Burns

What You ll Cover

- Common causes and classification of pediatric burns
- Initial assessment and management of pediatric burns
- Assessing the depth and extent of a pediatric burn
- Special transport criteria in pediatric burn care

Glossary

The following specialized terms are used in this chapter:

asystole–absence of cardiac electrical activity
atony–lack of muscle tone; flaccidity
caustic–capable of burning or destroying tissue by chemical action
crepitation–a fine crackling sound resembling that of a hair rubbed between the fingers *or* a grating sensation felt over the seat of a fracture
dermis–deep layer of skin formed by dense connective tissue
dysphagia–difficulty swallowing
epidermis–the outer layer of skin formed by epithelial tissue
epithelium–the cellular, avascular layer covering tissue surfaces
erythema–redness of the skin due to inflammation
first-degree burn–a burn involving only the epidermis, characterized by erythema, edema, and hyperesthesia; also called a superficial burn
fourth-degree burn–a burn that penetrates through the dermis, damaging muscle, tendon, bone, and fat tissue
hemoglobin–the red oxygen-binding protein of erythrocytes
hyperesthesia–excessive sensation
lumen–the interior space of a tubular structure
necrosis–death of cells or tissues due to irreversible damage
Rule of Hands–a method for assessing the extent of a burn by estimating the number of times the *patient's* hand would cover the burned area
Rule of Nines–a method for assessing the extent of a burn by assigning a numeric value, usually 9, to each body region; must be modified for children
second-degree burn–a burn involving the epidermis and the dermis, characterized by hyperesthesia, erythema, and vesiculation; also called a partial thickness burn
third-degree burn–a burn involving all layers of the skin, destroying the epidermis and dermis and damaging or destroying subcutaneous tissue; also called a full thickness burn
vesicle–a blister
vesiculation–the formation or presence of a number of vesicles

Click to return to Table of Contents

Interventions described in this chapter are recommendations based on the medical literature, national pediatric prehospital protocols, and expert opinion. They are not intended to serve as a standard of care. Interventions for individual patients must adhere to regional protocols and medical direction.

Learning Objectives and Key Points

The following learning objectives are covered in this chapter. Key points are discussed in more detail within the chapter text.

identify 4 differences between pediatric burns and adult burns

There are 7 key differences between adult and pediatric burn patients: (1) children have thinner skin that is more easily damaged, so that a similar mechanism results in a deeper burn; (2) very young children are more likely to die from their burns; (3) infants, toddlers, and preschoolers are more likely to be burned as a deliberate act of abuse; (4) children's body proportions necessitate separate burn assessment charts for infants, young children, and adolescents; (5) infants and toddlers are more likely to suffer from scald burns; (6) inhalation injury can rapidly result in upper airway obstruction; (7) infants and toddlers can quickly dehydrate from second- and third-degree burns.

describe the first priority in managing pediatric burns

The first priority of pediatric burn management is to ensure scene safety and stop the burn process.

describe the second priority in managing pediatric burns

The second priority of pediatric burn management is to assess ABCs and mental status, providing appropriate interventions as needed.

name 3 assessment findings that indicate possible inhalation injury

Children should be treated for inhalation injury if they are found in a smoke-filled, enclosed space, or if they have any of the following assessment findings: carbonaceous material around the mouth and nose; signs of respiratory distress; a continual cough; stridor; hoarseness.

name 2 burn assessment factors that determine treatment and transport

To determine appropriate treatment and transport destination, assess the type, depth, extent, and location of the burn, and look for additional high-risk factors.

describe the method for determining the extent of a small burn

For small or irregular burns, use the Rule of Hands to estimate the percentage of body surface affected: The number of times the *child's* entire hand would cover the burned area is the approximate percentage of body surface burned.

describe the method for determining the extent of a large burn
To assess the extent of larger burns, refer to a burn chart or diagram that shows the Rule of Nines as modified for pediatric patients. Modification is required because younger children have larger heads and smaller legs than adolescents and adults.

list 3 assessment findings that identify a pediatric burn victim who should be routed to a burn center
If possible, a child with any of the following should be routed to a burn center: (1) a third-degree burn over more than 5% of the body; (2) second- or third-degree burns over more than 10% of the body in children younger than 10 years; (3) second- or third-degree burns over more than 20% of the body in children aged 10 years or older; (4) second- or third-degree burns on the face, hands, feet, genitals, rectal area, or major joints; (5) an electrical burn or a major chemical burn; (6) a second- or third-degree burn that completely encircles the chest, an arm, or a leg; (7) other major trauma in addition to the burn; (8) burns in combination with inhalation injury.

state the proper way to dress a burn
Cover burns with sterile, *dry* dressings to preserve body warmth.

