigment tests remain positive longer and should not be used for determining when to stop treatment.

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## WOUND CARE

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1. Significant resources are required for wound care of major burns. **At the Role 1 or Role 2, consider rapidly transferring a patient to a higher echelon of care if possible**, providing dry dressings and hypothermia protection enroute. Bear in mind that any dressings will likely be immediately removed upon arrival at the next echelon of care to facilitate patient evaluation.
2. Debride burns by removing sloughed skin, blisters, and debris, and apply an effective topical antimicrobial, within the first 24 hours postburn.
3. **Whenever possible, do debridement in the OR**, thereby providing a clean, warm environment to both examine the wounds and place sterile dressings. Use chlorhexidine gluconate or similar antiseptic cleanser. Debridement may be facilitated by scrub brushes and/or gauze sponges. **Definitive removal of burn eschar (sharp/surgical excision) will be performed after stabilization and transport to the Burn Center.**
4. **Topical antimicrobials.** One of the following regimens should be used for burn-wound care.
  - a. **Alternating agents.** After daily cleansing and debridement using CHG, **apply a layer of mafenide acetate (Sulfamylon) cream in the morning, and silver sulfadiazine (Silvadene) cream 12 hours later.** One 400-g container of burn cream covers about 20% TBSA. Although labor- and resource-intensive, this is the **ideal regimen.**
  - b. **Silver-nylon dressings (e.g., Silverlon).** This product is used in clean, fully debrided burns at low risk of infection. Apply to burns; cover with sterile gauze; moisten with clean or sterile water. **Remoisten QID** and as needed to keep dressings lightly moist. **The dressing may be kept in place for 3-5 days** if there is no evidence of infection. This is advantageous, for example, during long-distance evacuations.
  - c. **Antimicrobial solutions.** Apply gauze dressings, followed by diluted **Dakin's solution (e.g., quarter strength, 0.125%), 0.5% silver nitrate solution, or acetic acid.** Reapply the same solution at least every 6 hours. Change dressings daily.
  - d. **Bacitracin.** This topical agent has a limited spectrum of antimicrobial efficacy but is acceptable for small, clean, partial thickness burns treated on an outpatient basis. It may be covered by Xeroform gauze followed by a dry gauze dressing.
  - e. **Medihoney or Manuka honey** has been shown to be as effective as Silvadene for burn wounds. Honey can also promote healing in partial thickness burn wounds.<sup>26</sup> Honey dressings should be applied twice a day and used with Adaptic or Xeroform gauze to keep the wound moist. Honey has strong antimicrobial properties but is not easy to keep in contact with the burn wounds because it melts. One technique is to layer the honey on the Adaptic or Xeroform gauze and then lay it over the burn wound followed by dry gauze. Honey can cause discomfort (burning/stinging) when applied, which subsides in 15-20 minutes. Honey should not be used on full thickness burns.
5. **Face burns.** Shave and debride the face, covering wounds with a topical antibiotic ointment QID such as bacitracin. Ear burns are prone to chondritis; apply Sulfamylon cream twice a day. (An alternative is Silvadene cream.) Avoid pressure from endotracheal tube ties or pillows.
6. **Avoid over-wetting dressings** to avoid maceration of tissues. Frequent assessment of the patient's temperature is necessary to prevent hypothermia secondary to wet dressings, especially during air evacuation.

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## GUIDELINES FOR PATIENTS WHO CANNOT BE EVACUATED

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Definitive care is defined as surgical excision and grafting with healing of burns. For U.S. Service Members it is provided at the USAISR Burn Center at Brooke Army Medical Center, Fort Sam Houston, TX. Partner and/or ally forces progress along the evacuation chain to return to their home nation healthcare facilities. Depending on the theater of operations, the care available to local national patients may not compare to that available for U.S. and partner/ally forces.

For U.S. and partner/ally service members who cannot be evacuated to a higher level of care for days to weeks:

1. Call the Burn Center for consultation
2. Debride burns within 24 hours postburn as described above.
3. Perform daily wound care as described above based on available resources.
4. For patients with a less than 50% TBSA burn, proceed with resuscitation and wound debridement as described above if resources allow.
5. Burns in excess of 20% TBSA generally require early excision and grafting within a week to maximize chance of survival.
6. If performing excision and grafting (refer to [Appendix F](#)), contact the USAISR Burn center prior to the procedure if possible.

## TRIAGE PRINCIPLES

- Triage of patients to an expectant category may be required if their burns exceed local capacity to treat and rehabilitate. Local capacity refers to either the deployed U.S. MTF, or the local national healthcare system, depending on medical rules of engagement and U.S. MTF bed space.
- Another method for doing triage is based on the Baux score, defined as the age plus the burn size. For example, a 20-year-old with an 80% TBSA burn has a Baux score of  $20+80 = 100$ . At a Baux score of 100, the risk of death in a CONUS burn center is currently about 50%. In a mass-casualty or austere setting in which triage is required, a reasonable approach is to use scarce resources for patients with a Baux score of 100 or less.
- The above considerations mean that accurate calculation of burn size is essential to preclude wrongly placing a patient with a survivable burn in the expectant category. Burn size is often over-estimated by inexperienced personnel. Use the Lund Browder chart carefully ([Appendix B](#)).
- Consideration should also be taken for concomitant inhalation injury, medical co-morbidities, and nonburn trauma, all of which can increase mortality.
- Call the Burn Center for consultation.
- If caring for expectant casualties, provide adequate comfort-care measures.

The following factors should be considered when assessing whether to provide definitive care to a host-nation patient in the deployed setting:

- The deployed team's experience and skill level in burn care
- The bed capacity of the deployed hospital
- The tactical situation on the ground (e.g., the likelihood of casualty influx)
- The availability of dressings and other burn-specific supplies
- The quality and capacity, if any, of local host-nation facilities to provide follow-on care
- The availability of non-governmental organizations to provide care to certain patient groups, such as children

The following facts should be borne in mind as well:

- Burn patients in CONUS typically require one day of hospitalization per percent burn (e.g., a 30% TBSA burn patient requires on average a 30-day hospitalization).
- Because of infection risk, and unlike other forms of trauma, **burns in excess of about 20% TBSA constitute a life-threatening problem until the wounds are largely closed. Likewise, deep burns of functional areas like the hands and periorbital structures represent limb- or eyesight-threatening problems until the wounds are healed.** These considerations should influence the interpretation of the medical rules of engagement for host-nation burn patients.
- The 50% TBSA cut off for host-nation patients employed during OIF and OEF must be interpreted in the context of burn depth, not just burn size. A full thickness burn of 50% TBSA is much harder to take care of (and more likely to be lethal) than a superficial partial thickness burn of 50% TBSA. The full-thickness burn will require multiple

surgeries. The superficial partial-thickness burn may heal spontaneously with topical care. Also, clinical assessment of burn depth may change over time because of the effects of burn shock on wound perfusion. Thus, verification of burn depth and size after completion of resuscitation is a prudent best practice when deciding whether to proceed with definitive care, or not—especially in patients with burns at the margin, that is, about 50% TBSA or slightly greater.

It is sometimes difficult to determine the full extent of the full thickness burn at the time of initial presentation. For patients with **combined partial- and full-thickness burns initiate resuscitation and allow the partial thickness component to declare itself. After approximately 48-72 hours, reassess the patient to more accurately estimate the percentage of full-thickness burn.**

Burn injuries may initially appear survivable, but skin-graft loss, infections, or other complications may transform a potentially survivable injury into a fatal one. Be aware of this possibility and the potential change to an expectant category.

## CONSIDERATIONS FOR PEDIATRIC PATIENTS

Deployed teams frequently care for injured local national children. Burn care for children generally follows adult recommendations, with a few modifications as itemized below.<sup>27</sup> See [Appendix C: Pediatric Lund Browder Burn Estimate and Diagram](#).

Airway patency can be lost early in small children with facial burns, inhalation injury, or extensive body burns. Modest mucosal edema can quickly compromise a small airway. Carefully securing the ETT with umbilical ties and adequate sedation are important to prevent unplanned extubation.

Peripheral or intraosseous vascular access may suffice initially, but central venous access is more reliable during formal burn resuscitation; catheters should be sewn in place.

Children with burns under 10% TBSA usually do not need a calculated resuscitation. They can be given 1.5x calculated maintenance rate (see 4-2-1 Rule below) and have diapers weighed for urine output. If they can eat, they should be allowed access to bottle feeds. Some of these children can be supported enterally, with nasoenteric infusions of an oral resuscitation formula (see [Appendix G](#)).<sup>28</sup>

**Children with acute burns over 10% of the body surface usually require a calculated resuscitation.** Place a bladder catheter (size 6 Fr for infants and 8 Fr for most small children). The formula for pediatric resuscitation is as follows. The volume for the **first 24 hours is 3 x weight in kg x TBSA. Half of this is programmed for infusion during the first 8 hours.** This yields a starting rate of  $TBSA \times \text{weight in kg} \times 1.5 / 8 \text{ mL/hr}$ .

The fluid rate should be adjusted based on UOP and other indicators of organ perfusion. The goal UOP for children is 0.5-1 mL/kg/hr. Decrease or increase the isotonic fluid rate by approximately 20-25% per hour to maintain this UOP.

Children do not have adequate glycogen stores to sustain themselves during resuscitation. Administer a maintenance rate of D5LR to children <13 years of age. Utilize the 4-2-1 rule: 4 mL/kg for the first 10 kg + 2 mL/kg 2nd 10 kg + 1 mL/kg over 20 kg. This maintenance rate is in addition to the isotonic infusion calculated for burn resuscitation and is not titrated.

**In children with burns > 30% TBSA, early administration of a colloid may reduce overall resuscitation volume.** If needed, initiate 5% albumin at the child's calculated maintenance rate (use the 4-2-1 rule) and subtract this from the isotonic fluid rate; the albumin rate is maintained while the isotonic fluid is adjusted based on UOP.

Monitor resuscitation in children like adults, based on physical examination, input and output measurements, and analysis of laboratory data. The well-resuscitated child should have alert sensorium, palpable pulses, and warm distal extremities. Urine should be glucose negative. Monitor electrolytes every 8 hours during the first 72 hours to diagnose hypo- and hypernatremia and hypocalcemia. If available, monitor calcium levels and replete to maintain  $iCa > 1.1$ .

Cellulitis is the most common infectious complication and usually presents within 5 days of injury. Prophylactic antibiotics do not diminish this risk and should not be used unless other injuries require them. Most anti-streptococcal antibiotics such as penicillin are successful in eradicating this infection. Initial IV antibiotics are advised for most children presenting with fever or systemic toxicity.

