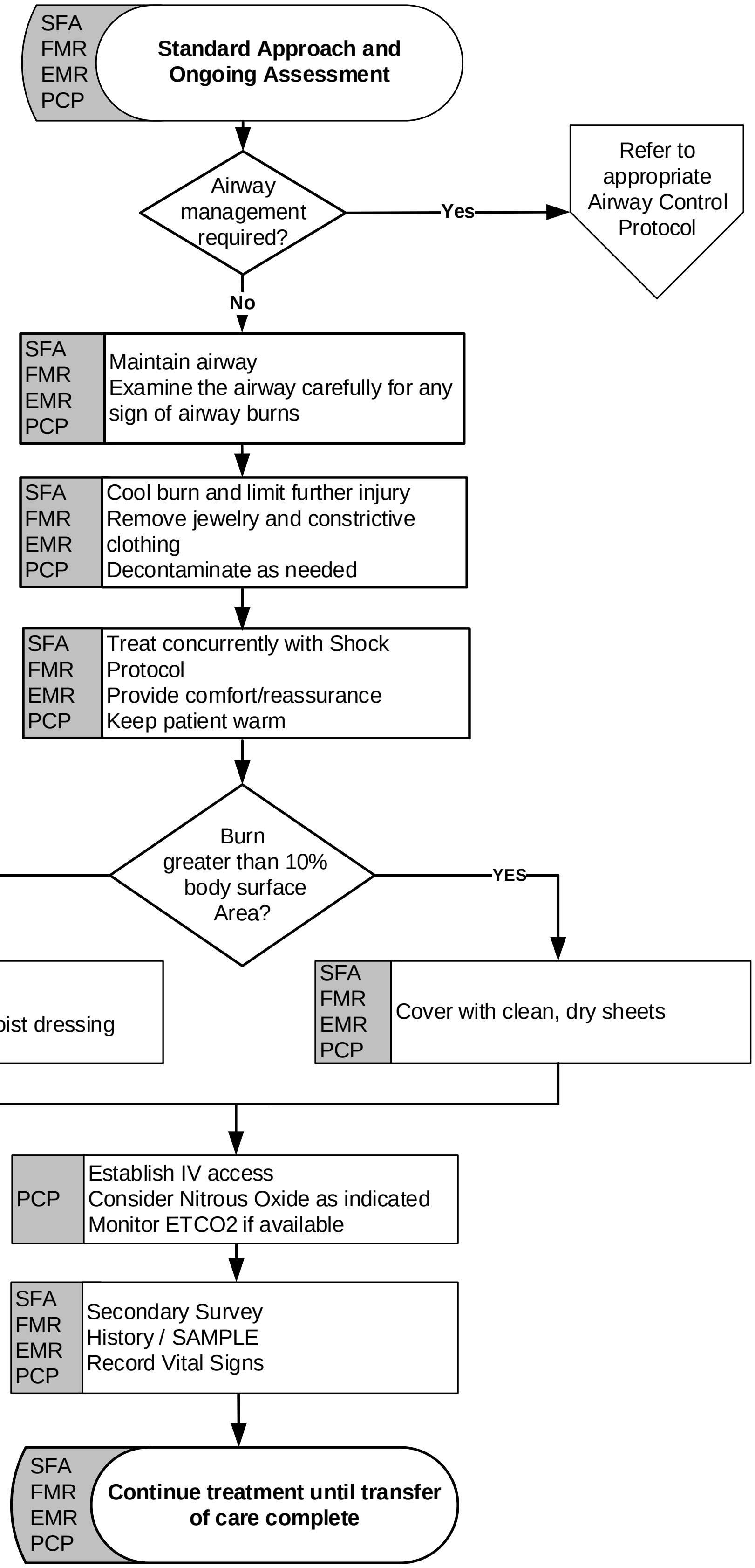
Burn Management

Patient Safety Considerations

- If time of injury greater than 30 minutes, do not cool burn
- Do not flush dry chemicals with water unless in the eyes; with some chemical water can cause burning to increase
- Remove wet dressings from large burns (10% or greater body surface area - BSA) after burning is stopped to prevent hypothermia

Critical Burns

- Any burn involving 20% or greater BSA (excluding superficial burns)
- Any full thickness burn involving 5% or greater BSA
- Any partial or full thickness burn to face, neck, hands, genitals, perineum, involving a major joint or feet
- Any burn with potential airway involvement
- Any high voltage electrical burn – non residential
- Chemical burns
- Radiation burns



Etiology

Burns result from damage to cell membranes which can cause widespread damage to the integumentary system. This cellular injury can lead to severe fluid loss, infection, hypothermia and other injuries. There are different types and causes of burns and while the tissue damage is similar, management strategies can differ.

