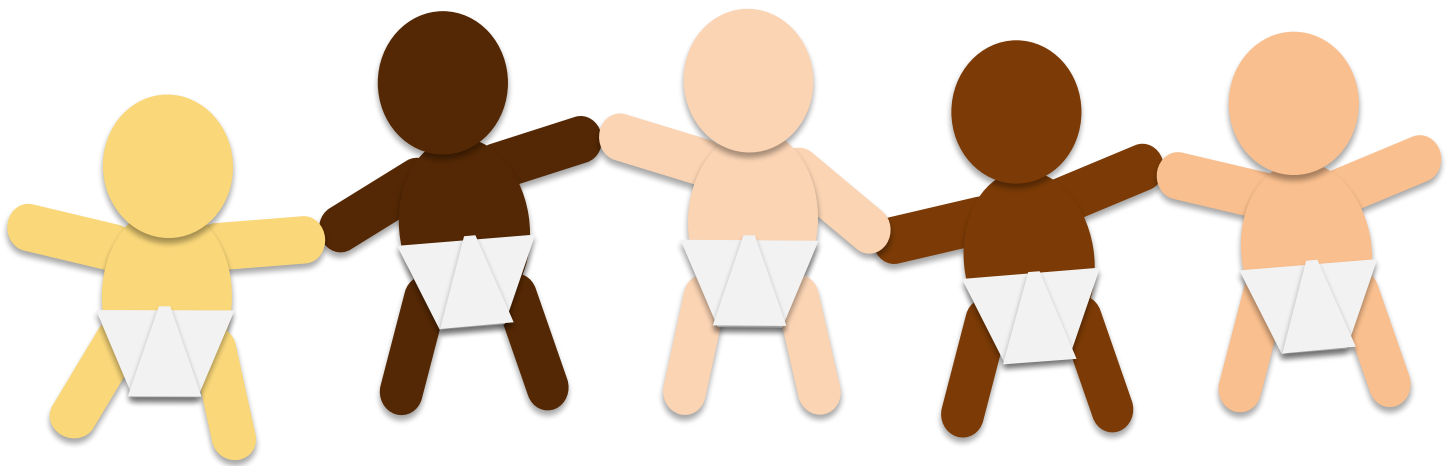


# Pediatric Readiness Simbox

## Pediatric Burn



Emergency Department



### Case Objectives

At the end of this simulation participants will be able to :

1. Apply Crisis Resource Management and teamwork in a pediatric resuscitation (with attention to role designation, directed orders, sharing mental model and closed loop communication with team and family members).
2. Prioritize treatment of potential etiologies to guide stabilization or escalation of care for a pediatric burn patient.
3. Determine the appropriate destination for transfer.

### Equipment

*\*\* Items should be ready for learner use or pulled by learner during simulation*

- Mannequin
- PPE if needed
- Glucometer
- IV supplies
- Fluids
- Pedi length-based tape
- Monitor equipment
- C-collar

### Team Roles

- Primary Nurse
- Physician
- Patient Care Technician
- Radiology Tech
- Social Worker
- Charge Nurse
- Respiratory Therapist
- APP

Helpful tips to navigate through the case progression.

Case Progression

Steps of the case progression and correlate with the interactive buttons in the video.



Expected Learner Actions

- Actions we expect the learners to complete, this is simply a guide.
- Helpful to guide your debriefing.
- If learners have achieved all of the expected actions you can click the next step on the video screen.

**Facilitator States:** Information provided to the learner as they progress through the case.

**Facilitator Response:** Read by the facilitator ONLY when the learner asks.

Scenario Outline

<input type="checkbox"/> Prebrief: Show video or Verbalize	3 mins
<input type="checkbox"/> Scenario Background: Facilitator Read	1 min
<input type="checkbox"/> Prepare for Patient: 2 min countdown <i>** Case specific to EMS arrivals</i>	2 mins
<input type="checkbox"/> Run Case Scenario	10 mins
<input type="checkbox"/> Debrief	15 mins
<input type="checkbox"/> Option: re-run scenario	10 mins

## Prebrief can be done by the video or facilitator read

Basic Assumption: "We believe that everyone participating in our activities is intelligent, capable, cares about doing their best and wants to improve."

[Center for Medical Simulation, Boston MA](#)

### Prebrief

Welcome your team, make introductions:

"This simulated resuscitation is to practice our team's response to an emergency. We will spend about 15 minutes in simulation, then we will debrief for 20 to discuss what went well and what could be improved with input from the team. Even though it is not real, and the manikin can't be harmed, everyone will get the most out of this scenario if we take it as seriously as possible."

### Describe

Describe simulator capabilities, equipment and how to participate:

"Act as you would within your role. You will not get monitor feedback unless your equipment is attached to the patient. Airway equipment should be attached to oxygen, etc. Try to make tasks realistic and timely using your equipment. Please ask for clarifications."