Nutrition is critical for pediatric burn patients. Nasogastric feeding may be started immediately at a low rate in hemodynamically stable patients and tolerance monitored. Start with a standard pediatric enteral formula (e.g., Pediasure) targeting 30-35 kcal/kg/day and 2 g/kg/day of protein.



Children may rapidly develop tolerance to analgesics and sedatives; dose escalation is commonly required. Ketamine is a useful procedural adjunct. Propofol should be avoided during burn shock.

When burned at a young age, many children will develop disabling contractures. These are often very amenable to correction which may be performed in theater with adequate staff and resources. Seek early consultation from the USAISR Burn Center.

Opportunities for pediatric surgical care provided by non-governmental organizations (NGOs) may be the best option but require the coordinated efforts of the military, host nation, and NGOs.

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## PERFORMANCE IMPROVEMENT (PI) MONITORING

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### POPULATION OF INTEREST

All burn casualties (as identified by diagnosis code).

### INTENT (EXPECTED OUTCOMES)

1. All burn patients with GCS < 8, symptomatic inhalation injury, deep facial burns, or burns ≥ 40% receive a definitive airway (endotracheal tube, cricothyroidotomy, or tracheostomy) prior to interfacility transfer (Role 2 to Role 3 or Role 3 to Role 4).
2. All patients with burns ≥ 20% TBSA receive formal fluid resuscitation documented on the burn flow sheet.
3. Urine output is documented for any patient undergoing fluid resuscitation.
4. Debridement (cleansing) of wounds with a surgical antiseptic to remove blisters and debris and application of a topical antimicrobial occurs within 24 hours of injury.
5. Escharotomy is performed for circumferential full-thickness burns.

### PERFORMANCE/ADHERENCE METRICS

1. Patients with burns ≥ 40% TBSA or GCS < 8 or inhalation injury with AIS severity code > 1 or facial burns with face AIS >2 who receive a definitive airway (endotracheal tube, cricothyroidotomy, or tracheostomy) at first surgical capability.
2. Patients with burn ≥ 20% TBSA who have burn flow sheet completed.
3. Patients have UOP documented during fluid resuscitation.
4. Patients who undergo debridement and application of a topical antimicrobial within 24 hours of injury.
5. Patients with circumferential full-thickness burn who receive escharotomy.

### DATA SOURCE

- Patient Record
- Department of Defense Trauma Registry (DoDTR)
- Burn Navigator data.

### SYSTEM REPORTING & FREQUENCY

The above constitutes the minimum criteria for PI monitoring of this CPG. System reporting will be performed annually; additional PI monitoring and system reporting may be performed as needed.

The system review and data analysis will be performed by the Joint Trauma System (JTS) Chief and the JTS PI team.

## RESPONSIBILITIES

It is the trauma team leader's responsibility to ensure familiarity, appropriate compliance, and PI monitoring at the local level with this CPG. It is the responsibility of the nurse assigned to the trauma patient to ensure the Burn Navigator or Burn Flow Sheet ([Appendix D](#)) is initiated and completed.

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## APPENDIX A: PHYSICIAN'S ORDER SET

1. **Diagnosis:** \_\_\_\_\_
2. **Condition:** VSI SI NSI Category: Nation/Service (e.g., US/USA, HN/IA)
3. **Allergies:** Unknown NKDA Other
4. **Monitoring**
  - 4.1. Vital signs: Q \_\_\_\_\_ hrs
  - 4.2. Urine output: Q \_\_\_\_\_ hrs
  - 4.3. Transduce bladder pressure Q \_\_\_\_\_ hrs
  - 4.4. Neurovascular/Doppler pulse checks Q \_\_\_\_\_ hrs
  - 4.5. Transduce: \_\_\_\_\_ CVP \_\_\_\_\_ A-line \_\_\_\_\_ Ventriculostomy
  - 4.6. Neuro checks: Q \_\_\_\_\_ hrs
  - 4.7. Cardiac monitor: Yes / No
5. **Activity**
  - 5.1. \_\_\_\_\_ Bedrest \_\_\_\_\_ Chair Q shift \_\_\_\_\_ Ad lib \_\_\_\_\_ Roll Q 2 hrs
  - 5.2. \_\_\_\_\_ Passive ROM to UE and LE Q shift
  - 5.3. Spine precautions: \_\_\_\_\_ C-Collar /C-Spine \_\_\_\_\_ TLS Spine
6. **Wound Care**
  - 6.1. \_\_\_\_\_ NS wet to dry BID to: \_\_\_\_\_
  - 6.2. \_\_\_\_\_ Dakin's wet to dry BID to: \_\_\_\_\_
  - 6.3. \_\_\_\_\_ VAC dressing to \_\_\_\_\_ 75 mm Hg \_\_\_\_\_ 125 mm Hg
  - 6.4. \_\_\_\_\_ Abdominal closure drains to LWS
  - 6.5. \_\_\_\_\_ Other: \_\_\_\_\_

### Face & Ears

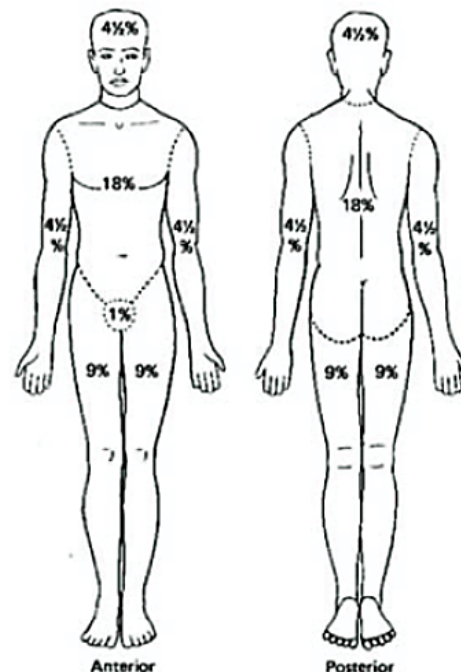
- \_\_\_\_\_ Bacitracin ointment BID & PRN
- \_\_\_\_\_ Sulfamylon cream to ears BID & PRN
- \_\_\_\_\_ Bacitracin ophth ointment: apply OU Q 6 hrs

### BUEs & Hands, BLEs, Chest, Abdomen & Perineum

- \_\_\_\_\_ Silvadine cream Q AM & PRN (*deep partial & full thickness*)
- \_\_\_\_\_ Sulfamylon cream Q PM & PRN (*deep partial & full thickness*)
- \_\_\_\_\_ Silver nylon dressing and moisten with sterile water approximately every 6 hrs PRN; dressings may be left in place for 72 hrs)

### Back

- \_\_\_\_\_ Silvadine cream Q AM & PRN (*deep partial & full thickness burns*)
- \_\_\_\_\_ Sulfamylon cream Q PM & PRN (*deep partial & full thickness burns*)
- \_\_\_\_\_ Silver nylon dressing and moisten with sterile water approximately every 6 hrs PRN; dressings may be left in place for 72 hrs)



Rule of Nines to calculate initial burn size

## 7. Tubes/Drains

- 7.1. \_\_\_\_ NGT to LCWS or \_\_\_\_ OGT to LCWS
- 7.2. \_\_\_\_ Place DHT \_\_\_\_ Nasal \_\_\_\_ Oral and confirm via KUB
- 7.3. \_\_\_\_ Foley to gravity
- 7.4. \_\_\_\_ Flush feeding tube Q shift with 30 mL water
- 7.5. \_\_\_\_ JP(s) to bulb suction; strip tubing Q 4 hrs and PRN
- 7.6. \_\_\_\_ Chest tube to: \_\_\_\_ 20 cm H<sub>2</sub>O suction (circle: R L Both) or \_\_\_\_ Water seal: (circle: R L Both)

## 8. Nursing

- 8.1. Strict I & O and document on the JTTs Burn Resuscitation Flow Sheet Q 1 hr for burn > 20% TBSA
- 8.2. \_\_\_\_ Clear dressing to Art Line/CVC, change Q 7D and prn
- 8.3. \_\_\_\_ Bair Hugger until temperature > 36° C
- 8.4. \_\_\_\_ Lacrilube OU Q 6 hrs while sedated
- 8.5. \_\_\_\_ Oral care Q 4 hrs; with toothbrush Q 12 hrs
- 8.6. \_\_\_\_ Maintain HOB elevated 45°
- 8.7. \_\_\_\_ Fingerstick glucose Q \_\_\_\_ hrs
- 8.8. \_\_\_\_ Routine ostomy care
- 8.9. \_\_\_\_ Ext fix pin site care
- 8.10. \_\_\_\_ Trach site care Q shift
- 8.11. \_\_\_\_ Incentive spirometry Q 1 hrs while awake; cough & deep breath Q 1 hr while awake

## 9. Diet

- 9.1. \_\_\_\_ NPO
- 9.2. \_\_\_\_ PO diet
- 9.3. \_\_\_\_ TPN per Nutrition orders
- 9.4. \_\_\_\_ Tube Feeding: \_\_\_\_ @ \_\_\_\_ mL/hr OR \_\_\_\_ Advance per protocol

## 10. Burn Resuscitation (%TBSA &gt; 20%)

- 10.1. If available, initiate [Burn Navigator computer decision support system](#) and follow prompts on screen. System will provide recommendations for burn fluid resuscitation; provider should use clinical judgment and consider entire clinical scenario when interpreting recommendations.
- 10.2. Start initial infusion of Lactated Ringers (LR) at \_\_\_\_ mL/hr IV (10 x % TBSA >40 kg <80 kg) (Add 100 mL/hr for every 10 kg > 80 Kg)
- 10.3. Titrate resuscitation IVF as follows to maintain target UOP (Adult: 30-50 mL/hr; Children: 1.0 mL/kg/hr)
  - Decrease rate of LR by 20% if UOP is greater than 50 mL/hr for 2 consecutive hrs
  - Increase rate of LR by 20% if UOP is less than 30 mL/hr (adults) or pediatric target UOP for 2 consecutive hrs
- 10.4. If patient still hypotensive (SBP < 90 mm Hg), begin vasopressin gtt at 0.04 Units/min
- 10.5. Post burn day #2 (Check all that apply)

\_\_\_\_ Continue LR at \_\_\_\_ mL/hr IV

\_\_\_\_ Begin \_\_\_\_ @ \_\_\_\_ mL/hr IV for insensible losses

\_\_\_\_ Start Albumin 5% at \_\_\_\_ mL/hr IV ((0.3 – 0.5 x %TBSA x wt in kg) / 24) for 24 hrs

