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Guidelines for Burn Care Under Austere Conditions

Introduction to Burn Disaster

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Intro to Disasters

Incidence of fire/explosion disasters has decreased during the past 50 years, recent natural disasters and acts of war/terrorism highlight the need for ongoing preparedness.

- Many types of disasters:
  - Nightclub fires (Volendam Café Fire in the Netherlands (2001) the Rhode Island Station Night Club Fire (2003), and the Kiss Night Club Fire (2013) in Santa Maria, Brazil)
  - Natural disasters (Haiti Earthquake-2010, Great East Japan Earthquake-2011)
  - War/terrorism (9/11 attacks-2001, Madrid Train Bombing-2004, and London Subway/Bus Bombings-2005)
- Each type of disaster poses particular challenges.
- Incidents resulting in trauma, burn, or a combination of burn and trauma patients generate competition for scarce resources.
- Health system infrastructure can be catastrophically destroyed and limit the ability to provide the accepted injury standard of care.

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Burn Mass Casualty Incident (BMCI)

- A **BMCI** occurs when the number of burn injuries exceeds available burn resources and exceeds the capacity of the local burn center to provide optimal care
  - Non-disaster medical care criteria are not applicable in such situations
- **Surge capacity** is the balance of staff, space, and supplies (to include equipment and pharmaceuticals) available to meet the needs of a sudden influx of a large number of patients.
- **Triaging** patients requires a rapid, stream-lined approach and the willingness to limit care for one to benefit the many.

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Triage

- To appropriately triage patients, centers must be able to assess both capacity and capability.
- **Capacity** is typically discussed in terms of available designated burn beds and does not consider burn center capability.
- **Capability** encompasses the need for specialized personnel and support staff, operating rooms, supplies, equipment

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Assessment

- A benefit-to-ration triage decision table provides an objective framework for BMCI treatment decisions.
- Patients are classified based on **TBSA**, **age** and whether they have **inhalation injury**.

TBSA = Total Burn Surface Area. It is shown as a percent of total body surface area.
It can be calculated using the rule of nines

Classifications:

1)	Outpatient	<10% TBSA with no inhalation injury
2)	Very High	Mortality $\leq$10%, anticipated length of stay $\leq$14 to 21 days, 1 to 2 surgical procedures
3)	High	Mortality $\leq$10%, anticipated length of stay $\geq$14 to 21 days, multiple surgical procedures
4)	Medium	Mortality 10% to 50%
5)	Low	Predicted mortality 50% to 90%
6)	Expectant	Predicted mortality >90%

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Burn Size Group, % TBSA All

Age	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥ 90
0-1.99	Very High	Very High	High	High	High	Medium	Medium	Medium	Low	Low
2-4.99	Outpatient	Very High	High	High	High	Medium	Medium	Medium	Low	Low
5-19.99	Outpatient	Very High	High	High	High	High	Medium	Medium	Low	Low
20-29.99	Outpatient	Very High	High	High	High	Medium	Medium	Medium	Low	Low
30-39.99	Outpatient	Very High	High	High	Medium	Medium	Medium	Low	Low	Expectant
40-49.99	Outpatient	Very High	High	Medium	Medium	Medium	Medium	Low	Low	Expectant
50-59.99	Outpatient	Very High	High	Medium	Medium	Low	Low	Expectant	Expectant	Expectant
60-69.99	Outpatient	High	Medium	Medium	Low	Low	Low	Expectant	Expectant	Expectant
≥ 70	Very High	Medium	Low	Low	Low	Expectant	Expectant	Expectant	Expectant	Expectant