NSC Objectives

Information in this chapter supports the following objectives from the paramedic *National Standard Curriculum:*

4-4.8 Differentiate criteria for determining the severity of a burn injury between a pediatric patient and an adult patient. (C-3)
4-4.9 Describe special considerations for a pediatric patient with a burn injury. (C-1)
4-4.12 Discuss conditions associated with burn injuries, including trauma, blast injuries, airway compromise, respiratory compromise, and child abuse. (C-1)

Introduction

Each year, more than a thousand children aged 1 to 14 years die of burns, making this the second leading cause of injury-related death in this age group. Burn injuries are the leading cause of death within the home. They are particularly common in children younger than 3 years. Eighty percent of childhood burns result from preventable household injuries, while many of the rest are due to child abuse.

Children have thinner skin than adults, so they are more easily burned and more likely to die of a comparable burn injury. Seventy-five percent of all children younger than 3 years who have burns involving more than 40% of the body surface area will die. More than 85% of all children

with burns covering more than half their body surface will die. These figures are considerably higher than for adults.

Impact of burn injuries

The skin is the largest organ of the body, and in children, its surface area is proportionately larger than in adults. Skin acts as a barrier against bacteria and evaporative water loss from underlying tissues. Serious burn injuries place greater stress on the child's body systems than any other type of injury. Dehydration, hypothermia, infection, and damage to internal organs are frequent short-term complications. Long-term effects include severe physical and emotional scarring. Burn survivors frequently require prolonged hospital stays as well as extensive, painful rehabilitation.

Causes and Types of Burn Injuries

Pediatric burn injuries can be divided into 6 major categories according to etiology: scalds, contact burns, flame burns, electrical burns, chemical burns, and radiation burns.

Scalds account for up to 85% of severe pediatric burns. Most scalds involve toddlers. Hot tap water is the most common cause of scalding, followed by hot beverages and cooking liquids.

Contact burns occur when the child touches a hot object, such as a stove or iron. The skin initially adheres to the hot object, prolonging the time of contact.

Flame burns are distinct from contact burns in that they involve actual contact with flames. Traumatic injuries and airway damage often accompany flame burns. Altered mental status, hypoxemia, and shock due to tissue destruction and fluid loss are other common problems. Children burned in house fires are at risk for inhalation injury causing upper airway obstruction and carbon monoxide poisoning requiring high concentration or hypobaric oxygen.

Electrical burns are caused by contact with electricity in any form. Most pediatric electrical burns involve household current, which has a comparatively low voltage. These burns typically occur when a toddler chews on an electrical cord or a child puts an object into an electrical outlet. High-voltage injuries due to lightning strikes or contact with live power lines are likely to involve older children. These injuries may cause airway damage, seizures, injury to deep muscles, fractures due to severe muscle spasms, and disturbances in cardiac function, such as asystole or fibrillation.

Chemical burns occur when a child handles or swallows a caustic substance. In children, chemical burns usually involve household products, such as drain cleaner or automotive battery acid. Alkaline agents cause *liquefaction necrosis,* a process that turns tissue fats and proteins to soap, damaging all tissue layers. Ingestion can cause esophageal stenosis. Acid agents cause *coagulation necrosis,* which damages superficial layers of tissue. Ingestions of corrosive substances can result in esophageal perforation.

Radiation burns in children are almost always caused by overexposure to sun. Sunburns are usually first-degree burns involving erythema, but occasionally second-degree burns with vesiculation may result in areas of very thin skin.

Scene Safety

On arrival, secure the area and ensure scene safety as directed by regional protocols. Check for potential dangers from the source of the injury, such as fire, chemical spills, or a live high-voltage wire. Separate the child from the burn source *only* if you can do so without endangering yourself, the patient, and others on the scene. Call for special assistance if necessary before approaching the patient. Use appropriate precautions, such as hand and eye protection against caustic chemicals.

Take any necessary steps to stop the burn process before proceeding with assessment. For example, smother or douse flames if the child's clothing is on fire and remove any smoldering clothing that is not stuck to the child's skin.