## 11. IVF (% TBSA ≤ 20%): \_\_\_\_ LR \_\_\_\_ NS \_\_\_\_ D5NS \_\_\_\_ D5LR \_\_\_\_ D5 .45NS \_\_\_\_ + KCl 20 mEq/L @ \_\_\_\_ mL/hr

## 12. Laboratory Studies &amp; Radiology

- 12.1. \_\_\_\_ CBC, Chem-7, Ca/Mg/Phos: \_\_\_\_ ON ADMIT \_\_\_\_ DAILY @ 0300
- 12.2. \_\_\_\_ PT/INR \_\_\_\_ TEG \_\_\_\_ Lactate: \_\_\_\_ ON ADMIT \_\_\_\_ DAILY @ 0300
- 12.3. \_\_\_\_ LFTs \_\_\_\_ Amylase \_\_\_\_ Lipase: \_\_\_\_ ON ADMIT \_\_\_\_ DAILY @ 0300
- 12.4. \_\_\_\_ ABG: \_\_\_\_ ON ADMIT \_\_\_\_ 30 mins after ventilator change \_\_\_\_ Q AM (while on ventilator)
- 12.5. \_\_\_\_ Triglyceride levels after 48 hours on Propofol
- 12.6. \_\_\_\_ Portable AP CXR on admission
- 12.7. \_\_\_\_ Portable AP CXR Q AM



## 13. Prophylaxis

- 13.1. \_\_\_\_\_ Protonix 40 mg IV Q day
- 13.2. \_\_\_\_\_ Lovenox 30 mg SQ BID OR \_\_\_\_\_ Heparin 5000 U SQ TID starting \_\_\_\_\_
- 13.3. \_\_\_\_\_ Pneumatic compression boots

## 14. Ventilator Settings

- 14.1. Mode: \_\_\_\_\_ SIMV \_\_\_\_\_ CMV \_\_\_\_\_ AC \_\_\_\_\_ CPAP
- 14.2. FiO<sub>2</sub>: \_\_\_\_\_ %
- 14.3. Rate: \_\_\_\_\_
- 14.4. Tidal Volume: \_\_\_\_\_ cc
- 14.5. PEEP: \_\_\_\_\_
- 14.6. Pressure Support: \_\_\_\_\_
- 14.7. Insp Pressure: \_\_\_\_\_
- 14.8. I/E Ratio: \_\_\_\_\_
- 14.9. \_\_\_\_\_ APRV: Phi \_\_\_\_\_ Plow \_\_\_\_\_ Thi \_\_\_\_\_ Tlow \_\_\_\_\_ FiO<sub>2</sub>: \_\_\_\_\_ %
- 14.10. \_\_\_\_\_ Maintain patient in soft restraints while on ventilator
- 14.11. \_\_\_\_\_ Wean FiO<sub>2</sub> to keep SpO<sub>2</sub> > 90-96% or PaO<sub>2</sub> 60-100 mmHg
- 14.12. \_\_\_\_\_ nebulizer/MDIs: \_\_\_\_\_ Albuterol \_\_\_\_\_ Atrovent \_\_\_\_\_ Xopenex Unit Dose Q 4 hrs

## 15. Analgesia/Sedation/PRN Medications

- 15.1. Analgesia/sedation goal is Richmond Agitation Sedation Scale (RASS), scale below, of 0 (alert and calm) to -3 (moderate sedation). Hold continuous infusion for RASS of -4 (deep sedation) or higher.
- 15.2. \_\_\_\_\_ Propofol gtt at \_\_\_\_\_ mcg/kg/min, titrate up to 50 mcg/kg/min.
- 15.3. \_\_\_\_\_ Fentanyl gtt at \_\_\_\_\_ mcg/hr titrate up to 250 mcg/hr; for analgesia may give 25-100 mcg IVP Q 15 minutes for acute pain or burn wound care.
- 15.4. \_\_\_\_\_ Morphine gtt at \_\_\_\_\_ mg/hr, titrate up to 10 mg/hr, for analgesia may give 2-10 mg IVP Q 15 minutes for pain or burn wound care.
- 15.5. \_\_\_\_\_ Versed gtt at \_\_\_\_\_ mg/hr, titrate up to 10 mg/hr ; may give 2-5 mg IVP Q 15 minutes for acute agitation or burn wound care.
- 15.6. \_\_\_\_\_ Ativan gtt at \_\_\_\_\_ mg/hr, titrate up to 10 mg/hr; may give 1-4 mg IVP Q 2-4 hours for acute agitation.
- 15.7. Important: Hold continuous IV analgesia/sedation at 0600 hrs for a RASS of -4 or -5. If further analgesia/sedation is indicated, start medications at ½ of previous dose and titrate for target RASS.
- 15.8. \_\_\_\_\_ Morphine 1-5 mg IV Q 15 minutes prn pain
- 15.9. \_\_\_\_\_ Fentanyl 25-100 mcg IV Q 15 minutes prn pain
- 15.10. \_\_\_\_\_ Ativan 1-5 mg IV Q 2-4 hrs prn agitation
- 15.11. \_\_\_\_\_ Percocet 1-2 tablets po Q 4 hrs prn pain
- 15.12. \_\_\_\_\_ Tylenol \_\_\_\_\_ mg / Gm PO / NGT / PR Q \_\_\_\_\_ hrs PRN for fever or pain
- 15.13. \_\_\_\_\_ Morphine PCA; Program (circle one): 1   2   3   4
- 15.14. \_\_\_\_\_ Zofran 4-8 mg IVP Q 4 hrs PRN for nausea/vomiting
- 15.15. \_\_\_\_\_ Dulcolax 5 mg PO / PR Q day PRN for constipation

## 16. Specific Burn Wound Care

- 16.1. Cleanse and debride facial burn wounds with Sterile Water or (0.9% NaCl) Normal Saline Q 12 hrs, use a washcloth or 4x4s to remove drainage/eschar
- 16.2. Cleanse and debride trunk and extremities with chlorhexidine gluconate 4% solution (Hibiclens) and Sterile Water or Normal Saline, before prescribed dressing changes
- 16.3. Change fasciotomy dressings and outer gauze dressings daily and as needed; moisten with sterile water Q 6 hours and as needed to keep damp, not soaking wet.

## 17. Other Orders

- 17.1. \_\_\_\_\_
- 17.2. \_\_\_\_\_

- 18. **Notify Physician if:** SBP < \_\_\_\_\_, MAP < \_\_\_\_\_, HR < \_\_\_\_\_ or > \_\_\_\_\_, SaO<sub>2</sub> < \_\_\_\_\_%, T > \_\_\_\_\_, UOP < 30 mL/hour for 2 consecutive hours

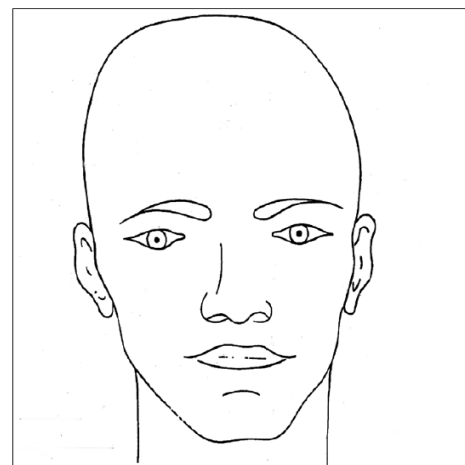
**Richmond Agitation Sedation Scale (RASS)**

| Score | Term              | Description   |
|-------|-------------------|---|
| +4    | Combative         | Overtly combative or violent; immediate danger to staff   |
| +3    | Very agitated     | Pulls on or removes tube(s) or catheter(s) or has aggressive behavior toward staff              |
| +2    | Agitated          | Frequent nonpurposeful movement or patient–ventilator dyssynchrony                              |
| +1    | Restless          | Anxious or apprehensive but movements not aggressive or vigorous                                |
| 0     | Alert and calm    | Spontaneously pays attention to caregiver   |
| -1    | Drowsy            | Not fully alert, but has sustained (more than 10 seconds) awakening, with eye contact, to voice |
| -2    | Light sedation    | Briefly (less than 10 seconds) awakens with eye contact to voice                                |
| -3    | Moderate sedation | Any movement (but no eye contact) to voice  |
| -4    | Deep sedation     | No response to voice, but any movement to physical stimulation                                  |
| -5    | Unarousable       | No response to voice or physical stimulation  |

## APPENDIX B: ADULT LUND BROWDER BURN ESTIMATE & DIAGRAM

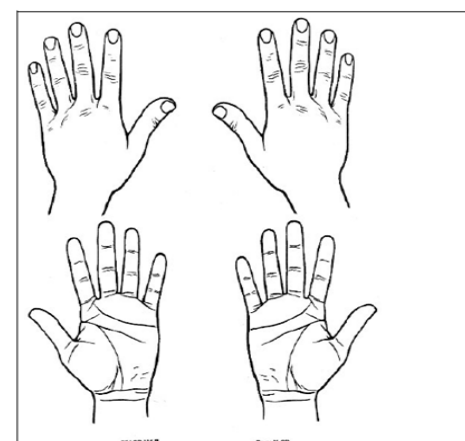
| Total Area front/back<br>(circumferential) |       | one side-<br>anterior | one side-<br>posterior | Do not<br>include in<br>total TBSA |                   |                   |      |
|--|-------|-----------------------|------------------------|------------------------------------|-------------------|-------------------|------|
|  | Adult | adult                 | adult                  | 1 <sup>st</sup> °                  | 2 <sup>nd</sup> ° | 3 <sup>rd</sup> ° | TBSA |
| Head                                       | 7     | 3.5                   | 3.5                    |                                    |                   |                   | 0    |
| Neck                                       | 2     | 1                     | 1                      |                                    |                   |                   | 0    |
| Anterior trunk*                            | 13    | 13                    | 0                      |                                    |                   |                   | 0    |
| Posterior trunk*                           | 13    | 0                     | 13                     |                                    |                   |                   | 0    |
| Right buttock                              | 2.5   | na                    | 2.5                    |                                    |                   |                   | 0    |
| Left buttock                               | 2.5   | na                    | 2.5                    |                                    |                   |                   | 0    |
| Genitalia                                  | 1     | 1                     | na                     |                                    |                   |                   | 0    |
| Right upper arm                            | 4     | 2                     | 2                      |                                    |                   |                   | 0    |
| Left upper arm                             | 4     | 2                     | 2                      |                                    |                   |                   | 0    |
| Right lower arm                            | 3     | 1.5                   | 1.5                    |                                    |                   |                   | 0    |
| Left lower arm                             | 3     | 1.5                   | 1.5                    |                                    |                   |                   | 0    |
| Right hand                                 | 2.5   | 1.25                  | 1.25                   |                                    |                   |                   | 0    |
| Left hand                                  | 2.5   | 1.25                  | 1.25                   |                                    |                   |                   | 0    |
| Right thigh                                | 9.5   | 4.75                  | 4.75                   |                                    |                   |                   | 0    |
| Left thigh                                 | 9.5   | 4.75                  | 4.75                   |                                    |                   |                   | 0    |
| Right leg                                  | 7     | 3.5                   | 3.5                    |                                    |                   |                   | 0    |
| Left leg                                   | 7     | 3.5                   | 3.5                    |                                    |                   |                   | 0    |
| Right foot                                 | 3.5   | 1.75                  | 1.75                   |                                    |                   |                   | 0    |
| Left foot                                  | 3.5   | 1.75                  | 1.75                   |                                    |                   |                   | 0    |
|  |       |                       |                        |                                    |                   |                   |      |
|  | 100   | 48                    | 52                     | 0                                  | 0                 | 0                 | 0    |