Burn Size Group, % TBSA All no inhalation injury

Age	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥ 90
0-1.99	Very High	Very High	High	High	High	High	Medium	Medium	Medium	Medium
2-4.99	Outpatient	Very High	High	High	High	High	High	Medium	Medium	Medium
5-19.99	Outpatient	Very High	High	High	High	High	High	Medium	Medium	Low
20-29.99	Outpatient	Very High	High	High	High	Medium	Medium	Medium	Medium	Low
30-39.99	Outpatient	Very High	High	High	Medium	Medium	Medium	Low	Low	Expectant
40-49.99	Outpatient	Very High	High	High	Medium	Medium	Medium	Low	Low	Expectant
50-59.99	Outpatient	Very High	High	Medium	Medium	Low	Low	Expectant	Expectant	Expectant
60-69.99	Very High	High	Medium	Medium	Low	Low	Expectant	Expectant	Expectant	Expectant
≥ 70	High	Medium	Medium	Low	Low	Expectant	Expectant	Expectant	Expectant	Expectant

Burn Size Group, % TBSA All with inhalation injury

Age	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥ 90
0-1.99	High	Medium	Medium	Medium	Medium	Medium	Low	Low	Expectant	Expectant
2-4.99	High	High	High	High	High	Medium	Medium	Medium	Low	Low
5-19.99	High	High	High	High	Medium	Medium	Medium	Medium	Low	Low
20-29.99	Very High	High	High	Medium	Medium	Medium	Medium	Low	Low	Expectant
30-39.99	Very High	High	High	Medium	Medium	Medium	Medium	Low	Low	Expectant
40-49.99	Very High	High	Medium	Medium	Medium	Low	Low	Low	Low	Expectant
50-59.99	High	Medium	Medium	Medium	Medium	Low	Low	Expectant	Expectant	Expectant
60-69.99	Medium	Medium	Medium	Low	Low	Low	Expectant	Expectant	Expectant	Expectant
≥ 70	Medium	Medium	Low	Low	Expectant	Expectant	Expectant	Expectant	Expectant	Expectant

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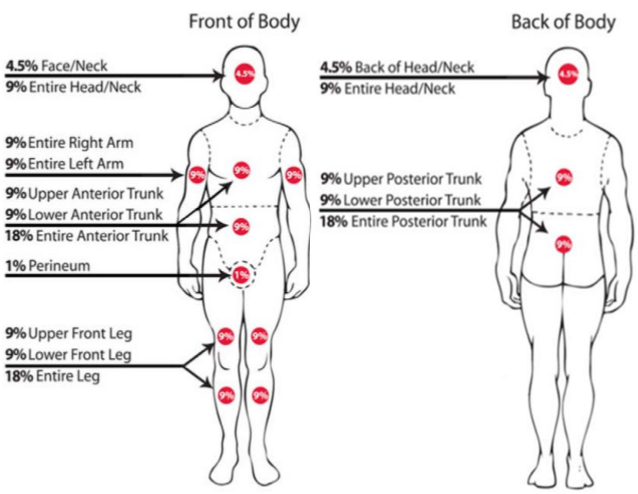
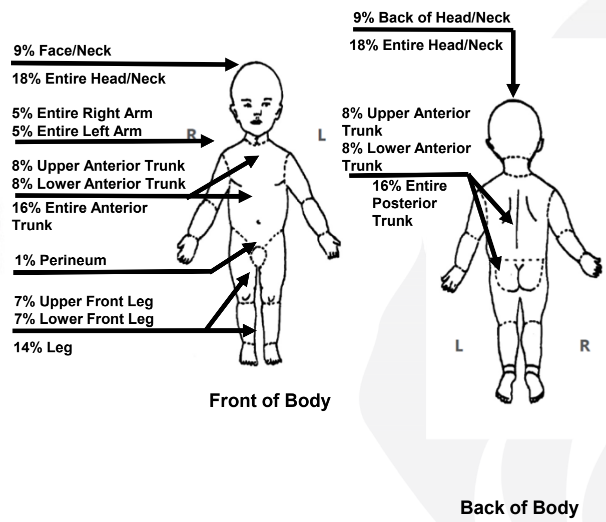
Calculating TBSA





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Primary Assessment

Initial assessment of a burn patient begins with **primary stabilization**:

- Maintaining a patent airway
- Ensuring adequate breathing and circulation
- Providing analgesia to manage pain and anxiety, assessing level of consciousness
- Minimizing the risk of hypothermia.