First Impression

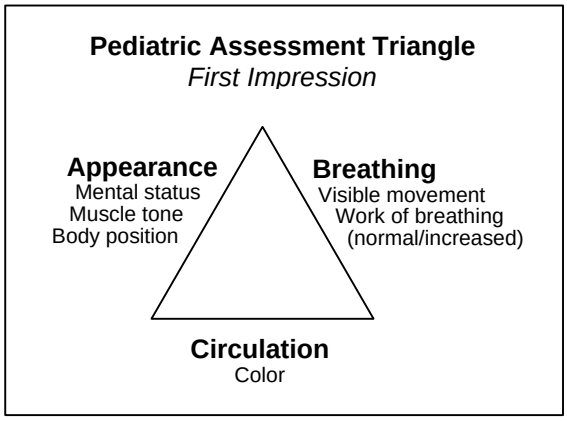

Figure 1

Form a rapid first impression of the patient's appearance, breathing, and circulation as illustrated in the Pediatric Assessment Triangle (*Figure 1*). In some cases, you may perform this step as you secure the scene. Visually evaluate mental status, muscle tone and body position, chest movement, work of breathing, and skin color. Look for obvious injuries at the same time.

Depending on the severity of the burn and the source of exposure, you may note reduced responsiveness due to hypoxemia or shock; increased work of breathing secondary to inhalation injury; or atony in severe electrical burns. Children with moderate or severe burns will require immediate interventions. Keep in mind, however, that they will be experiencing a great deal of pain and fear. Maintain a calm, friendly demeanor and speak soothingly to help the child feel more relaxed and cooperative.

Initial Assessment

Proceed with initial assessment of the patient's airway, breathing, circulation, and mental status, applying appropriate interventions as you go. If the patient was not alert or responsive to voice during the first impression, establish level of consciousness by gently rubbing the child's sternum while observing spinal precautions, before beginning the airway assessment.

> Observe body substance isolation procedures (universal precautions) before performing any action that may involve contact with blood, emesis, or secretions.

Airway

Assessment

Look for movement of the chest or abdomen, listen for breath sounds, and feel for airflow at the child's mouth or nose. Be alert for the following signs, which can help you determine the potential severity of the exposure:

- Circumoral or intraoral burns, indicating that the child may have ingested a caustic substance.
- Edema of the lips and tongue, carbonaceous material around the nose or mouth, singed hairs within the nares, coughing, drooling, dysphagia, and hoarseness, signs associated with inhalation injury to the airway.
- Severe inspiratory stridor, a sign of partial upper airway obstruction that may indicate inhalation injury.

Inhalation injury often causes rapid and progressive tracheal edema *(see Figure B18)*. Since the lumen of a child's airway is already small, this can quickly lead to partial or complete upper airway obstruction. Look for signs of airway compromise in children who have been rescued from a closed-space fire. Airway obstruction can also arise due to caustic ingestions and severe electrical burns.

Management

Open the airway as necessary. In injuries involving closed-space fires, assume that trauma is possible and observe spinal precautions. Provide suctioning as indicated. All children with moderate to severe burns, particularly those who are at risk for inhalation injury, should receive high-concentration oxygen. Reassess the airway frequently. Consider endotracheal intubation if progressive airway obstruction is noted especially after inhalation injury. Monitor for secretions that may occlude the airway.

Breathing

Assessment

Evaluate work of breathing and listen for breath sounds. Count the respiratory rate, assess

respiratory depth and pattern, check central color at the lips, tongue, and oral mucosa, and inspect for chest trauma. Initiate pulse oximetry if possible, as this may help to identify subtle cases of hypoxia. Note that carbon monoxide poisoning may cause deceptively high oxygen saturation readings. Always correlate pulse oximetry with clinical findings to guide management actions.

Management

Give high-concentration oxygen if signs of respiratory distress are present. Initiate assisted ventilation for children with signs of respiratory failure or arrest. Patients who have circumferential burns to the thorax *or* inhalation injury with lower-airway edema may require higher ventilatory pressure than normal. Watch carefully for chest rise during assisted ventilation. Reassess breath sounds frequently.

Circulation

Assessment

Control rapid hemorrhage, if present. Evaluate the central and peripheral pulses, count the heart rate, and evaluate skin color, temperature, and capillary refill rate. Measure blood pressure in children older than 3 years. If possible, initiate continuous cardiac monitoring.