### ADULT BURN DIAGRAM: HEAD

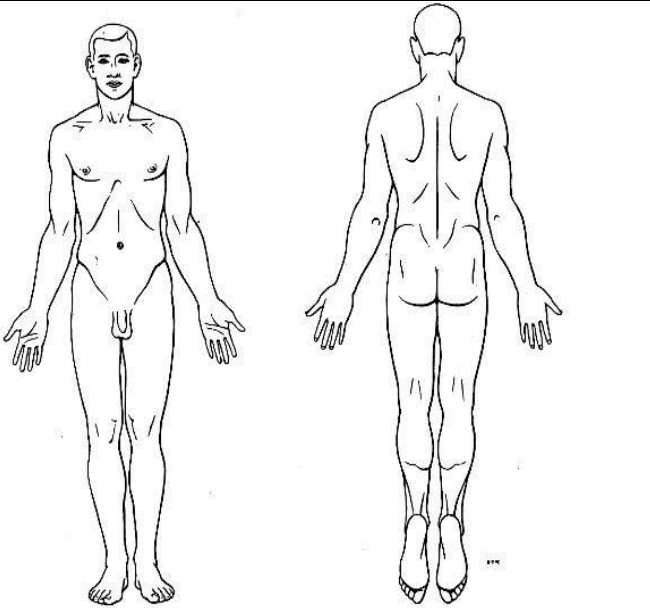


A line drawing of a human head and neck, used for recording burn areas. The drawing is facing forward. Below the drawing, there are two horizontal lines for recording data: "Date: \_\_\_\_\_" and "Name: \_\_\_\_\_".

### ADULT BURN DIAGRAM: HANDS



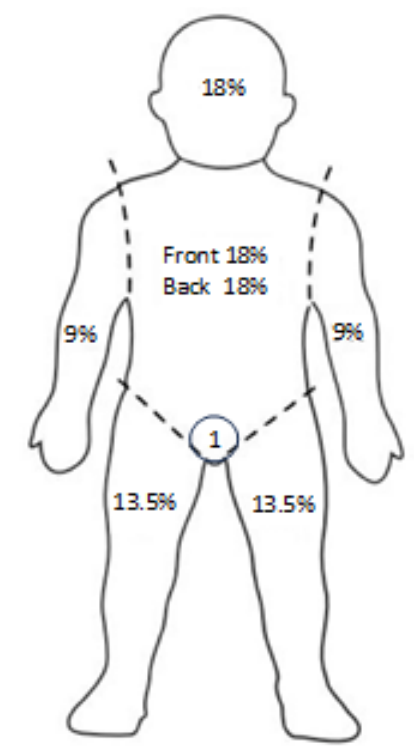
A line drawing of two hands, palms facing forward, used for recording burn areas. Below the drawing, there are two horizontal lines for recording data: "Date: \_\_\_\_\_" and "Name: \_\_\_\_\_".

|                        |  |   |  |
|------------------------|--|---|--|
|                        |  |  <p>DIAGRAM A</p> <p>Figure 22 (17)</p> |  |
| Age:                   |  |   |  |
| Sex:                   |  |   |  |
| Weight:                |  |   |  |
| Patient Identification |  |   |  |

## APPENDIX C: PEDIATRIC LUND BROWDER BURN ESTIMATE & DIAGRAM

### INFANT BURN ESTIMATE AND DIAGRAM

| Total area front/back (circumferential) | Birth-1 yr | Do NOT include in total TBSA 1st | 2nd | 3rd | TBSA |
|---|------------|----------------------------------|-----|-----|------|
| Head                                    | 19         |                                  |     |     | 0    |
| Neck                                    | 2          |                                  |     |     | 0    |
| Anterior trunk                          | 13         |                                  |     |     | 0    |
| Posterior trunk                         | 13         |                                  |     |     | 0    |
| Right buttock                           | 2.5        |                                  |     |     | 0    |
| Left buttock                            | 2.5        |                                  |     |     | 0    |
| Genitalia                               | 1          |                                  |     |     | 0    |
| Right upper arm                         | 4          |                                  |     |     | 0    |
| Left upper arm                          | 4          |                                  |     |     | 0    |
| Right lower arm                         | 3          |                                  |     |     | 0    |
| Left lower arm                          | 3          |                                  |     |     | 0    |
| Right hand                              | 2.5        |                                  |     |     | 0    |
| Left hand                               | 2.5        |                                  |     |     | 0    |
| Right thigh                             | 5.5        |                                  |     |     | 0    |
| Left thigh                              | 5.5        |                                  |     |     | 0    |
| Right leg                               | 5          |                                  |     |     | 0    |
| Left leg                                | 5          |                                  |     |     | 0    |
| Right foot                              | 3.5        |                                  |     |     | 0    |
| Left foot                               | 3.5        |                                  |     |     | 0    |



## CHILD BURN ESTIMATE AND DIAGRAM

| Total area front/back<br>(circumferential) | 1 -4<br>years | 5 -9<br>years | 10 -14<br>years | 15<br>years | Do NOT<br>include in<br>total TBSA<br>1st | 2nd | 3rd | TBSA |
|--|---------------|---------------|-----------------|-------------|---|-----|-----|------|
| Head                                       | 17            | 13            | 11              | 9           |   |     |     | 0    |
| Neck                                       | 2             | 2             | 2               | 2           |   |     |     | 0    |
| Anterior trunk*                            | 13            | 13            | 13              | 13          |   |     |     | 0    |
| Posterior trunk#                           | 13            | 13            | 13              | 13          |   |     |     | 0    |
| Right buttock                              | 2.5           | 2.5           | 2.5             | 2.5         |   |     |     | 0    |
| Left buttock                               | 2.5           | 2.5           | 2.5             | 2.5         |   |     |     | 0    |
| Genitalia                                  | 1             | 1             | 1               | 1           |   |     |     | 0    |
| Right upper arm                            | 4             | 4             | 4               | 4           |   |     |     | 0    |
| Left upper arm                             | 4             | 4             | 4               | 4           |   |     |     | 0    |
| Right lower arm                            | 3             | 3             | 3               | 3           |   |     |     | 0    |
| Left lower arm                             | 3             | 3             | 3               | 3           |   |     |     | 0    |
| Right hand                                 | 2.5           | 2.5           | 2.5             | 2.5         |   |     |     | 0    |
| Left hand                                  | 2.5           | 2.5           | 2.5             | 2.5         |   |     |     | 0    |
| Right thigh                                | 6.5           | 8             | 8.5             | 9           |   |     |     | 0    |
| Left thigh                                 | 6.5           | 8             | 8.5             | 9           |   |     |     | 0    |
| Right leg                                  | 5             | 5.5           | 6               | 6.5         |   |     |     | 0    |
| Left leg                                   | 5             | 5.5           | 6               | 6.5         |   |     |     | 0    |
| Right foot                                 | 3.5           | 3.5           | 3.5             | 3.5         |   |     |     | 0    |
| Left foot                                  | 3.5           | 3.5           | 3.5             | 3.5         |   |     |     | 0    |

|   |  |
|---|--|
| 1 |  |
| 2 |  |
| 3 |  |



## APPENDIX D: BURN RESUSCITATION PROTOCOL, WORKSHEET & FLOW SHEET

### THE BURN RESUSCITATION PROTOCOL

The JTS Burn Resuscitation Flow Sheet provides clinicians with a tool to track burn resuscitation over a 72-hour period. Conceptually, the flow sheet creates a continuum between clinicians during the resuscitation phase. This format allows clinicians to accurately trend intake and output, hemodynamics and vasoactive medications, and promotes optimal outcomes through precise patient management.

1. The clinicians at the first medical facility where the patient receives treatment will initiate the JTS Burn Resuscitation Flow Sheet. This treatment facility will be listed in the “Initial Treatment Facility” block. Clinicians at any role of care (R1, R2, R3, R4) may initiate the flow sheet.
2. Record today’s date in the “Date” block according to the current date where the recorder is located. (Do not adjust this date based on the patient’s origin or destination; use the local date).
3. Record the patient’s full name and DoD ID number or social security number in the “Name” and “SSN” blocks. Document name and DoDID/SSN on all three pages of the flow sheet.
4. Record the patient’s weight in the “Pre-burn est. wt (kg)” block. In theater, record the estimated weight based on the patient’s weight prior to injury or “dry weight.” If a patient presents prior to initiating resuscitation and an accurate weight can be easily obtained without delaying care, providers are urged to weigh the patient and record the result.
5. Record the total body surface area burned in the “%TBSA” block (do not include superficial injury in this calculation). Clinicians will assess the burn size and use this value to determine fluid resuscitation requirements. Following the patient’s transfer to another facility, the receiving clinicians are required to “re-map” the burn, considering the burn wound may “convert” (or become deeper) between assessments or during transport between two facilities.
6. Burn Fluid Resuscitation Calculations: Use the Rule of Tens to determine fluid requirements for the first 24 hours post-burn. (Rule of Tens:  $10 \times \% \text{ TBSA} > 40 \text{ kg}$  and  $< 80 \text{ kg}$ ; if  $> 80 \text{ kg}$ , add 100 ml/hr for every 10 kg  $> 80 \text{ kg}$ ). At 8-12 hours post-burn, reevaluate resuscitation efforts and assess for potential over resuscitation. If fluid resuscitation needs exceed 6 ml/kg/%TBSA in 24 hours, consider the guidelines established in the Emergency War Surgery Handbook and the addendum to the handbook, “Recommendations for Level IV Burn Care.” [LRMC specific: USAISR/BAMC Burn Unit Guidelines can also be found in the LRMC Burn Care Guide.]
  - a. Clinicians at the first medical facility to treat the patient will calculate the fluid requirements for the first 24 hours post-burn and record the amount in the block on page 1 labeled “Estimated fluid volume patients is administered.”
  - b. Clinicians will record the “fluid volume ACTUALLY received” during the first 24 hours of resuscitation in the block labeled as such at the top of page 2. This amount will equal the actual volume delivered during the first 24 hours (as recorded on page 1).
  - c. Clinicians will transcribe the 24-hour fluid volume totals recorded on pages 1 and 2 of the flow sheets onto page 3 in the block labeled “fluid volume ACTUALLY received.” This allows clinicians to see the first 48-hour totals as the patient enters into the last 24 hours of the 72-hour period.
7. Record the local date and time that the patient was injured in the “Date & Time of Injury” block. This date and time IS NOT the time that the patient arrived at the medical facility, but rather the date and time of INJURY.
8. Record the facility name and/or treatment team in the “Tx Site/Team” block. The facility name/team name is the team of clinicians who managed the patient during each specified hour on the flow sheet. This team may reside within a facility, in which case the facility name is recorded, or be a transport team (e.g., MEDEVAC, CCATT, AEROVAC).
9. “Hr from burn” is defined as the number of hours after the burn injury occurred. If a patient does not arrive at a medical facility until 3 hours after the burn occurred, clinicians do not record hourly values for hours 1-3 but begin

recording the row marked “4th” hour post-burn. To the extent possible, clinicians should confer with level I and II clinicians to determine fluid intake and urine output. These totals may be record in the 3rd hour row.