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Other Factors in Assessment

- Mechanism of injury (underlying complications, concomitant trauma, or chemical injury).
- Allergies, medications, past medical history, last meal and events/environment related to the injury (AMPLE).
- If obtaining a tetanus history is unclear, or the most recent tetanus vaccination is more than 5 years and resources allow, consider revaccination.
- As there is no definitive evidence regarding prophylactic antibiotic use early on in the burn process, antibiotics should not be administered prophylactically in the austere environment.
- Baseline laboratory values such as hematocrit, chemistries, urinalysis, or chest x-ray may be beneficial for burns >15% TBSA. Circumstances will likely limit any ability to perform such testing initially and these too may have to be deferred.

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Transfer

- Depending on the size and scope of an incident, the number of injured or the available personnel, detailed histories and physical exams may not be possible early on. Once conditions permit a complete head-to-toe assessment should be conducted and recorded for each patient.
- Despite the circumstances of a disaster every effort should be made to ensure patients are stabilized, kept warm, and transported to (verified) burn centers.
- In situations where the number of injured exceeds capability of the local burn center, it may be necessary for patients to be referred to a regional burn center. Transport arrangements should be coordinated in accordance with established local, regional, or national disaster plans. All available documentation should accompany the patient.
- Detailed information and extensive medical histories may not be readily available during the initial stages of a BMCI, thus triage tags should be completed as accurately as possible and remain with each patient to ensure continuity of care, as injured personnel are moved from one site to another.

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Recommendations

- All medical providers should be familiar with basic disaster tenets and apply these principles in a disaster.
- Disaster triage criteria should be implemented for patients resulting from a mass casualty incident. Centers should distinguish between capacity and capability.
- Burn patients should be stabilized in terms of airway, breathing, circulation, and fluid resuscitation and burn size estimated using Rule of Nines or Palmar method. If possible, transport patients to a (verified) burn center within 24 hours.

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Airway & Ventilation Management

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Airway Management

Burn patient airway management requires a considerable amount of clinical judgement.

- Often, the establishment of a definitive airway may not be necessary in the prehospital setting if the patient is awake, alert, and able to ventilate and oxygenate on his own—even in the presence of large burns.
- When resources are limited, as they would be in a mass casualty situation, the decision to intubate is of critical importance.
- Signs or symptoms that may trigger the decision to intubate include:
    1. Decreased mental status (secondary to direct trauma or to inhalation of toxic gases, such as carbon monoxide or cyanide)
    2. Facial burns with evidence of thermal injury to the upper airway (characterized by edema of the lips, oral mucosa, hoarseness, or stridor)
    3. Evidence of subglottic inhalation injury (soot in the sputum, hypoxemia, and tachypnea)

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Decision Matrix and Special Considerations

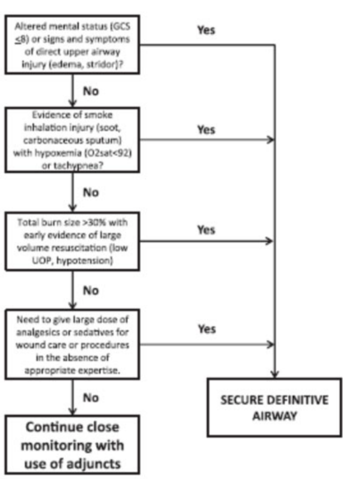

Figure 2. Proposed decision matrix for airway management during burn disasters.