Thermal Burns

Caused by exposure to heat such as hot liquids, gases or solids. Examples include spilling boiling water on clothing or directly on skin, touching a hot stove or flash burns from a natural gas explosion. Thermal burns are the most common burns among adults. In a thermal burn, heat is transmitted through tissues causing widespread damage to multiple layers of tissue.
The extent of injury is directly related to the amount of heat energy transferred to and through the tissue and depends on factors such as temperature, concentration of energy and duration of exposure.

Electrical burns

Caused by exposure to electrical currents. As the current enters the body it creates heat based on the strength of the current and the resistance of the tissues. Damage occurs from the inside out, causing increased damage to internal organs whole leaving visible surface damage as well. The extent of injury is related to the strength of the current and the length of exposure. Electrical current can paralyze respiratory muscles leading to apnea and death and can also disrupt the normal electrical conduct of the heart resulting in dysrhythmias and death.
Alternative current (AC), which is found in household electrical systems can cause tetany of muscles, preventing the patient from letting go if they have touched or grasped something conducting electrical current.

Chemical burns

Caused by exposure to a chemical that destroys the cells with the most common exposures from strong acids or bases (alkalis). Acids usually form a thick, insoluble mass at the point of contact which limits the depth of the resulting burn. Alkali burns do not form a mass allowing them to penetrate more deeply. Thus, alkali burns may be associated with an underestimated severity of injury due to their deep penetration of tissues. Deployed airbags may release an alkali chemical causing both chemical and thermal burns.

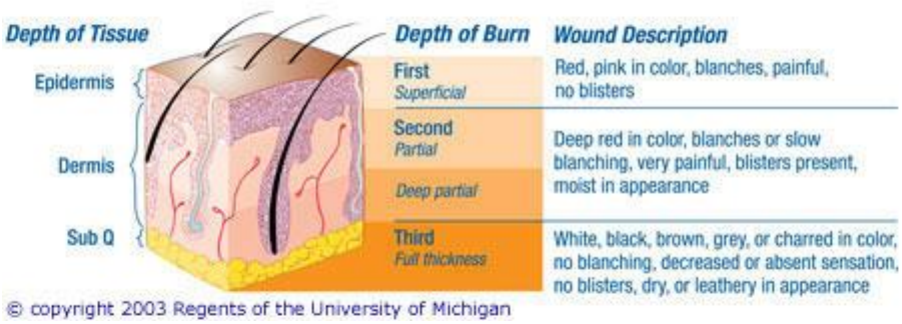
Radiation burns

Caused by radioactive energy particles changing atoms in the body in a process called ionization. Commonly encountered types of radiation include alpha, beta, gamma, X-ray and neutron.
Exposure and the risk of injury are associated with time, distance and shielding. For instance, the shorter the duration of radiation exposure, the lower the risk of injury. Likewise, the further the patient is from the source of radiation, the lower the risk of injury. Finally, if the patient is shielded by material(s), this shielding can reduce injury. Denser materials such as earth, concrete, lead and water provide a greater degree of protection.

Patients exposed to certain types of radiation can contaminate others and it is critical they are decontaminated by qualified individuals such as those trained in hazmat. Only decontaminated patients or patients relatively free of contamination are to be transported to the hospital.

Burn Management
In order to determine how to treat a burn, the responder must first determine the severity of the injury.

Burn severity
The severity of any burn is based upon the depth of injury and the body surface area involved.



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Superficial burns – first degree burn
Involves only the epidermis.
Characterized by red skin and pain at the site of the burn.

Superficial partial thickness – second degree burn
Penetrates the epidermis and involves the dermis.
Characterized by white to red skin, moist and mottled skin, blisters and intense pain. This is commonly experienced as a bad sunburn.

Deep partial thickness – second degree burn
Penetrates the epidermis and involves the deep dermal layers.
Characterized by blisters that are easily deroofed (blisters that easily lose the top layer of the blister's damaged skin), wet, waxy dry and of variable colour.