10. Record the current local time of the recorder in the “Local Time” block. As with date do not adjust time based on the patient’s origin or destination; use the local time.
11. Record the **total volume of crystalloids and colloids administered in the “crystalloid/colloid” column, not the specific fluids delivered**. Clinicians should refer to the critical care flow sheet to determine the fluid types and volumes. This burn flow sheet is designed to track total volumes. Examples of crystalloid solutions are LR, 0.45% NS, 0.9% NS, D5W, and D5LR. Examples of colloids are Albumin (5% or 25%) and blood products. The use of hydroxyl ethyl starch (hexend) as a resuscitation fluid is no longer recommended.
12. Document the name, dosage, and rate of vasoactive agents in the “Pressors” block. Patients who receive vasoactive agents may also have invasive pressure monitoring devices (e.g., arterial line, central venous line, pulmonary artery catheter), in which case significant values should be recorded in the “BP” and MAP (>65)/CVP” columns.
13. For additional guidelines refer to the Emergency War Surgery Handbook and the Recommendations for Level IV Burn Care.

## JTS BURN RESUSCITATION WORK SHEET

Initiate **AFTER** completion of trauma assessment and interventions.

**Adults only:** Refer to [Additional Considerations for Pediatric Burn Patients](#) in the Burn Care CPG.

**1. Contact USAISR Burn Center** (DSN 312-429-2876) or email: usarmy.jbsa.medcom-aisr.list.armyburncenter@health.mil

Date/Time contact: \_\_\_\_\_ POC: \_\_\_\_\_ by: \_\_\_\_\_

**2. Estimated Pre-burn Weight (wt):** \_\_\_\_\_ kg (Average Service Members are 82 ± 15 kg)

**3. Estimate Total Burn Surface Area (TBSA) using Rule of Nines** (refine with Lund-Browder after wounds are cleansed)

Partial thickness (2nd) \_\_\_\_\_ % + Full thickness (3rd) \_\_\_\_\_ % = **TBSA** \_\_\_\_\_ %

**IF TBSA >40%:** intubate (use ETT ≥ 7.5 fr to facilitate bronchoscopy)

**IF TBSA <15%:** formal resuscitation may not be required, provide maintenance and/or oral fluids

**4. Standard Burn Resuscitation Fluid: Lactated Ringers (LR) or Plasmalyte**

**5. Calculate INITIAL Fluid Rate using Rule of 10 (adults):**

- IF wt < 40kg: 2ml x %TBSA \_\_\_\_\_ x wt(kg) \_\_\_\_\_ ÷ 16 = \_\_\_\_\_ ml/hr
- IF wt ≥ 40kg: %TBSA \_\_\_\_\_ x 10 = \_\_\_\_\_ ml/hr
- IF wt > 80kg: add 100ml/hr to initial rate for every 10 kg>80: adjusted initial fluid rate = \_\_\_\_\_ ml/hr
- (Example: 100kg patient with 50% TBSA burn = 50% x 10 = 500 ml + 200 ml = 700 ml for first hour)

**6. If Inhalation Injury Present:** administer aerosolized heparin in albuterol (5,000 units Q4 hours)

**7. Titrate Resuscitation Fluid: maintain target UOP 30-50ml/hr (Q 1 hour)**

- If rhabdomyolysis present: use target UOP 75-100 ml/hr (Contact USAISR Burn Center DSN 312-429-2876)
- Goals: UOP >30 but <50ml/hr; adequate tissue perfusion (normalized lactate/base deficit), MAP >65 mmHg
- Minimum fluid rate 125mL/hr LR
- \* Avoid fluid boluses
- \*\* Too much fluid as dangerous as too little

**High risk for over resuscitation/abdominal compartment syndrome:**

- If hourly rate >1500 mL/hr x 2 hrs OR
- If total 24 hr volume exceeds: wt (kg) x 250 ml = \_\_\_\_\_ ml (includes all infused fluids)
- Contact USAISR Burn Center (DSN 312-429-2876)
- Consider adjuncts (below)
- Check bladder pressures Q4hrs (>20 mmHg notify physician)
- Avoid surgical decompression (significant mortality risk in burns).

**Adjuncts:**

1. Colloids: 5% albumin/FFP (Use hextend only if others unavailable; Hextend, as a resuscitation fluid, is no longer recommended.)

- \* Colloids not preferred until hour 8-12; can consider earlier in difficult resuscitation
- Infuse at ml/hr according to chart below based on adult patient weight and burn size.

| 5% Albumin Infusion (ml/hr) | 30-49%TBSA | 50-69% TBSA | 70-100%TBSA |
|-----------------------------|------------|-------------|-------------|
| <70 kg                      | 30         | 70          | 110         |
| 70-90 kg                    | 40         | 80          | 140         |
| >90 kg                      | 50         | 90          | 160         |

2. Vasopressors: Contact USAISR Burn Center (DSN 312-429-2876)

Ensure adequate volume; maintain MAP > 65 mmHg

- Maintain ionized Ca >1.1 mmol/L.
- Start with vasopressin 0.04 units/min. **DO NOT TITRATE.**
- Second line pressor: norepinephrine 2-20 mcg/min.
- Refractory shock: consider epinephrine or phenylephrine infusion.
- Refractory shock: consider adrenal insufficiency, give hydrocortisone 100mg IV Q8 hours.
- Manage acidemia (pH < 7.2): Use ventilator interventions first, then bicarbonate.
- Renal replacement therapy if available (Contact USAISR Burn Center DSN 312-429-2876).

#### Assessment/Interventions:

- Complete full secondary trauma exam
- Ensure thermoregulation; administer warmed fluids; cover with space blanket; elevate burned extremities.
- Superficial burn (1<sup>st</sup> degree): Sunburn, no blister, blanch readily; NOT included in TBSA
- Partial thickness (2<sup>nd</sup> degree): Blanch, moist, blisters, sensate
- Full thickness (3<sup>rd</sup> degree): Leathery, white, non-blanching, dry, insensate, thrombosed vessels
- Protect eyes with moisture shields if corneas exposed or blink reflex slow; apply ophthalmic erythromycin ointment at least Q2hrs.
- Prompt intubation for facial burns, suspected inhalation injury, TBSA >40%
  - Anticipate induction-associated hypotension.
  - Use size 8 ETT.
  - Secure ETT with cloth tie, not adhesive tape.
  - Reassess ETT position at teeth Q1 hour as edema develops and resolves.
  - Intubated patients require oro/naso-gastric tube for decompression.
  - Administer IV proton-pump inhibitor.
- Monitor bladder pressure at least Q4hrs for large burns or high-volume resuscitations.
  - Abdominal compartment syndrome: decreased UOP, increased pulmonary pressures, difficulty ventilating, bladder pressure remains > 20 mmHg.
  - Avoid decompressive laparotomy; consider percutaneous peritoneal drainage.
  - Reduce crystalloid volume using colloid or vasopressors.
- Monitor pulses hourly: palmar arch, dorsalis pedis, posterior tibial with Doppler.
  - Consider escharotomy if signal diminished; refer to Burn CPG for technique (Call USAISR Burn Center DSN 312-429-2876).
- Monitor extremity compartment pressures as clinically indicated.
  - Elevate burned extremities at all times.
  - Extremity compartment syndrome: pain, paresthesia, pallor, paralysis, pulselessness (late sign)
  - Fasciotomy may be required.
- Wound care
  - Thoroughly cleanse burn wounds, preferably in Operating Room.
  - Select topical antimicrobial in consultation with Burn Surgeon (Call USAISR Burn Center DSN 312-429-2876) based on product availability, expected transport time, etc.
  - Acceptable to cover burns with dry sheets or clean dressings for first 48 hours.
- All definitive burn surgery done at USAISR Burn Center for US Service Members (DSN 312-429-2876).