While signs of shock may be evident in any child with burn injuries, you should look for evidence of internal hemorrhage and other trauma if shock develops within 1 hour after the burn occurred. Children with severe electrical injuries may have irregular central pulses, ventricular fibrillation, ventricular tachycardia or asystole, particularly if high-voltage current has traversed the thorax from arm to arm or from arm to leg. Peripheral pulses may be absent in extremities with circumferential burns.

Management

Initiate fluid resuscitation in children with signs of shock (see *Circulatory Emergencies*). Treat asystole and other dysrhythmias as described in *Dysrhythmias*.

Mental Status

Evaluate mental status and neurologic function. To perform a brief neurologic assessment, check pupil size and reactivity to light, then check all extremities for sensation and movement. Note any changes in mental status since your earlier assessment.

Children with inhalation injuries or severe electrical injuries may present with decreased responsiveness. Continue oxygenation; begin assisted ventilation as necessary. Document changes in mental status since your earlier assessment.

Completing the Initial Assessment

Prepare for rapid transport if you discover any significant abnormal findings during the initial assessment. In patients with potential spinal injury, quickly assess the patient's back for

tenderness, ecchymoses, and crepitation before placing the patient on a spine board. If you have not already done so, begin pulse oximetry and continuous cardiac monitoring during transport.

CUPS Assessment

Table 1 summarizes assessment findings to help you determine CUPS status. You may have to modify the patient's CUPS status later as you evaluate the severity of the burn itself.

Table 1. CUPS Assessment of Pediatric Burns

Category	Assessment	Actions
Critical	Absent airway, breathing, or circulation; AVPU=P or U	Perform initial interventions and transport simultaneously; request routing to a burn center if possible
Unstable	Compromised airway, breathing, or circulation; AVPU=V or P	Perform initial assessment and interventions; transport promptly; request routing to a burn center if possible
Potentially unstable	Normal airway, breathing, and circulation, AVPU=A, *BUT* meets burn center criteria, has risk of inhalation injury, or shows signs suggesting child abuse	Perform initial assessment and interventions; assess and treat burns; transport promptly; begin focused history and physical exam during transport if time allows; consider requesting burn center routing
Stable	Normal airway, breathing, and circulation; AVPU=A; no risk factors noted	Perform initial assessment and interventions; assess and treat burns; perform focused history and detailed physical exam; transport promptly

Based on CUPS Assessment Table © 1997 ND Sanddal, et al. *Critical Trauma Care by the Basic EMT, 4th ed*.

Focused History

Conduct a focused history if the patient's condition permits. In children who have appeared stable so far, find out whether there is any mechanism that could cause inhalation injury, such as exposure to a closed-space fire. In children who have experienced a high-voltage electrical injury, find out whether the child lost consciousness or exhibited seizures after the event.

Be prepared to modify the patient's CUPS status and initiate immediate transport if you discover any of the following:

- burn injuries that meet the requirements for routing to a burn center (see *Transport Criteria*)
- risk for inhalation injury in children who do *not* show signs of respiratory distress
- evidence suggesting a potential for child abuse
- chronic medical problems, such as diabetes or asthma
- evidence of traumatic injuries, including possible fractures

- deterioration of the airway, breathing, circulation, or mental status

Detailed Physical Examination

During the physical examination, look for signs associated with the injury, including

- burns on the face or upper chest
- carbonaceous material around the mouth or nose
- sooty secretions from the mouth or nose
- edema of the tongue, mouth, or nose with hoarseness and a history suggesting inhalation injury
- deformities or apparent fractures of extremities after severe electrical burns
- circumferential burns to extremities with loss of peripheral pulse, movement, or sensation
- with electrical injury look for entrance and exit wounds

Be prepared to modify the patient's CUPS status and initiate immediate transport if you discover any of these findings. Circumferential burns can cause localized edema; be sure to remove rings, bracelets, or other items from the injured area.

Assessment and Management of Burn Injuries

Begin this assessment after initiating transport in children who exhibited abnormalities during the initial assessment. Factors that affect burn management and triage include

- the *type* of burn
- the *depth* of the burn through the skin layers
- the *extent* of the burn as a rough percentage of the child's total body surface area
- the *location* of the burn
- *special circumstances* that require routing to a burn center if possible

Taken together, these 5 elements determine the severity of the burn and the risk to the patient.