Full thickness – third degree burn
Penetrates the epidermis, dermis and involves the subcutaneous layers, muscles and internal organs.
Characterized by charring, dark brown or white skin that is hard to the touch, little or no pain at the site and pain at the periphery of the burn.

Deeper injury – fourth degree burn
Deep and potentially life-threatening.
Extend through epidermis and dermis to the fascia, muscle, and/or bone.

Estimating burned body surface area
Body surface area (BSA) affected can be estimated in different ways. The goal is to identify severity and to prevent further injury from heat loss, as well as to identify when additional resources should be dispatched. Burn wounds are expressed as percentages of the total body surface area and do not include superficial burns.

The Lund-Browder Chart

One common method to calculate body surface area is using the Lund-Browder (LB) Chart (below).

Lund & Browder Chart

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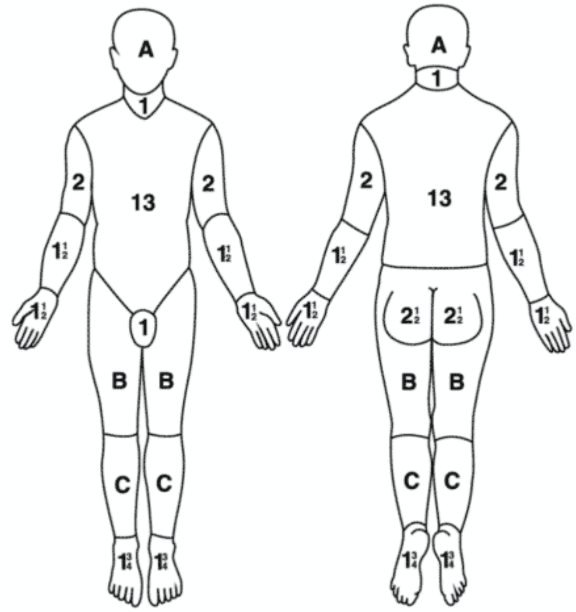
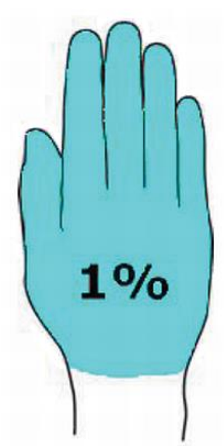
1. Mark the areas of the burn
2. Calculate area using the age-table below
3. Do not include superficial burns

Age		0	1	5	10	15	Adult
Front or back half		(%)	(%)	(%)	(%)	(%)	(%)
A	(Head)	9½	8½	6½	5½	4½	3½
B	(Thigh)	2¾	3¼	4	4¼	4½	4¾
C	(Leg)	2½	2½	2¾	3	3¼	3½