**JTS BURN RESUSCITATION FLOW SHEET** (1 of 3)

|                       |                    |            |                                     |                                      |  |   |  |              |   |
|-----------------------|--------------------|------------|-------------------------------------|--------------------------------------|--|---|--|--------------|---|
| Date                  |                    |            |                                     |                                      | Initial Treatment Facility   |   |  |              |   |
| Name                  |                    | DoDID/SSN  |                                     | Pre-burn<br>estimated<br>weight (kg) | %TBSA<br>(Do not<br>include<br>superficial 1 <sup>st</sup><br>degree burn) | Calculate Rule<br>of Tens (if<br>>40<80kg,<br>%TBSA x 10 =<br>starting rate<br>for LR | Calculate max 24hr<br>volume (250 ml x<br>kg)<br>Avoid over-<br>resuscitation, use<br>adjuncts if<br>necessary |              |   |
|                       |                    |            |                                     |                                      |  |   |  |              |   |
| Date & Time of Injury |                    |            |                                     |                                      |  | BAMC/ISR Burn Team DSN 312-429-2876: Yes No   |  |              |   |
| Tx Site/<br>Team      | HR<br>from<br>burn | Local Time | Crystalloid<br>*<br>(LR)<br>Colloid | Total                                | UOP<br>(Target 30-<br>50ml/hr)   | Base Deficit/<br>Lactate  | Heart<br>Rate  | MAP<br>(>65) | Pressors<br>(Vasopressin 0.04<br>u/min)<br>Bladder Pressure<br>(Q4) |
|                       | 1 <sup>st</sup>    |            |                                     |                                      |  |   |  |              |   |
|                       | 2 <sup>nd</sup>    |            |                                     |                                      |  |   |  |              |   |
|                       | 3 <sup>rd</sup>    |            |                                     |                                      |  |   |  |              |   |
|                       | 4 <sup>th</sup>    |            |                                     |                                      |  |   |  |              |   |
|                       | 5 <sup>th</sup>    |            |                                     |                                      |  |   |  |              |   |
|                       | 6 <sup>th</sup>    |            |                                     |                                      |  |   |  |              |   |
|                       | 7 <sup>th</sup>    |            |                                     |                                      |  |   |  |              |   |
|                       | 8 <sup>th</sup>    |            |                                     |                                      |  |   |  |              |   |
|                       | 9 <sup>th</sup>    |            |                                     |                                      |  |   |  |              |   |
|                       | 10 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 11 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 12 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 13 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 14 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 15 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 16 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 17 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 18 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 19 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 20 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 21 <sup>st</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 22 <sup>nd</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 23 <sup>rd</sup>   |            |                                     |                                      |  |   |  |              |   |
|                       | 24 <sup>th</sup>   |            |                                     |                                      |  |   |  |              |   |
| Total Fluids:         |                    |            |                                     |                                      | *Titrate LR to maintain adequate UOP (30-50ml/hr) and perfusion            |   |  |              |   |

**JTS BURN RESUSCITATION FLOW SHEET** (2 of 3)

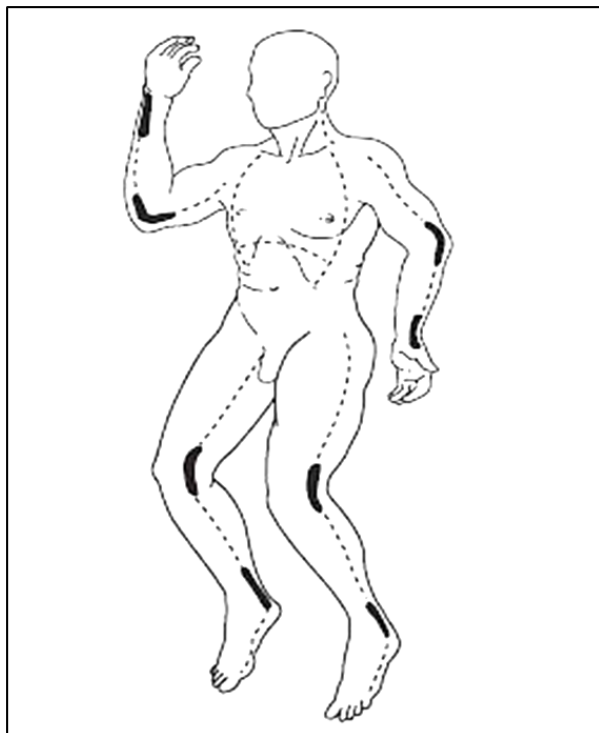
|                       |                  |            |                            |   |                                |  |   |  |  |
|-----------------------|------------------|------------|----------------------------|---|--------------------------------|--|---|--|--|
| Date                  |                  |            |                            | Initial Treatment Facility                                      |                                |  |   |  |  |
| Name                  |                  |            |                            | DoDID/SSN   | Pre-burn estimated weight (kg) | %TBSA (Do not include superficial 1 <sup>st</sup> degree burn) | Calculate Rule of Tens (if >40<80kg, %TBSA x 10 = starting rate for LR) | Calculate max 24hr volume (250 ml x kg)<br>Avoid over-resuscitation, use adjuncts if necessary |  |
|                       |                  |            |                            |   |                                |  |   |  |  |
| Date & Time of Injury |                  |            |                            |   |                                |  | BAMC/ISR Burn Team DSN 312-429-2876: Yes No                             |  |  |
| Tx Site/ Team         | HR from burn     | Local Time | Crystalloid * (LR) Colloid | Total   | UOP (Target 30-50ml/hr)        | Base Deficit/ Lactate  | Heart Rate  | MAP (>65)  | Pressors (Vasopressin 0.04 u/min)<br>Bladder Pressure (Q4) |
|                       | 25 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 26 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 27 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 28 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 29 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 30 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 31 <sup>st</sup> |            |                            |   |                                |  |   |  |  |
|                       | 32 <sup>nd</sup> |            |                            |   |                                |  |   |  |  |
|                       | 33 <sup>rd</sup> |            |                            |   |                                |  |   |  |  |
|                       | 34 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 35 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 36 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 37 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 38 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 39 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 40 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 41 <sup>st</sup> |            |                            |   |                                |  |   |  |  |
|                       | 42 <sup>nd</sup> |            |                            |   |                                |  |   |  |  |
|                       | 43 <sup>rd</sup> |            |                            |   |                                |  |   |  |  |
|                       | 44 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 45 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 46 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 47 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
|                       | 48 <sup>th</sup> |            |                            |   |                                |  |   |  |  |
| Total Fluids:         |                  |            |                            | *Titrate LR to maintain adequate UOP (30-50ml/hr) and perfusion |                                |  |   |  |  |



**JTS BURN RESUSCITATION FLOW SHEET (3 OF 3)**

|                       |                    |            |                                     |   |                                |   |  |  |  |
|-----------------------|--------------------|------------|-------------------------------------|---|--------------------------------|---|--|--|--|
| Date                  |                    |            |                                     | Initial Treatment Facility                                      |                                |   |  |  |  |
| Name                  |                    |            |                                     | DoDID/SSN   | Pre-burn estimated weight (kg) | %TBSA<br>(Do not include superficial 1 <sup>st</sup> degree burn) | Calculate Rule of Tens<br>(if >40<80kg, %TBSA x 10 = starting rate for LR) | Calculate max 24hr volume (250 ml x kg)<br><br>Avoid over-resuscitation, use adjuncts if necessary |  |
|                       |                    |            |                                     |   |                                |   |  |  |  |
| Date & Time of Injury |                    |            |                                     |   |                                | BAMC/ISR Burn Team DSN 312-429-2876: Yes No                       |  |  |  |
| Tx Site/<br>Team      | HR<br>from<br>burn | Local Time | Crystalloid<br>*<br>(LR)<br>Colloid | Total   | UOP<br>(Target 30-50ml/hr)     | Base Deficit/<br>Lactate  | Heart<br>Rate  | MAP<br>(>65 )  | <b>Pressors</b><br>(Vasopressin 0.04 u/min)<br><br>Bladder Pressure (Q4) |
|                       | 49 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 50 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 51 <sup>st</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 52 <sup>nd</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 53 <sup>rd</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 54 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 55 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 56 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 57 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 58 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 59 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 60 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 61 <sup>st</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 62 <sup>nd</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 63 <sup>rd</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 64 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 65 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 66 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 67 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 68 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 69 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
|                       | 70 <sup>th</sup>   |            |                                     |   |                                |   |  |  |  |
| Total Fluids:         |                    |            |                                     | *Titrate LR to maintain adequate UOP (30-50ml/hr) and perfusion |                                |   |  |  |  |

## APPENDIX E: ESCHAROTOMY FIGURE



- Dashed lines indicate the preferred sites for escharotomy incisions.
- Bold lines indicate the importance of extending the incision over involved major joints.
- Incisions are made through the burned skin into the underlying subcutaneous fat using a scalpel or electrocautery.
- For a thoracic escharotomy, begin incision in the midclavicular lines.
- Continue the incision along the anterior axillary lines down to the level of the costal margin.
- Extend the incision across the epigastrium as needed.
- For an extremity escharotomy, make the incision through the eschar along the midmedial or midlateral join line.

*Source: Figure 26.2-1 Emergency War Surgery; Fourth United States Revision; 2013 (page 379).*

### CLINICAL INDICATIONS:

Deep partial-thickness or full-thickness **circumferential** burns to arms or legs.

- This may mimic compartment syndrome or act like a tourniquet, reducing arterial circulation resulting in ischemia or necrosis of the limb.
- Pulses will feel diminished on exam even after elevation.

**Circumferential**, full thickness burns to the chest wall.

- This can result in restriction of chest wall expansion and decreased compliance causing difficulty oxygenating and ventilating of intubated patients.
- Clinical manifestations of chest wall restriction include rapid, shallow respirations; poor chest wall excursion; and severe agitation.

### CONTRAINDICATIONS: No contraindications

### EQUIPMENT:

1. Scalpel, an electrocautery device, or both
2. Chlorhexidine prep
3. Combat gauze and Kerlix
4. Sterile towels

### PROCEDURE:

1. Remove patient's rings, watch, and other jewelry during the initial examination.
2. Prep sterile items/equipment.
3. Outline or identify landmarks.

4. Follow guidelines to make escharotomies bilaterally (medial and lateral) down to the subcutaneous tissue.
  - a. Preferred sites of escharotomy (dashed and solid lines). Particular care is needed to divide eschar over involved joint (solid lines). Care must be taken to avoid major nerves, vessels, and tendons.
  - b. The incision along the extremities should extend through the length of the eschar, over joints, and down to the subcutaneous fat, laterally and medially.
  - c. Chest incisions usually are made bilaterally along the anterior axillary lines and are connected by a transverse incision at the costal margin.
5. Repeat pulse exam in all extremities, if there is no return of circulation return to step 4.
6. Achieve hemostasis with combat gauze and dry Kerlix.
7. Skin color, sensation, capillary refill, and peripheral pulses are assessed and documented hourly.

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## APPENDIX F: BURN EXCISION AND GRAFTING

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Burned patients should undergo evacuation to a role of care capable of prolonged burn care, however, if evacuation is not possible, a surgical team may need to perform definitive burn care (excision and grafting). If members of the surgical team have not had recent experience with burn care, contact the USAISR Burn Center or Advisor Line for assistance.

### **EXCISION OF THE BURN WOUND INDICATIONS:**

- Large (>2%) deep burns to critical areas (hands, feet, face, joints)
- Deep partial-thickness burns not demonstrating wound healing by day 7
- Burn infection (stopped healing or have signs of erythema)

### **EQUIPMENT:**

1. Prep
2. Sterile drapes
3. Weck, Goulian, dermatome, or amalgatome
4. Electrocautery device
5. Epinephrine-soaked gauze
6. Post-op dressings

### **PROCEDURE:**

1. **Use a guard with a depth of 0.008-0.012 inches for excision; deeper burns will need the larger guard.**
2. Optional: place an orthopedic tourniquet for large burns to minimize blood loss. Keep tourniquet time <1hr.
3. Place the blade and guard on the burned skin firmly at a 30–45° angle. Press downward on the burn and move the knife in a slicing motion.
4. Excise down to healthy bleeding tissue (if using a tourniquet, look for healthy tissue).
5. Place epinephrine-soaked gauze over excision and obtain hemostasis with cautery.
6. Autograft (See grafting below) or place dressings.
7. Place topical antibiotic ointment + xeroform gauze for deep partial thickness or a wound vac/wet to dry for full thickness injury.
8. Re-examine in 48-72 hours (sooner if showing systemic/local signs of infection) to ensure no further excision is needed or the wound bed is ready for grafting.