- In the absence of symptoms, the mere presence of soot and or singed hairs should not be an immediate trigger for intubation, especially in a resource-constrained environment.
- Of previously healthy patients with cutaneous burns as their only injury, those with less than 30% TBSA burn seldom require intubation in the collective experience of the authors.
- For those with burns >30% TBSA, the decision should be based on how the fluid resuscitation is progressing, as the degree of oral and facial edema should drive the decision to intubate.
- Finally, any burn patient whose anticipated narcotic or sedative requirement for wound care or other procedures such as escharotomies could potentially result in airway compromise warrant consideration for intubation. This is especially true in resource-limited settings, in which expertise in the delivery of light sedation may not be readily available.

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Tools and Limitations to Anticipate

Limited availability of advanced airway tools is anticipated in large mass casualty settings – discussion here limited to a few easily stored and readily available items.

- The laryngoscope is a widely utilized airway instrument consisting of a blade and a light source.
  - Consider consolidating all the used blades in a central location and develop a rapid sterilization technique to turn them around rapidly for use in other patients.
- Video-guided laryngoscopy (e.g., Glide Scope) has become readily available in many hospitals and can be a great alternate airway management tool that is easily cleaned for reuse.
- The lighted stylet is useful in a variety of circumstances, including patients with limited oral aperture or those for whom cervical spine stability must be maintained.
  - The stylet and handle may be cleaned and reused.
  - The principle limitation of this tool is that it is a blind intubation technique but in a resource-depleted environment, this technique may be useful.

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Tools and Limitations to Anticipate

- The Airtraq (Prodol Meditec, Ambler, PA), or similar endotrachealtube-channel optical device, is a low-impact, easily stored device.
  - Provides indirect visualization of the laryngeal structures and is also useful for limited neck extension scenarios.
  - The channel is also suitable for use with a gum elastic bougie when advancing the endotracheal tube proves difficult.
- When only an endotracheal tube is available, the provider may manually elevate the base of the tongue anteriorly with either hand, using the alternate hand to guide the endotracheal tube along the groove between the index and middle fingers, and through the glottis aperture.

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Oxygen in Burn Disasters

- Oxygen is a typically abundant resource that may be become limited in a large-scale disaster.
- The 2007 Task Force for Mass Critical Care listed that most countries do not have sufficient supplies or oxygen therapy to treat a surge of patients.
- In the United States, only 65% of urban hospitals and 47% of all hospitals reported that oxygen supplies in their emergency departments were at or above capacity.
- FEMA and the CDC provide supplies during U.S. domestic disasters -- however, neither provide oxygen supplies or therapy.
- The Strategic National Stockpile provides a "12-hour push pack" with medical supplies, but does not include oxygen therapy or supplies.

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Available Forms of Oxygen Therapy

- Hospitals primarily have liquid oxygen (LOX) because many liters of oxygen can be stored in a small space.
- Portable oxygen cylinders are also used.
  - H cylinders are the largest (6900 L of gas).
  - E cylinders are small (679 L of gas) and are used when transporting patients.
- The cylinders have a high internal pressure and are a risk to patients if they are damaged or mishandled.
  - The larger cylinders should be stored away from direct patient care areas.
- The National Fire Protection Association has specific guidelines on their storage.

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Oxygen Contingency Plans for Disaster

A hospital's disaster contingency plan should include an approach to providing oxygen therapy.

- Determine how much oxygen is provided daily at the hospital, and how many days the hospital can provide oxygen without being serviced.
- Create different scenarios of events when performing disaster planning exercises.
  - When tornados struck the hospital in Joplin, their LOX system, emergency back-fill lines, and connector lines through the building were all damaged in one event.
- The H cylinders are often used for backup when the LOX system is down or damaged, however, they are not allowed in patient rooms.
- During a disaster, patients may be placed in alternate sites (cafeteria, conference room, and hallways).
- If oxygen is provided to these areas from the main LOX system, depressurization could occur and render the ventilators inoperable.