Rule of Palms

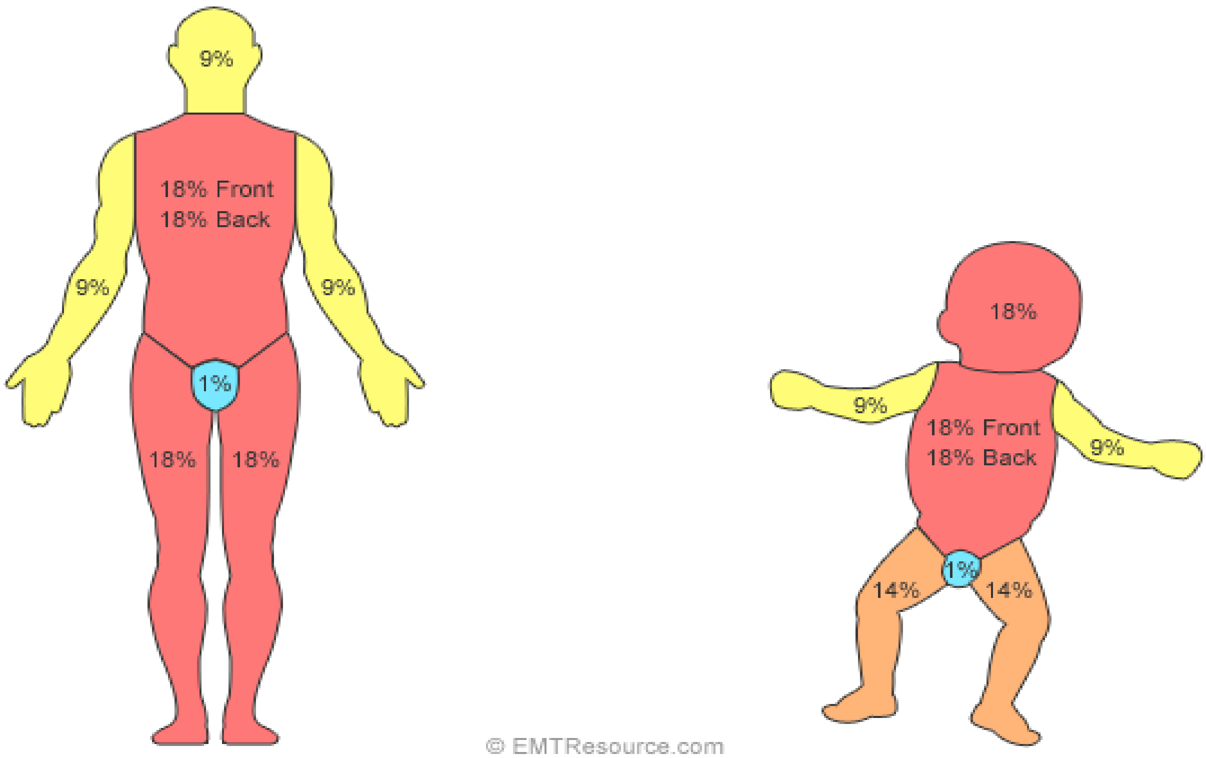
Another method to calculate the burned body surface area is to use the Rule of Palms, which is a simple and quick way to estimate the size of smaller burns. Using the rule of palms, the surface of the patient's palm represents approximately 1% of body surface area.



Rule of Nines

Lastly, the Rule of Nines can be useful in estimating the burned body surface area of larger injuries. To approximate the percentage of burned surface area, the body has been divided into eleven sections including the head, right arm, left arm, chest, abdomen, upper back, lower back, right thigh, left thigh, right leg (below the knee), left leg (below the knee).

Burn Management



Critical burns

The following criteria will categorize a burn as critical, and these burns require specialty care at a burn centre. If you identify critical burns, it is prudent to update the incoming EMS crew with this information.

1. Any burn involving 20% or greater body surface area (excluding superficial burns).
2. Any full thickness burn involving 5% or greater body surface area.
3. Any partial or full thickness burn to the face, neck, hands, perineum or burns to a major joint or the feet.
4. Any burn with potential airway involvement.
5. Any high voltage electrical burn, non-residential.
6. Chemical burns.
7. Radiation burns.

Incident Response Paramedics

The IRP Team consists of a specially trained group of advanced care paramedics who are skilled in the management of events involving mass casualty incidents, hazardous materials, chemical, biological, radiological, nuclear and explosives within Alberta. This team is trained to work effectively to manage the assessment and treatment of patients resulting from these unique events while collaborating with other emergency first response and law enforcement agencies to ensure public and patient safety. Additionally, the IRP team is equipped with CyanoKits that should be considered for possible cyanide exposure/toxicity.

Interventions

The priority after ensuring rescuer safety is to remove the patient from the source of injury.

1) Remove patient from source of injury.

2) Stop the burning process.
    a. Thermal and wet chemical burns
        i. Flush thoroughly with copious amounts of water or normal saline with the goal of cooling as well as removal of the chemical agent.
        ii. Patients that are receiving copious flushing to cool or rinse the wound are at risk of hypothermia. Ensure the ambient temperature is kept warm.
        iii. If greater than 30 minutes has passed since the burn occurred, do not cool it but you may still need to flush the burn in order to remove the chemical agent.
        iv. Ensure water is irrigated away from the unaffected tissues to ensure there is no spread of the chemical agent.

    b. Burns involving the eye
        i. These burns require continuous flushing with water or normal saline for a minimum of 15 minutes, if possible. Dry chemical burns to the eye require attempts at brushing away the chemical followed by flushing with water or saline.
        ii. Irrigate for greater than 30 minutes if the burn was caused by a known alkali substance. Do not delay rendezvous with EMS to achieve flushing times in the event of a back country rescue, but try to flush enroute to meet EMS.

    c. Dry chemical burns
        i. Do not flush with water or normal saline.
        ii. Remove dry chemicals from the patient by brushing the product off of the body. Some dry chemicals (dry lime, phenols, sulfuric acid, muriatic acid, etc.,) create an exothermic reaction when exposed to water which can increase the burning.
        iii. Ensure complete removal of the chemical with the recommended antidote, if available.