### **SKIN GRAFT HARVEST AND GRAFTING**

Autologous autografting involves taking a segment of skin (epidermis and a portion of the dermis) and placing it on a viable wound bed. A dermatome (or amalgatome) will be needed for grafting. If a large areas are needed to be grafted, a mesher is ideally used to increase the graft coverage. If available, the anterior and lateral thigh is the best option for donor skin.

### **PROCEDURE:**

1. Prep skin (donor site and wound bed ready for grafting ) and drape.
2. Choose width of Dermatome guard (usually 3-4 inches) and set to a depth of 0.010-0.015 in.
3. The skin being harvested must be kept taught to avoid skipping of the Dermatome. This can be done by using a tumescent solution (500mg lidocaine, 0.5mg of epinephrine and 10 mEq of sodium bicarbonate in 1 L of Normal Saline) injected subdermal to raise and tighten the epidermis evenly to allow the Dermatome to pass

evenly over the donor site. The skin can also be kept taught by keeping it under tension with manual pressure or using two penetrating towel clips and pulling on the skin to keep it taught.

4. Place sterile oil (mineral oil) or dilute surgical soap on the site to reduce friction while harvesting.
5. Turn the dermatome on and place it firmly at a 30-degree angle and advance slowly – maintain steady pressure the entire time (pushing hard will not increase the depth of the graft, but pushing too little will result in a thin graft).
6. Watch the donor skin to ensure depth is appropriate (thin portion of white dermis). If this is not seen, increase depth by another 0.002 inches.
7. Near the completion of the graft, flatten the angle and lift away from the skin. If this does not detach the graft from the donor bed, a scalpel or Metzenbaum scissors can be used to transect the graft.
8. Place episoaked gauze on the donor site.
9. Prepare skin graft – pie crust or mesh (1:1.5 or 1:2 is most commonly used).
10. Ensure hemostasis of the donor site and wound bed.
11. Place graft in the wound bed and secure to the wound edges using staples or 4-0 chromic/nylon. Fibrin glues may be used in the wound bed to assist with adherence (if desired/available).
12. Autograft dressing options:
  - a. Xeroform© (or Adaptec© or Telfa©), over the autograft. Topical antibiotic on top of the Xeroform. Then kerlix to secure. OR
  - b. Nonstick dressings over the autograft (above) and then wound vac sponge (black) and then secure the vac sponge with the accompanying supplies. Place suction to 100-125mmHg. OR
  - c. Moisten silver-impregnated bandage and cover the graft. Then place ABD pads and wrap with kerlix.
13. Donor site dressing options:
  - a. After hemostasis, place xeroform directly on the donor site. Cover with ABD pads and kerlix to secure. OR
  - b. Moisten silver impregnated dressing and place directly on the wound. Then wrap with Kerlix. OR
  - c. Tegaderm directly onto the donor site, and secure with an ace bandage.

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## APPENDIX G: ENTERAL RESUSCITATION FOR ADULTS<sup>1</sup>

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Salt-containing fluids, such as World Health Organization Oral Rehydration Solution (WHO ORS), commercially available ORS (e.g., Drip Drop, Ceralyte), or homemade ORS solution (see below), can be given by mouth or nasogastric tube (NGT) when IV fluids are unavailable.

### PROTOCOL

1. Start enteral resuscitation as soon as tactically feasible using rule of 10s to determine initial fluid rate.
  - a. Use a graduated container to measure intake (if one is not available, an adult sip is ~15 mL)
  - b. A straw may make it easier for the casualty to drink.
  - c. If the casualty becomes unconscious or is unable to drink on their own (e.g., hand burns) then place an NGT for administration of resuscitation fluids. Do not place the tube post pyloric, enteral resuscitation must be gastric.
  - d. Obtain IV access and place Foley catheter if available.
  - e. If patient arrives in shock,\* administer 500-mL LR bolus prior to starting enteral resuscitation.
2. Monitor vital signs and urine output hourly (with Foley if available)
  - a. Goal urine output is 30-50 mL/hr
  - b. If urine output monitoring is not available resuscitate to vitals sign goals of:
    - HR <140 BPM
    - SBP >90 mmHg or present radial pulse
    - Normal mental status
    - Capillary refill time < 2 s
    - If patient is in shock\* then administer 500 mL LR bolus and continue enteral resuscitation
3. Titrate fluids based on urine output similar to IV-based resuscitation covered above
4. Give at least 100 mL/hr of enteral resuscitation for the first 48 hours.
5. Ensure adequate pain control and anti-nausea therapy throughout resuscitation.
6. Handling GI discomfort and GI intolerance
  - a. GI discomfort (nausea, fullness)—Continue enteral resuscitation, assess pain/nausea control, administer prokinetic agent (e.g., metoclopramide, erythromycin)
  - b. GI intolerance (distention, vomiting)—Stop enteral resuscitation and start IV fluids at the same rate, administer prokinetic agent, restart enteral resuscitation in 2 hours once intolerance resolves.
7. When to augment enteral resuscitation with IV fluids or switch to IV fluid resuscitation
  - a. Persistent shock\* despite LR bolus
  - b. Persistent oliguria for 4 hours
  - c. Large burns >40%

### Homemade ORS solution recipe:<sup>2</sup>

1. 1 L clean water (sterile water is not necessary)
2. Stir in ½ level teaspoon of salt (or 4 grams)
3. Stir in 6 level teaspoons of sugar (or 20 grams)

\*Shock: SBP <90 or absent radial pulses.

### References

1. Jones, IF; Nakarmi, K; Wild, HB, et al. Enteral resuscitation: a field-expedient treatment strategy for burn shock during wartime and in other austere settings. *Eur. Burn J.* 2024, 5, 23-37.
2. Anonymous. Oral rehydration solutions: Made at home. Mother and child health and education trust, Rehydration Project.



## APPENDIX H: WOUND CARE SUPPLY LIST FOR PERCENTAGE OF CASUALTIES WITH >50% TBSA BURNS

| This list will treat five patients with ≥50% burns for three dressing changes. Topical Creams |  |   |
|---|--|---|
| Description   | Quantity   | Notes   |
| 1% silver sulfadiazine cream  | 50 jars  | 5 jars for 2 dressing changes   |
| 8.5% mafenide acetate cream   | 25 jars  | 5 jars for 1 dressing change  |
| Silver Nylon  |  |   |
| 4-inch roll   | 10 rolls   | For arms BWD-466  |
| 6-inch roll   | 10 rolls   | For legs BCW 6108   |
| Medium glove  | 6 gloves   | ABG-01M   |
| Large glove   | 6 gloves   | ABG-01L   |
| 4x8 sheet   | 5 sheets   | For patching BCD-48   |
| 8x16 sheet  | 5 sheets   | For patching BCD-816  |
| 16x16 sheet   | 5 sheets   | For patching BCD-1616   |
| 24x24 sheet   | 5 sheets   | For an entire torso (one side) BCD 2424   |
| Dressing Supplies   |  |   |
| Description   | Quantity   | Notes   |
| Wound Veil (24x36in)  | 20 packets   | If wound veil is unavailable, Adaptic can be substituted (Adaptic to veil ratio 6:1).   |
| Kerlix  | 90 rolls   | 6 rolls per dressing  |
| 18x18 4-ply gauze pads  | 40 packs   | 5 gauze pads per pack   |
| Tubular elastic netting #1  | 2 boxes  | 25 yards per box  |
| Tubular elastic netting #5  | 2 boxes  | 25 yards per box  |
| Tubular elastic netting #8  | 2 boxes  | 25 yards per box  |
| Tubular elastic netting #11   | 2 boxes  | 25 yards per box  |
| Chlorhexidine gluconate 4% (CHG) or mild, non-perfumed soap, or baby shampoo.                 | 10 bottles of CHG<br>ALTERNATIVES<br>15 bars of individual soap<br>15 1oz bottles baby shampoo | Larger bottles of CHG may be multi-use and poured at a central location. Bars of soap or smaller containers should be single-patient use. |
| Scissors – straight and curved  | 15 pairs   |   |
| Tape  | 30 rolls   | To secure dressings. May also use skin staplers to use in conjunction with netting to secure dressing to dressing                         |

## APPENDIX I: THE BURN NAVIGATOR

The Burn Navigator is a clinical decision support tool available at most burn centers. It guides and monitors fluid resuscitation for severe burn patients who have >20% TBSA burned. If a burn navigator is not available at your location, there is a Burn Navigator mobile application available in the Apple App Store or the Google Play Store. It is called Burn NAV by Arcos Inc.

### INDICATIONS FOR USE

- The Burn Navigator is indicated for use in the care of adult patients with 20% or more TBSA burned, or pediatric patients, 24 months old or older, weighing at least 10 kg with 15% or more TBSA burned, as a fluid resuscitation monitor and calculator for hourly fluid recommendations.
- The Burn Navigator is intended to be used for burn patients of all ages, weights, and co-morbidities as a fluid resuscitation monitor.
- The Burn Navigator is intended to be initiated within 24 hours of the burn incident and to be used no longer than 72 hours post burn.