Preparation

Undress the child as necessary to evaluate burn. Pediatric burn patients lose body warmth and water faster than adults, placing them at risk for hypothermia; cover exposed areas with blankets.

Remove any items that might cause constriction if edema occurs, such as a watch or jewelry. If the child is not alert, remove glasses or contact lenses.

Assessing burn depth

Burns are assessed as first-, second-, third-, or fourth-degree according to how deeply they

penetrate the skin layers. Color may help you determine the depth of a burn. Second-degree burns destroy the pigment layer at the junction of the epidermis and dermis, exposing the reddish hemoglobin. Third-degree burns are avascular and may appear yellow due to the presence of carotene.

First-degree (superficial). These are painful burns involving the epidermis. The patient will exhibit hyperesthesia, edema, and erythema without vesiculation. Sunburn is a common example.

Second-degree (partial thickness). These burns penetrate the epidermis and involve part of the dermis. The patient will exhibit hyperesthesia, edema, and vesiculation; broken vesicles are red, moist, and very painful. Second-degree burns are often caused by scalds.

Third-degree (full thickness). These burns typically result from flame or contact injuries, destroying the full thickness of the skin and sometimes exposing fat or muscle tissue. Color may vary from yellow or pallid to black and charred, with a dry, waxy, or leathery appearance. Third-degree burns are often insensate to pinprick because nerve endings have been destroyed, but the patient experiences hyperesthesia at the margins of the burns.

Fourth-degree. These burns destroy the epidermis and dermis, damaging underlying muscle, tendon, bone, and fat tissue. High-voltage electrical injuries may cause fourth-degree burns.

Assessing burn extent

When calculating burn extent, do not include first-degree burns except in the case of scalds and some sunburns as noted below:

- A first-degree sunburn covering 40% or more of the total body surface area in an infant or toddler should be treated as potentially serious burn.

- Scald burns that initially appear only red may later develop vesicles, showing that they are second-degree burns.

When reporting scalds, do a separate estimate of areas that appear to be first-degree burns. For example, a 19% scald burn might be better described as a scald burn with an 11% area of second-degree burn with vesicles and an 8% area of first-degree burn with erythema.

When toddlers exhibit scald burns that have a glove or stocking appearance, suspect child abuse *(see Figure 21)*. Intentional scald burns generally have no associated splash patterns, whereas a scald with irregular splash marks might have been caused by the child tipping over a container of hot liquid. See *Child Abuse* for more information.

Form a rough estimate of the total burned surface area using either the Rule of Hands or a

modified version of the Rule of Nines.

Rule of Hands. If the burn is fairly small or irregular, visually estimate how many times the *child's* entire hand (*not* your hand) would cover the burned area. The *child's* handprint is equal to about 1% of the child's body surface area, so the number of handprints equals the burn extent. For example, if the child's hand would fit over the burned area 3 times, the extent of the burn is 3% of the total body surface area *(see Figure B19).*

Rule of Nines. For larger burns, use a modified version of the Rule of Nines as illustrated in Table 2. Since a child's head is larger and legs are smaller than an adult's in proportion to the body, adjustments are needed in these areas to make an accurate assessment.

Table 2. Rule of Nines for Pediatric Burn Assessment

Body area	**Percentage of total body surface**		
	Adolescent	*1–8 y*	*<1 y*
Head	9	12	18
Chest	9	9	9
Abdomen	9	9	9
Upper back	9	9	9
Lower back and buttocks	9	9	9
Genitals	1	1	1
Each arm (front and back)	9	9	9
Each leg (front and back)	18	16.5	13.5

Example: A 10-month-old child has burns covering half of the head (.5 × 18 = 9%). One leg is burned (13.5%) as well as the entire back (18%). The total body surface area burned is 9 + 13.5 + 18, or 40.5%.

A simple diagram based on Table 2 can also be used *(see Figures B17a,b,c).*

Assessing burn location

Second- or third-degree burns in the following areas should be considered potentially serious and treated in a burn center if possible:

- burns on the face, genitals, rectal area, hands, feet, or major joints (elbows, knees, wrists, ankles, shoulder, hips)

- circumferential burns to the thorax, arm, or leg

Assessing special circumstances

There are 2 types of burns that should *always* be treated as potentially serious injuries:

- high-voltage electrical burns, in which a small area of visibly burned skin may cover a large, severely burned area of skin, muscle, or bone that is not apparent

- chemical burns involving *ingested* caustic substances, which can cause internal burns with possible respiratory compromise

Burn Management

Burn interventions focus on preventing further damage to the burned area, providing analgesia, and preventing hypothermia.