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Oxygen Contingency Plans for Disaster (continued)

- Conserving oxygen use in the hospital and creating a mix of high- and low oxygen-requiring patients in the alternate areas may avert depressurization.
  - Reduce passive oxygen consumption in the hospital.
  - Reduce acceptable pulse oximeter thresholds to less than 90 to 92%.
  - Decrease the lowflow oxygen into the carbon dioxide absorbers in the operating rooms.
  - Shut off the passive flow oxygen in the flowmeters in the neonatal intensive care and post anesthesia-care units.

Oxygen can be withheld for patients in whom the focus of care has been transitioned to comfort measures only.

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Treatment of Carbon Monoxide Toxicity When Oxygen Is Limited

- In a large-scale burn disaster, large numbers of patients may present with carbon monoxide toxicity.
  - For mild toxicity, symptoms are headache, lethargy, and dizziness.
  - Effects of moderate toxicity are sedation, vomiting, syncope, and chest pain.
  - Severe effects are coma, seizures, focal neurologic deficits, and acidosis.
- Most patients with carbon monoxide exposure or toxicity require only a full exam and evaluation and treatment with oxygen.
- Given that oxygen therapy may be a limited resource, oxygen may need to be rationed and utilized judiciously when this scenario is present.
- Patients with exposure (no clinical effects) or mild effects (headache and dizziness) could be managed on room air alone or reduced, low-flow oxygen.
- High-flow oxygen could be reserved for patients with at least moderate effects.
- Oxygen should be administered in those with carbon monoxide levels greater than 10% with symptoms until the carbon monoxide level is undetectable.

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Treatment of Carbon Monoxide Toxicity When Oxygen Is Limited (continued)

- The half-life of carbon monoxide is 4 to 5 hours on room air, 1 hour on 100% oxygen (e.g., nonrebreather mask).
  - In most patients, oxygen therapy can be discontinued relatively quickly.
  - Clinicians should keep this in mind and be sure to discontinue oxygen therapy in those that no longer need it in an effort to conserve oxygen for those who will.

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Treatment of Cyanide Toxicity When Oxygen Is Limited

Patients involved in mass burn disasters may also be exposed to cyanide which is produced from combustion of synthetic and natural products.

- Cyanide primarily inhibits the cellular electron transport chain by binding cytochrome aa3 and induces cellular hypoxia.
  - Mild symptoms of inhaled cyanide include dizziness, headache, and vomiting.
  - Moderate and severe symptoms include lactic acidosis, tachycardia, depressed mental status and then coma, apnea, hypotension, seizures, and cardiac arrest.
- Oxygen should be administered to all patients with clinical symptoms.
- Oxygen alone may be sufficient for very mild toxicity, in particular when there is limited antidote available.

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Treatment of Cyanide Toxicity When Oxygen Is Limited (continued)

- Two available antidotes are hydroxocobalamin, and sodium nitrite with sodium thiosulfate.
  - They can be administered intravenously (IV) or intraosseously, but not intramuscularly.
- Sodium nitrite and sodium thiosulfate together are effective.
  - Sodium nitrite causes methemoglobinemia and hypotension.
  - Sodium thiosulfate has a few adverse effects; however, in one recent study of cyanide-induced hypotension, sodium thiosulfate was ineffective when administered alone.
- Hydroxocobalamin is also effective for cyanide toxicity.
  - It does not cause hypotension or methemoglobinemia, but adds a red hue to body fluids (i.e., urine) and the skin which interferes with some laboratory test methods.

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Treatment of Cyanide Toxicity When Oxygen Is Limited (continued)

In a resource-limited setting, sufficient antidotes may not be available and oxygen resources may be threatened so it is important to ration both cyanide therapies as well as oxygen.

- Those with no clinical symptoms may only require observation without oxygen.
- Those with mild symptoms may benefit from low-flow oxygen.
- Antidotes should be reserved for those patients who continue to have persistent lactic acidosis and hypotension despite adequate resuscitation and oxygen therapy.

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Ventilator Allocation

The most valuable but limited resource after a large-scale burn disaster may be the availability of mechanical ventilators.