### BURN NAVIGATOR SCREEN

Room: Training    Weight: 80kg    TBSA: 80%    HPB: 12    13:30

Home   Patient   **Notes**   I/O Table   Volume   I/O Graph

**Notes:**

13:00 HPB: 12  
 Hypotensive: Yes  
 Hyperglycemic: No  
 Pressors: No  
 Diuretics: No

13:00 HPB: 12  
 Recommended rate: 680 mL/hr  
 Entered rate: 700 mL/hr  
 Physician: Dr.  
 Caregiver: Nurse  
 Rationale: Physicians direction

10:14 HPB: 9  
 Confounders:  
 Myoglobinuria: Unknown  
 Hyperglycemic: Unknown  
 High blood alcohol/EtOH: Unknown

**Checklists:**

10:15 HPB: 9  
 Checklist  
 Systolic BP = 85 mmHg  
 Diastolic BP = 64 mmHg  
 CVP = mmHg  
 Heart rate = 115 BPM  
 Bladder pressure = mmHg  
 ScvO2 = %  
 Lactate = 2.1 mg/dL  
 Base Excess = mEq/L  
 Hemoglobin = 10.5 g/dL  
 Left upper pulses = normal  
 Right upper pulses = weak  
 Left lower pulses = normal  
 Right lower pulses = weak  
 Burned extremities elevated  
 Tightness checked

Fluid Update   Stop Burn Navigator   Enter Notes   Enter Checklist   Main Menu   PDF Report

## APPENDIX J: CLASS VIII MEDICAL MATERIEL

Based on the CPG, below is an extensive list of medical supplies, fluid and blood requirements, monitoring equipment, pain medications, and antibiotics for managing burn injuries:

### Medical Supplies

1. Sterile burn dressings
2. Burn sheets or blankets
3. Burn gel or ointment
4. Saline solution for irrigation
5. Tetanus prophylaxis
6. Antibacterial creams or ointments
7. Airway management equipment
8. Burn assessment tools (rule of nines and Modified Brooke)
9. Ambulance equipped with burn-specific supplies
10. Intravenous catheters
11. Blood pressure cuffs and monitors
12. Laboratory equipment for tests (iSTAT blood analyzer and cartridges)
13. Wound care supplies
14. Surgical instruments
15. Nutritional support
16. Psychological support services
17. Endotracheal tubes (size 8 or larger for adults)
18. Cotton umbilical ties for securing ETT
19. Stainless-steel wire for securing ETT, especially in extensive facial burns
20. Laryngeal mask airways (may be ineffective due to edema)
21. Foley catheters with urimeter chamber
22. Fox shields for eye protection
23. Syringes and IV tubing for fluid administration.

### Fluid and Blood Requirements

1. Large-bore IV catheters
2. Central lines kits
3. A-line kits
4. IV fluids (e.g., LR, PlasmaLyte, normal saline)
5. Blood (Whole blood, component therapy)
6. Albumin

### Monitoring Equipment

1. Portable monitor providing continuous vital signs display and invasive monitoring
2. Capnography or capnometry for intubated patients
3. Blood pressure cuff
4. Stethoscope
5. Pulse oximetry
6. Hourly urine output monitoring
7. Burn Resuscitation Worksheet
8. Burn Navigator for fluid rate recommendations
9. Stryker monitor for compartment pressures (can use arterial line setup though)

### Other Equipment

1. Tonometer for measuring intraocular pressure
2. Handheld Doppler flowmeter for vascular exams
3. Telemedicine and associated equipment
4. Patient warming device (Bair Hugger)
5. Hypothermia prevention kit (HPMK)
6. Fluid warming devise (Belmont, buddy light)
7. Laryngoscope
8. Commercial intubation device (Glide scope)
9. Mechanical ventilator (Impact, Save 2, Sparrow)
10. Oxygen (concentrator, or tanks)
11. Vascular doppler
12. ISTAT blood analyzer and cartridges
13. Wood's lamp for eye examination
14. Litmus pH paper for chemical injury

**Surgical Debridement Supplies**

1. Scalpel handles and blades
2. Surgical scissors
3. Forceps
4. Sterile drapes
5. Sutures or staples
6. Wound irrigation solution
7. Surgical suction device
8. Hemostatic agents
9. Dressing materials for post-debridement wound care
10. Electrocautery (Bovie)
11. Surgical scrub brush (chlorhexidine, Hibiclens)

**Medications**

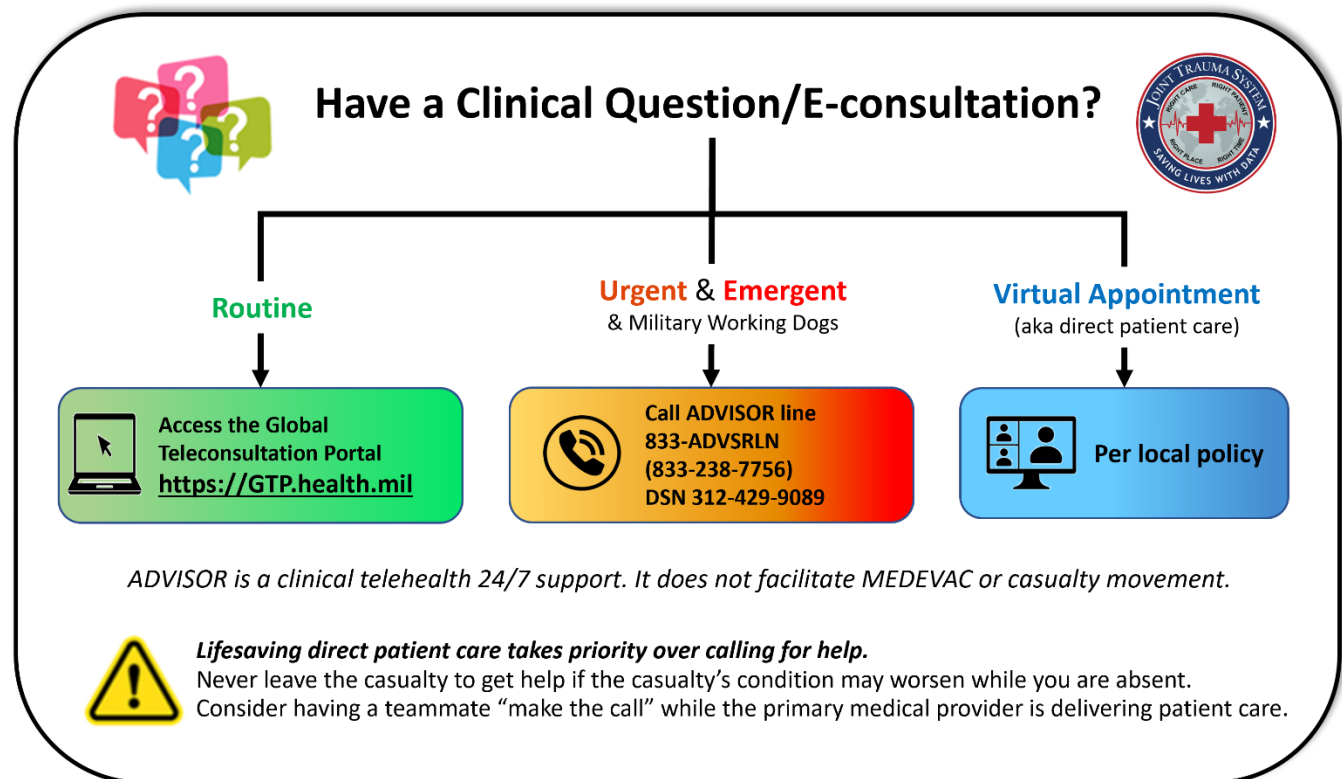
1. Oral rehydration solutions
2. Aerosolized unfractionated heparin mixed with albuterol for inhalation injury
3. Hydroxocobalamin (Cyanokit) for cyanide toxicity
4. IV proton pump inhibitors for stress ulcer prophylaxis
5. Ophthalmic erythromycin ointment
6. Topical antimicrobials (mafenide acetate, silver sulfadiazine, chlorhexidine gluconate)
7. Bacitracin ointment for facial burns
8. Pain medications (e.g., morphine, fentanyl, ketamine, and benzodiazepines)
9. Prophylactic antibiotics not normally used unless other open wounds require them
10. Cefazolin or clindamycin for cellulitis development
11. Broad-spectrum antibiotics for invasive burn wound infection (e.g., ertapenem + ciprofloxacin)
12. Vasoactive medications (vasopressin, levophed)

This comprehensive list covers the necessary medical supplies, fluid and blood requirements, monitoring equipment, pain medications, and antibiotics for managing burn injuries as outlined in the CPG.

For additional information including National Stock Number (NSN), refer to [Logistics Plans & Readiness \(sharepoint-mil.us\)](https://sharepoint-mil.us/LogisticsPlans&Readiness)

**DISCLAIMER:** This is not an exhaustive list. These are items identified to be important for the care of combat casualties.

## APPENDIX K: TELEMEDICINE / TELECONSULTATION



*Illustration by Raymond Samonte*

GTP: <https://GTP.health.mil>

*Theater Patient Movement Requirements Center (TPMRC): to coordinate evacuation*

- TPMRC - Americas (NORTHCOM & SOUTHCOM), 618-817-4200
- TPMRC - East (EUCOM, AFRICOM, CENTCOM), DSN 314-480-8040
- TPMRC - West (INDOPACOM), DSN 315-448-1062

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## APPENDIX L: INFORMATION REGARDING OFF-LABEL USES IN CPGS

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### PURPOSE

The purpose of this Appendix is to ensure an understanding of DoD policy and practice regarding inclusion in CPGs of “off-label” uses of U.S. Food and Drug Administration (FDA)–approved products. This applies to off-label uses with patients who are armed forces members.

### BACKGROUND

Unapproved (i.e., “off-label”) uses of FDA-approved products are extremely common in American medicine and are usually not subject to any special regulations. However, under Federal law, in some circumstances, unapproved uses of approved drugs are subject to FDA regulations governing “investigational new drugs.” These circumstances include such uses as part of clinical trials, and in the military context, command required, unapproved uses. Some command requested unapproved uses may also be subject to special regulations.

### ADDITIONAL INFORMATION REGARDING OFF-LABEL USES IN CPGS

The inclusion in CPGs of off-label uses is not a clinical trial, nor is it a command request or requirement. Further, it does not imply that the Military Health System requires that use by DoD health care practitioners or considers it to be the “standard of care.” Rather, the inclusion in CPGs of off-label uses is to inform the clinical judgment of the responsible health care practitioner by providing information regarding potential risks and benefits of treatment alternatives. The decision is for the clinical judgment of the responsible health care practitioner within the practitioner-patient relationship.

### ADDITIONAL PROCEDURES

#### Balanced Discussion

Consistent with this purpose, CPG discussions of off label uses specifically state that they are uses not approved by the FDA. Further, such discussions are balanced in the presentation of appropriate clinical study data, including any such data that suggest caution in the use of the product and specifically including any FDA-issued warnings.

#### Quality Assurance Monitoring

With respect to such off-label uses, DoD procedure is to maintain a regular system of quality assurance monitoring of outcomes and known potential adverse events. For this reason, the importance of accurate clinical records is underscored.

#### Information to Patients

Good clinical practice includes the provision of appropriate information to patients. Each CPG discussing an unusual off-label use will address the issue of information to patients. When practicable, consideration will be given to including in an appendix an appropriate information sheet for distribution to patients, whether before or after use of the product. Information to patients should address in plain language: a) that the use is not approved by the FDA; b) the reasons why a DoD health care practitioner would decide to use the product for this purpose; and c) the potential risks associated with such use.