Burns are extremely painful when exposed to air. Cover them promptly with dry, sterile dressings to decrease the pain. Nonstick gauzes or a burn sheet make suitable coverings. Cool, moist dressings will help minimize additional damage to the skin, but they can reduce core body temperature if applied to a large area.

Chemical burns

Chemical burns require special handling. Contact a poison control center or medical control for advice before treating the patient, particularly if the substance was ingested. Don protective clothing to protect yourself from chemical contact before treating the child. Generally, you should

- brush dry chemicals from the child's skin, using towels, sheets, or gloved hands
- remove any of the child's clothing that has come into contact with the chemical
- flush external chemical burns with large amounts of water, *except for sodium burns*
- cover metallic sodium burns with an oil-based dressing, such as petrolatum gel

Some chemicals, particularly lye, can continue to burn and destroy tissue even after initial fluid washing. Begin washing at scene, and continue for at least 20 minutes or until care has been transferred. In all cases, cover the patient with blankets to preserve body warmth. Transport promptly.

Lightning strikes

Assessment. A child who suffers a direct hit by lightning may experience burns, fractures, explosive exit wounds, respiratory arrest, and various dysrhythmias. Traumatic injury from exploding debris is also common. Since lightning may follow sweat patterns or arc between body areas, it is important to remove the patient's clothing and examine all parts of the body for burns and exit wounds, including the soles of the feet and between the toes.

The child may exhibit retrograde amnesia or sudden loss of hearing, vision, taste, and smell. The skin may be mottled. A conscious child who has suffered a lightning strike is likely to be confused and extremely frightened, making communication and treatment difficult.

Management. Victims of lightning strikes should be extricated from the scene as rapidly as possible. At minimum, move the patient to the ambulance or a safe structure before continuing assessment and treatment. Observe spinal precautions at all times.

Airway protection is a priority. Give oxygen in all cases; consider endotracheal intubatation as indicated, particularly if rapid airway swelling is noted. If cardiopulmonary arrest is present, initiate CPR; prolonged resuscitative efforts may be required. Initiate continuous cardiac monitoring and provide appropriate treatment for dysrhythmias. Obtain vascular access and administer lactated Ringer's solution at a maintenance rate. Document level of consciousness for serial exams. Treat burns and potential fractures according to normal protocols; contact medical control for additional instructions. Transport promptly.

Further Treatment

Administer appropriate analgesics to control pain associated with burn injuries as permitted by regional protocols. See *Pain Management and Sedation* for information on appropriate pediatric analgesics and dosage. Continuously monitor respiratory status for all children receiving narcotic analgesia. Do not give oral medications or allow the child to drink, as this is likely to cause emesis in children with burn injuries.

Reassessment and Transport

Monitor airway patency, breathing, circulation, and mental status throughout transport, observing the child carefully for signs of deterioration. Modify interventions if necessary. Keep the patient warm. Inform the receiving hospital of the patient's status. Be sure to relay

- the time that the burn occurred
- the cause of the burn
- the extent, depth, and location of the burn
- complicating medical conditions or trauma

Request routing to trauma center or burn center as appropriate.

Transport criteria

Base all transport decisions on regional protocols and directives from medical control. The American Burn Association recommends that a patient who has any of the following problems

should be treated in a burn center if possible:

- second- or third-degree burns covering more than 10% of the body surface area in patients younger than 10 years
- second- or third-degree burns covering more than 20% of the body surface area in all patients aged 10 years or older
- third-degree burns covering more than 5% of the body surface area
- second- or third-degree burns that pose a serious danger for loss of function or permanent disfigurement, including burns involving the face, genitals, rectal area, hands, feet, or major joints
- any electrical burn
- chemical burns that pose a serious danger for loss of function or permanent disfigurement (especially ingested caustics and burns involving the eyes or face)
- burns in combination with inhalation injury
- circumferential second- or third-degree burns to an extremity or the chest
- burns with associated trauma in which the burn is the greatest risk to life

In some cases, it may be more practical to transport the patient to the nearest emergency department for stabilization before transferring care to a burn center. Proceed according to regional protocols.