- While the Strategic National Stockpile does include mechanical ventilators, disaster medical assistance team (DMAT) caches do and many hospitals can expect to have delivery of these limited items within short time frame.
  - In many large-scale disaster scenarios, these supply lines may be disrupted.
- As with any other life-saving or life-sustaining therapy, there must be a shift in priority from addressing the needs of individual patients to doing the "greatest good for the greatest number."
- This shift is often very difficult and requires a significant amount of predisaster education and training.
- A team-based approach to addressing these ethical decision is optimal.
- Careful and deliberate ventilator allocation by a separate "ventilator triage team" consisting of individuals experienced in the management of critical care patients has been advocated.
- Ideally, this team would be tasked with performing airway and ventilator rounds at regular intervals to optimize ventilator resource allocation.

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Ventilator Allocation (continued)

- It is important to emphasize that patients will present with varying degrees of need for ventilator support:
  - Those who only need airway protection and supplemental oxygen.
  - Those who develop significant ventilation and oxygenation abnormalities requiring maximum ventilator support.
- Decoupling the need for a protected airway with the need for mechanical ventilation may be necessary.
- In some patients, a simple t-piece device delivering blow-by oxygen attached directly to the endotracheal tube may be sufficient while in others, noninvasive ventilation may be utilized.
- In those with definitive airways with minimal ventilator needs, any available transport ventilator may be adequate.
- In situations in which ventilators are no longer available and the patient requires ventilatory assistance, the "walking wounded" could be recruited for assistance with bag-mask ventilation, freeing up valuable health care provider assets.
- For the right group of patients requiring similar levels of ventilator support, the option of connecting multiple patients to one ventilator should be considered.

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Conclusions

- Critically evaluate the need for a definitive airway in a resource-constrained environment.
- Reuse disposable airway adjuncts if necessary (with proper disinfection).
- Develop procedures to ration oxygen when supplies are limited.
- Treat CO and CN toxicity in only those patients with symptoms.
- Employ a deliberate system of ventilator allocation, if needed, aided by a separate 'ventilator triage' team.

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Fluid Resuscitation

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Burn Shock

Burn shock is a condition characterized by inadequate oxygen delivery to organs and insufficient elimination of tissue metabolites following thermal injury to the skin.

- After burn injury patients become dehydrated and can develop shock due to fluid loss through the burn.
- If untreated, burn shock—along with smoke inhalation injury—is the most common cause of death after burns.
- Before the initiation of resuscitation regimens, the LD50 burn size (burn size in which half the people died) was ~30% TBSA.
- Major burn wounds, defined as >20% TBSA, require significant fluid administration, particularly in the first 24 hours post injury.
- After the first day, fluid requirements decrease, but are still above baseline due to evaporative losses through the burn wound.
- Plans for resuscitation need to consider the prolonged need for fluids, both IV and oral, for weeks to months after the initial event.
- There are several options for resuscitation of the burn injured patient after a burn mass casualty event -- the method used will depend on local resources and specifics of the situation.

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Intravenous Resuscitation

- Prevention and treatment of burn shock can be accomplished by the IV administration of electrolyte solutions, such as lactated Ringer's or Hartmann's solution.
- Initial fluid requirements can be estimated by the Parkland formula: 2 to 4 ml/kg/% burn of lactated ringers solution over 24 hours, half in the first 8 hours and the remainder in the next 16 hours.
- This formula is an estimate -- ideally, fluids should be adjusted to maintain a urine output of approximately 0.5 ml/kg/hr in adults and 1 ml/kg/hr in children <12 years.
  - Typically, fluids are increased or decreased by 10 to 20% to maintain urine output in that range.
- Burn size and patient weight need to be recorded.
  - Burn size can be estimated by the Rule of Nines or the Palmar method (patient's palm and fingers represent 1% of their BSA).
  - Weight is often difficult to directly measure, but driver's license or ID cards frequently have weight, and Breslow tapes can be helpful for children.
  - A more detailed description for estimating burn size can be found in the wound section of the austere guidelines.