### Demo

DEMO: Closed loop communication.

Know your role and task designation. Use closed loop communication to verify and complete.

Leader: Tech, we need an EKG.

Tech: OK going to get the machine.

Tech: OK, I've got the EKG machine here.

### Disclose

If a safety concern arises during the simulation, I will state:

"Let's take a safety pause."

If a real event happens that is not part of the simulation, I will state:

"This is not a simulation."

Disclose if video recording, privacy and permission.

## Scenario Background

Facilitator states: **A 18 month old male is brought to the Emergency Department with a scald burn.** (Facilitator starts "Run Case Scenario" in video)

### Run Case Scenario

From Video EMS Stated:  
 "ED, ED this is an ALS unit, coming in with a 18 month old boy with significant burns that he got after pulling hot water off the stove over himself. We will arrive in 2 minutes."

### 2 minute countdown

- Team assembles + confirms roles
- Asks for equipment: Broselow tape/ app, monitors, access, medications
- Calls for help

Facilitator Response: "The patient has arrived. You have put on the appropriate PPE (mask and gloves). The patient is crying and screaming in pain. His clothes appear wet and you can see large blisters on his exposed skin."

### Step 1

HR 160  
Sat 99% RA

- Team places patient monitors, pulse oximeter, BP cuff, temp probe
- Estimates weight
- Assesses ABCDEs
- Begins to carefully remove all clothes

Facilitator Statement (IF asked): "Airway is patent. Breath sounds are equal bilaterally. Femoral pulses are 2+ and CRT 2 sec. He is alert and moving all limbs. We are trying to remove all his clothes, but he is crying inconsolably. His weight is 10 kg."

### Step 2

HR 170  
RR 24  
Sat 99% RA  
Temp 37 C

- Asks to remove the patient's diaper too (if not done)
- Asks RN for access and verbalizes need to start fluid resuscitation at 125 mL/hr
- Checks BP and temperature

Facilitator Response (IF Asked): "He is still screaming in pain, IV placement and BP measurement attempted and unsuccessful. Is there anything we can give him for his pain right away?"

SAMPLE history (IF asked):

S/Sx: "He was in the living room watching TV. I was in the kitchen making lunch. I stepped away from the kitchen for less than a minute to let the dog outside. All of a sudden I heard crying coming from the kitchen and he was standing by the stove soaking wet. He must have pulled the pot with boiling noodles in it down from the stove top on top of himself."

Allergies/ Medications: None.

Past Medical History: Term delivery, no medical problems, up to date with immunizations.

Last meal: Pancakes, 4 hours prior to event

Events: No injuries, no sick contacts per parent.

Step 3

HR 150  
BP 100/60  
RR 24  
Sat 99% RA  
CRT 2 sec

- Team verbalizes illness state: Patient with extensive scald burns
- Orders 1 mcg/kg IN fentanyl
- Asks to cover patient with dry, clean sheet
- Performs secondary survey

Facilitator Response (IF team asks): "1 mcg/kg IN fentanyl given. Patient seems much more comfortable now. His BP is 100/60, and his HR is now 150. We were able to get an IV. Secondary survey with no new significant findings."

Step 4

HR 150  
BP 100/60  
RR 22  
Sat 100% RA

- Team notes improvement in tachycardia and normal BP with appropriate pain management
- Asks for POC glucose
- Calculates the total body surface area (TBSA) burned
- Calculates the rate of resuscitation fluids using the "3 mL/kg LR x % TBSA burn PLUS D5LR or D5 1/2NS maintenance" formula

Facilitator Response: "LR started. POC glucose is 107. Do we need to cover these burns?"

Step 5

HR 130  
BP 100/60  
RR 22  
99% RA

- Team dresses burns in dry, clean, sterile dressings
- Reassesses ABCDE
- Informs the social work team
- Discusses what is the most appropriate destination for transfer (eg pediatric burn center) & contacts burn team

Facilitator Response (IF asked): "We have covered the burns with dry, sterile dressings. He is calm and comfortable. Accepting team is ready for handoff."