Documentation

Describe the child's appearance and initial assessment findings in the patient care record and note any changes that develop over time. Also list any significant findings gathered during the focused history and detailed physical examination, if performed. Describe the burn in detail; diagrams are particularly useful in documenting the degree and extent of burns. Note unusual circumstances, such as lengthy extrication from a motor vehicle. List interventions and the child's response to treatment. Continue to record vital signs and cardiac rhythm during transport; this documentation may be helpful should the child's condition deteriorate en route to the hospital or soon after arrival.

Explanatory Text

Inhalation Injuries

Carbon monoxide poisoning is implicated in 50% to 60% of fatalities involving house fires (see *Poisonings* for information on assessment and treatment). Other toxic substances that may be inhaled during a structural fire include cyanide, phosgene gas, and benzene. Exposure may be worst when a child is trapped in a burning structure above the area of maximal involvement, as heat will cause smoke and heated gases to rise and spread through central heating ducts and stairwells.

If the child is still in the structure when water is applied to the fire, superheated steam will also spread throughout the area, greatly increasing the likelihood of severe inhalation injury. In dry air, the upper airways work efficiently to protect the lungs from thermal injury, withstanding air as hot as 260ºC. Once humidity is added, however, greater heat transfer is possible and airway damage increases.

While 75% of fire-related pediatric deaths occur as a result of house fires, most of these deaths are caused by anoxia or exposure to toxic gases rather than burn injuries. Exposure to carbon monoxide, which is often present in closed-space fires, causes cellular hypoxia through displacement of oxygen from the hemoglobin molecule and inhibition of oxygen release to cells. Associated trauma arises in 10% of burns caused by structure fires.

Scald Injuries

Many hot water tanks are set as high as 160º. Tap water heated to 140º can scald a child in a single second. At 130º, third-degree burns can arise in just 30 seconds. Household water heaters should be set to 120º; at this temperature it takes 10 minutes to cause a serious injury.

Assessing Burn Depth

The dividing line between second- and third-degree burns is not always clear. Deep second-degree burns that extend through the capillary layer of dermis into the reticular layer may have clinical findings similar to third-degree burns. When in doubt, it is better to overestimate depth.

Chemical Burns

Mixing metallic sodium and water produces salt and explosive hydrogen gas; therefore, this type of burn should never be flushed with water. A child may encounter sodium in a science classroom or laboratory.

Electrical Injuries

Electrical injuries can produce dysrhythmias, including ventricular fibrillation, ventricular tachycardia, or asystole. Electric current that crosses the chest (from arm to arm or from arm to leg) is most likely to produce these dysrhythmias. High-voltage electrical injury is most

frequently associated with cardiac dysrhythmias, which rarely occur with household current.

Barriers to Learning

Since burn injuries are among the more common pediatric emergencies, it is important to learn all you can about pediatric burn care. It is not unusual to feel strong emotional reactions when learning about pediatric burns; it may be helpful to remember that this is a normal response to a disturbing subject. By becoming more knowledgeable about assessment and management of young burn patients, you will be better prepared to approach these patients calmly and provide them with the best possible care.

Practice Sessions

Click here to view scenario

Watch videos or slide presentations depicting young burn victims and practice assessing the depth and extent of the burns shown. This will help you accustom yourself to the appearance of pediatric burn victims while increasing your familiarity with the modified assessment techniques used in calculating the extent of burns in children.

Organize presentations on fire hazards and burn prevention measures for school assemblies and community meetings. Topics you might discuss include smoke detectors, flame retardant clothing, electrical safety, proper handling and storage of chemicals, and safe temperature settings for home water heaters.

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EMSC Resources

Item 0793. *Illinois Prehospital Pediatric Course*. (IL) Disk Set. Instructor Manual: "Pediatric Trauma: Burn Injuries," 45-49.
Item 0866. *Alaska Medevac Manual*, 3rd ed. (AK) "Pediatric Burns," 41-46.
Item 0871. *Emergency Medical Services for Children Pediatric Emergency Care Course*. (TN and NC) Instructor Manual: "Pediatric Trauma." Student Manual: "Burns."

Additional Reading

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■ HANDOUT Key Points

There are 7 key differences between adult and pediatric burn patients: (1) children have thinner skin that is more easily damaged, so that a similar mechanism results in a deeper burn; (2) very young children are more likely to die from their burns; (3) infants, toddlers, and preschoolers are more likely to be burned as a deliberate act of abuse; (4) children's body proportions necessitate separate burn assessment charts for infants, young children, and adolescents; (5) infants and toddlers are more likely to suffer from scald burns; (6) inhalation injury can rapidly result in upper airway obstruction; (7) infants and toddlers can quickly dehydrate from second- and third-degree burns.