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IV Resuscitation in Austere Conditions

IV resuscitation may be difficult in a resource-constrained environment for several reasons.

- IV fluids and supplies (such as IV catheters, tubing, pumps, and alcohol swabs) may be limited or inadequate in a mass casualty event, particularly in facilities that do not routinely treat trauma or burns.
- Traditional IV resuscitation also often requires prodigious amounts of IV fluids.
  - For example, a 40% burn in a 70 kg male will require approximately 11,200 ml in the first 24 hours.
- In addition to the first 24 hours, fluid losses continue until wounds are closed.

The estimated daily fluid requirement in milliliters can be estimated by the formula: (25 + %TBSA burn) × BSA burned plus normal fluid maintenance requirements; hence, the need for large volumes of IV fluid for weeks after burn injury.

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IV Resuscitation in Austere Conditions (continued)

Fluids will need to be thoughtfully administered and monitored.

- Patients requiring massive volumes may need to be critically evaluated with respect to limiting resuscitative efforts.
- If lactated ringers is not available, isotonic fluids should be used.
- IV resuscitation requires frequent monitoring of urine output and IV fluid rate adjustment, which may not be possible with an overwhelming number of casualties.
- The reliability of BSA estimates in a disaster are not known, which could lead to either over- or underestimation of burn size and resuscitation.

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Oral Resuscitation

- Resources for administering large volumes of IV fluids may be lacking in an austere environment, so practitioners should develop an alternative plan for oral fluid resuscitation.
- The GI tract has the ability to absorb large amounts of fluid, up to 20 L per day.
- The intestine retains its capacity for fluid absorption even with burns of up to 40% TBSA.
- Oral rehydration therapy (ORT) is a well-established technique for preventing dehydration caused by diarrhea.
- ORT is the technique of giving patients adequate amounts of a solution containing glucose and electrolytes p.o.
- ORT can be delivered by local health care workers or family members at acceptably low cost.
- Since 1975, the WHO and UNICEF have provided packets of glucose and salts to be used in ORT for infectious diarrhea.
- The original formulation contained glucose, sodium chloride, potassium chloride, and trisodium citrate, with a resulting total osmolarity of 311 mOsm/L.
- In 2003, the formula was modified. Current recommendations are for use of reduced osmolarity oral rehydration solution (ORS) to reduce stool output from diarrhea.

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Oral Resuscitation (continued)

- Free water is toxic to patients recovering from burn shock -- allowing patients to drink free water creates deadly hyponatremia, leading to cerebral edema and death.
- Sodium is an absolute requisite for the electrolyte composition of ORS for burn resuscitation.
- Nutrient-independent salt-absorption exchange mechanisms are present in enterocytes (Na/H and Cl/HCO3), but the sodiumglucose cotransporter (SGLT1) moves a significant portion of sodium from the gut.
- Two sodium ions are transported for every molecule of glucose.
- The osmolality of ORS can be increased and transport of sodium facilitated by addition of glucose polymers, rice powders, or other simple carbohydrates.
- Expert opinion is that ORT can be used successfully to resuscitate patients from burn shock with TBSA<40% and no other injuries or illnesses that would preclude safe oral intake.
- An additional approach that may be of value in remote or rural settings is rectal infusion therapy (proctoclysis).
- Rectal infusions of either tap water or saline have been tolerated at rates up to 400 ml/hr.