3. Remove any jewellery, contact lenses or other accessories that could create a tourniquet effect as the patient's tissues swell.

4. Remove any burning, smoldering or constrictive clothing. Do not pull on any materials stuck to the skin.

5. Maintain cool, moist dressings on burns less than 10% of body surface area.

6. Apply clean, dry sheets on burns extending to 10% or greater of body surface area.

7. Separate fingers and toes with dressings to keep them from sticking.

Airway considerations

If the patient was in an enclosed space at the time of the burn, whether chemical or thermal, a strong possibility of airway damage exists.

a. Continually monitor the airway for evidence of obstruction and be aware that respiratory problems due to damage of airway tissues may not develop immediately.
b. Alert the incoming EMS crew and consider asking for air ambulance support for patients with suspected airway burns.
c. Be aware that if the airway is occluded due to swelling and injury, OPAs, NPAs and supraglottic airway adjuncts will likely be unsuccessful.
d. These patients will ultimately require intubation or a surgical airway in the event the airway is significantly compromised.

Signs of upper airway burns

1) Burns to the face.
2) Singed eyebrows or nasal hair.
3) Burns in the mouth.
4) Sooty sputum and/or soot in the nostrils.
5) History of being in an enclosed space when burned.
6) Coughing, hoarseness, wheezing, crackles, stridor, dyspnea, tachypnea.

Treatment instructions

All patients who are suspected of suffering from airway exposure to fire, smoke, toxic chemicals, or gases should receive high flow oxygen therapy when it is safe to do so. Treat bronchospasm as per the Bronchospasm MCP.

Fluid resuscitation

The volume of fluid administered in the first 24 hours is based on the Modified Brooke's Formula, which is 2 mL/kg/%BSA in adults. Although possible, it is technically very difficult to calculate the exact percentage of BSA in the prehospital setting.

For this reason, the emphasis is on careful monitoring and documentation of the total volume of fluid administered. One of the biggest risks during resuscitation of a burn patient is the "over" and "under" resuscitation of the patient. Burns create an increase in vascular permeability from the release of inflammatory mediators which leads to the loss of intravascular fluid and consequently hypovolemia.

Over-resuscitation can cause compartment syndrome of both the abdomen and extremities and puts the patient at risk of Acute Respiratory Distress Syndrome (ARDS). Under-resuscitation can lead to poorly perfused tissue and can cause burn shock.

Shock from burns is usually delayed. If the patient is in shock, consider the more likely causes such as blood loss, tension pneumothorax, etc. Note that patients with burns greater than 20% of body surface area are highly likely to develop burn shock.

Avoid starting an IV distal to circumferential extremity burns and preferably well away from burned areas if possible.

Beyond immediate management of shock, if burn surface area is greater than 10%, contacting OLMC is mandatory to discuss proactive fluid management. In this event, consider requesting OLMC assistance only if there is a substantial period of time expected before rendezvous with EMS.

Infection Prevention and Control (IP&C) Considerations

1) Wear sterile gloves whenever possible when dressing wounds.
2) Clean dressings must be applied using aseptic technique as much as possible.
3) Use sterile dressings and sheets if available.
4) Burn patients are exceptionally susceptible to infection. Donning a procedural mask is best practice.

What to expect when EMS arrives

Depending on burn severity and what interventions have been performed already by MFR, the goal in critical burns is to get the patient to an appropriate burn centre as quickly as possible.

These are located in Calgary and Edmonton. Early notification when appropriate to the incoming EMS crew and requesting air support for faster transport should be considered by the MFR crew.

Ensure to communicate any safety concerns to the crew directly when they arrive and ensure they have listened by asking for verbal confirmation. If you have administered IV fluids, ensure you pass along the volume thus far infused and vital sign trending that could indicate shock.

Patient history that may be particularly important with burn patients include any history of respiratory disease such as asthma or COPD. Diabetic patients are at additional risk due to their compromised circulation.