The first priority of pediatric burn management is to ensure scene safety and stop the burn process.

The second priority of pediatric burn management is to assess ABCs and mental status, providing appropriate interventions as needed.

Children should be treated for inhalation injury if they are found in a smoke-filled, enclosed space, or if they have any of the following assessment findings: carbonaceous material around the mouth and nose; signs of respiratory distress; a continual cough; stridor; hoarseness.

To determine appropriate treatment and transport destination, assess the type, depth, extent, and location of the burn, and look for additional high-risk factors.

For small or irregular burns, use the Rule of Hands to estimate the percentage of body surface affected: The number of times the *child's* entire hand would cover the burned area is the approximate percentage of body surface burned.

To assess the extent of larger burns, refer to a burn chart or diagram that shows the Rule of Nines as modified for pediatric patients. Modification is required because younger children have larger heads and smaller legs than adolescents and adults.

If possible, a child with any of the following should be routed to a burn center: (1) a third-degree burn over more than 5% of the body; (2) second- or third-degree burns over more than 10% of the body in children younger than 10 years; (3) second- or third-degree burns over more than 20% of the body in children aged 10 years or older; (4) second- or third-degree burns on the face, hands, feet, genitals, rectal area, or major joints; (5) an electrical burn or a major chemical burn; (6) a second- or third-degree burn that completely encircles the chest, an arm, or a leg; (7) other major trauma in addition to the burn; (8) burns in combination with inhalation injury.

Cover burns with sterile, *dry* dressings to preserve body warmth.

■ HANDOUT

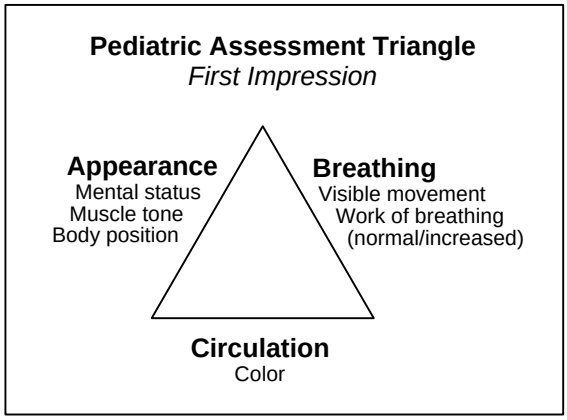

Figure 1

Table 1. CUPS Assessment of Pediatric Burns

Category	Assessment	Actions
Critical	Absent airway, breathing, or circulation; AVPU=P or U	Perform initial interventions and transport simultaneously; request routing to a burn center if possible
Unstable	Compromised airway, breathing, or circulation; AVPU=V or P	Perform initial assessment and interventions; transport promptly; request routing to a burn center if possible
Potentially unstable	Normal airway, breathing, and circulation, AVPU=A, *BUT* meets burn center criteria, has risk of inhalation injury, or shows signs suggesting child abuse	Perform initial assessment and interventions; assess and treat burns; transport promptly; begin focused history and physical exam during transport if time allows; consider requesting burn center routing
Stable	Normal airway, breathing, and circulation; AVPU=A; no risk factors noted	Perform initial assessment and interventions; assess and treat burns; perform focused history and detailed physical exam; transport promptly

Based on CUPS Assessment Table © 1997 ND Sanddal, et al. *Critical Trauma Care by the Basic EMT, 4th ed*.

Click to return to Table of Contents

■ HANDOUT

Table 2. Rule of Nines for Pediatric Burn Assessment

Body area	**Percentage of total body surface**		
	Adolescent	*1–8 y*	*<1 y*
Head	9	12	18
Chest	9	9	9
Abdomen	9	9	9
Upper back	9	9	9
Lower back and buttocks	9	9	9
Genitals	1	1	1
Each arm (front and back)	9	9	9
Each leg (front and back)	18	16.5	13.5

Example: A 10-month-old child has burns covering half of the head (.5 × 18 = 9%). One leg is burned (13.5%) as well as the entire back (18%). The total body surface area burned is 9 + 13.5 + 18, or 40.5%.

Click to return to Table of Contents