Wrap

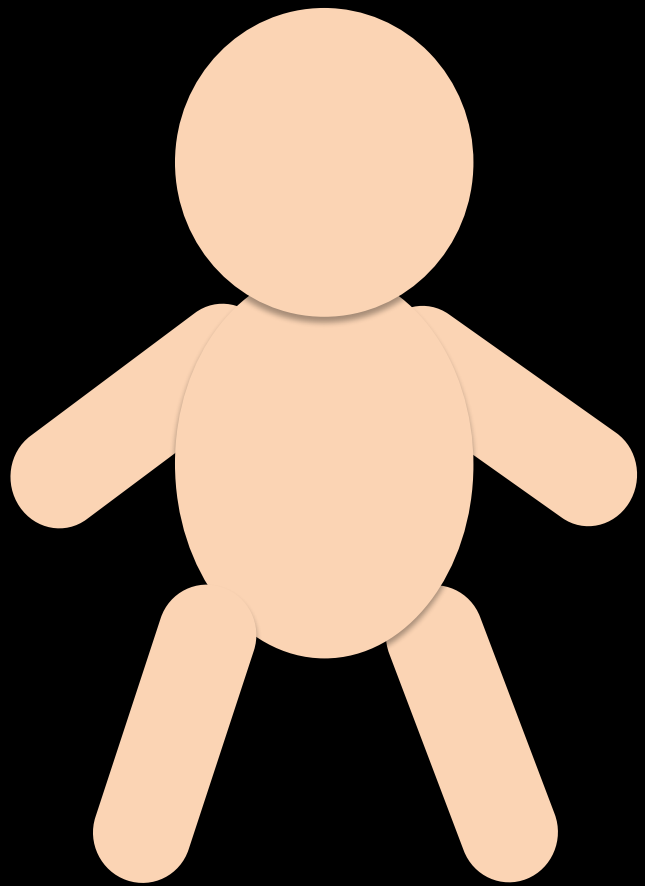
- Team handoffs to the receiving Transfer/ Pediatric Burn/ ICU team
- Formulates pain & fluid management plan for transport
- Updates family and answers their questions
- Prepares for transfer

Facilitator States: (After team performs handoff): "This concludes the simulation" and move to debrief.

Estimating our patient's burn area:



Front



Back





	Observed/verbalized/documented	Yes	No
Sim Objective	Mental status assessed using scale (GCS, AVPU, PAT)		
	Pt placed on full cardiac monitor (pulse ox, ECG, BP)		
	Glucose obtained		
	IV obtained (with labs)		
	Complete primary assessment		
	Complete secondary assessment		
	Demonstrate appropriate wound management (removing clothing/diaper, using dry, sterile dressings).		
	Prioritize early and efficient pain management, using intranasal fentanyl or other parenteral medications, when no IV access has yet been established.		
	Appropriately estimate TBSA in a pediatric burn patient to guide fluid resuscitation and proper destination for transfer.		
Teamwork	Roles designated		
	Closed loop communication throughout		
	Effective handoff to receiving team		
Pediatric Readiness	Proper weight in kg		
	Pediatric Assessment Triangle		
	Vital signs assessed AND re-assessed (including BP)		
	Precalculated med dosing tool used		
	Family permitted to stay in room AND updated by team (if present)		
	Required pediatric equipment located and functioning		
	Pain assessed		
	Mental status assessed using scale (GCS, AVPU, PAT)		

## Components of a Debrief (Based on 3Ds + PEARLS)

"The purpose of this debrief is to discuss areas of great performance and discover areas for improvement. It is not a blame session - everyone is here to do their best."

Defuse  
1-2 min

Solicit emotions and reactions  
"Reactions?"; "Let's take a moment to gather our thoughts."

Discover  
2-3 min

Clarify Facts:  
"Can a teammate share a short summary of the case?";  
"Were there other thoughts?"

Explore Performance  
"What went well?"  
"What could be improved?"



Use observations of learner experiences to highlight strengths of the team and individuals, while asking learners for their thoughts, observations, and reflections.

Deepen  
3-5 min

Identify patient care priorities. Then provide focused feedback and specific areas of opportunity for improvement.  
Elicit any other outstanding issues or concerns.

Summary  
3-5 min

Identify take-home points to apply to future practice:  
Round the room reflections and thanks for participation.



Click on the QR code if you would like the infographics to appear. Click on Pediatric Assessment Triangle to open the graphic.

This page provides possible questions to elicit teaching points during the debrief. These questions are not meant to replace your team's discussion, but can help to steer the debriefing session.

### CLASSIFY BURNS BY DEPTH OF INJURY

**SUPERFICIAL:** Dry, red. Blanches with pressure. Epidermis only.

**SUPERFICIAL PARTIAL-THICKNESS:** Blisters. Moist, red, weeping. Blanches with pressure. Extends into papillary dermis.

**DEEP PARTIAL-THICKNESS:** Blisters, easily unroofed. Wet or waxy dry. Variable color. Does not blanch with pressure. Includes more of the dermis.

**FULL THICKNESS:** Waxy white to gray to charred and black. Dry and inelastic. No blanching with pressure. All of dermis involved.

**FOURTH DEGREE:** Extends through the subcutaneous fat into the fascia and/ or muscle.

### HOW ARE BURNS IN CHILDREN DIFFERENT THAN ADULTS?



Infants and young children have a smaller body surface area (BSA) than adults, but are often exposed to the same offending agent (tap water, a hot drink, clothing iron), and thus sustain a proportionately larger TBSA burn than an adult.