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Resuscitation Options

- Up to 20% TBSA can be resuscitated with ORT.
- Some patients with burns up to 40% TBSA can also be resuscitated successfully with ORT.
- In the hospital, up to 15% of the total resuscitation fluids can be given orally.
- If urine output is satisfactory, IV fluid can be diminished as long as ORT can be continued.
- In the field, the decision is made by the availability (or lack) of IV fluids and cannulas.
- Additional fluids and electrolytes can be given by proctolysis if oral intake is restricted.
- Unlike burn resuscitation with IV fluids, there are no established guidelines that relate the size of burn to the amount of desired fluid intake.
- It is reasonable to assume that the patient should be encouraged to take as much oral fluid as can be tolerated.
- Monitoring of efficacy of ORT should include commonly used parameters of adequate circulation, including urine output and mental status.
- Patients with burn injury >20% have a hypermetabolic state, resulting in a baseline elevation in heart rate.
- Tachycardia alone is not an accurate measure of hydration but changes in heart rate may be useful.

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ORT Fluid Administration

- Adults and children greater than the age of 2 years should be allowed to take sips from a cup frequently, with the goal of consuming approximately 8 to 10 ounces every 10 to 15 minutes.
- Very young children less than the age of 2 years should be given a teaspoon of fluid every 1 to 2 minutes.
- ORT is unlikely to result in complications from overresuscitation, such as fluid overload; the usual complication from excessively rapid consumption of fluid is nausea and vomiting.
- If vomiting occurs, a few minutes should be given to allow symptoms to subside before resuming intake.
- Even if the patient vomits, there may still be significant absorption of fluids from the gastrointestinal tract.

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Preparing ORT Solution

- ORS can be made with 1 L of clean water, one teaspoon of table salt (3 g), and three tablespoons of sugar (36 g or 9 sugar cubes); it can also be purchased as commercially available packets.
- Clean water can be obtained by boiling the water, or by adding potassium alum, chlorine drops, or iodine tablets.
- As an alternative to table salt, sodium bicarbonate (baking soda) can be used as a source of sodium.
- If the quantity of added salt cannot be measured, the solution should have the taste of tears.
- Molasses and other forms of raw sugar can be substituted for white table sugar. (Note—both brown sugar and molasses add additional potassium.)
- If it is necessary to boil the water, do so before adding ingredients.
- If chemicals are being used to clean the water, warm the water before adding salt and sugar.
- Patients should drink sips every 5 minutes; wait 10 minutes after an episode of vomiting.
- At least 4 cups (1 L) per hour should be taken in orally.
- Keep the solution cool if possible; discard after 24 hours and make new batch.

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Alternate ORT Solutions

Other local solutions for ORT include:

- Rice water (congee) with salt
- Fresh lime water with salt and sugar
- Vegetable or chicken soup with salt
- Lassi (yogurt drink with salt and sugar)
- Sugarcane juice with lemon, black pepper, and salt
- Sports drink (e.g., Gatorade® or Powerade®) with one quarter teaspoon salt and one quarter teaspoon baking soda for each quart
- Carrot soup
- Gruel (cooked cereal diluted with water)

Because of the risk of osmotic diuresis, drinks to be **avoided** include soft drinks, fruit drinks with high sugar content, sweet tea or coffee, or herbal teas that contain diuretics.

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Proctolysis

Proctolysis can be performed by:

1. Boiling water to reduce risk of infection or allergic reaction
2. Warming the water to body temperature; formulating a balanced rehydration solution by the addition of salt and bicarbonate as described above
3. Inserting a urethral catheter into the rectum
4. Attaching a reservoir (such as 50 ml syringe with plunger removed) to the catheter
5. Infusing fluids at a rate comfortable to the patient and consistent with clinical signs

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Recommendations

- Patients with burns less than 20% BSA can be effectively resuscitated from burn shock using oral solutions; many patients with burns up to 40% BSA can also be safely resuscitated.
- For patients with burns >20%, IV resuscitation, if supplies permit, should be utilized using the Parkland formula. In resource-constrained environments, IV resuscitation may need to be restricted to survivable burns >40%.
- There are many formulas for oral rehydration solutions, but all include clean water, glucose, and electrolytes.
- Oral fluids should be given in amounts tolerated by the patient, accepting the occasional episode of nausea and vomiting as inevitable but not a reason to discontinue oral therapy.

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