A 7 kg child has a tenth of the weight of a 70 kg adult but a third of their TBSA. This relatively large body surface area results in both a greater surface exposure to the environment and a greater evaporative water loss per kg than adults. Therefore, children require more IV fluid per kg during resuscitation.

Infants less than 6 months have limited muscle mass, so cannot generate as much heat by shivering. Temperature regulation in this age group depends much more on environmental temperature control.

Children under age 2 years have thinner skin and are more prone to full thickness burns at lower temperatures or shorter duration of contact than adults.

### WHEN TO TRANSFER A CHILD TO A BURN CENTER?

- Partial thickness burns >10% of TBSA.
- Full-thickness burns.
- Burns of the face, hands, feet, genitalia, perineum or major joints.
- Inhalation, electrical or chemical injuries.
- Significant pre-existing medical disorders, concomitant trauma or need for special social, emotional or rehabilitative intervention.
- Burned children in hospitals without qualified personnel or equipment for the care of children.

# PEDIATRIC BURN MANAGEMENT

Primary Survey

## Airway/ Breathing

- Think of airway edema & smoke inhalation injury.
- Assess for CO poisoning by calculating the carboxyhemoglobin.
- Use humidified oxygen and treat bronchospasm with  $\beta$ -agonists.



## Circulation

- Initiate fluids early if > 20% TBSA (partial thickness or deeper).
- Preferred IV fluid is Lactated Ringer's (LR).
- Burns <20% TBSA do not require burn resuscitation.
- Do not bolus unless hypotensive.
- Start IVF during the primary survey:
  - <5 y/o: 125 mL/h
  - 6-13 y/o: 250 mL/h
  - >14 y/o: 500 mL/h



## Disability

- Altered mental status? Think hypoxia, hypoglycemia or non- burn related cause.

## Exposure

- Stop the burning process.
- Remove all clothing, diapers, shoes, jewelry.
- Examine for any associated, pre-existing or covert injuries; Burn injuries may mask less painful but more lethal injuries.
- Cover the wounds with dry clean linens and dressings.
- Take warming measures to conserve body temperature. Remember to cover the head to help maintain heat, and use warm/thermal blankets.
- Topical antibiotic ointments are not indicated if you will transfer to a burn center.
- Do not apply ice or cold cold solutions, as it may result in hypothermia and cold injury to the burned surface
- Burn debridement should be done at a Burn Center.

SimBox 3.0

Secondary Survey

## Fluid Resuscitation



Total fluid volume to be repleted over first 24h:

$\geq 30\text{kg}$ :  $2 \text{ mL/kg LR} \times \% \text{TBSA Burn}$ .

$< 30\text{kg}$ :  $3 \text{ mL/kg LR} \times \% \text{TBSA burn} \text{ PLUS D5LR or D5 1/2NS at maintenance rate}$ .

- Give half over the first 8 hours.
- Give the other half over the next 16 hours.
- Subtract any fluids given already.
- Use LR for resuscitation fluids.
- Only for second and third degree burns.
- Titrate based on response and UOP; insert Foley catheter.

E.g. 20 kg child with 40% TBSA Burn:

Total fluid resuscitation in first 24h:  $3 \text{ mL} \times 20 \text{ kg} \times 40 = 2.400 \text{ mL}$ .

$2.400 \text{ mL} / 2 = 1.200 \text{ mL}$  to be given over the first 8 hours, so the calculated initial rate will be  $1.200 \text{ mL} / 8\text{h} = 150 \text{ mL/h}$ .



**Primary Survey: GOAL is STOP THE BURN****A****🔥 Airway/ Breathing: CONSIDER EARLY AIRWAY PROTECTION**

- Apply 100% O2 ASAP, humidified if available
- Treat bronchospasm:  $\beta$ -agonists
- Stridor? Use smaller ET tube to accommodate evolving edema
- Smoke inhalation injury? Consider early bronchoscopy
- Carbon Monoxide poisoning? Measure carboxyhemoglobin level
- Cyanide poisoning? Initiate cyanocobalamin therapy

**B****🔥 Circulation (SEE BELOW FOR FLUID RESUSCITATION PEARLS)****For patients with > 20% TBSA (partial thickness or deeper)**

- Initiate fluid resuscitation with **Lactated Ringer's(LR)** solution
- Do not bolus** unless hypotensive
- May begin IVF during the primary survey:
  - <5 y/o: 125 mL/h
  - 6-13 y/o: 250 mL/h
  - >14 y/o: 500 mL/h
- Burns <20% TBSA do not require fluid resuscitation

**C****D****🔥 Disability/DECON****DECON SHOULD BE INITIATED PRIOR TO ED TRANSFER**

Altered mental status? Think hypoxia, hypoglycemia or non-burn related cause

**E****🔥 Exposure: Stop the burn while maintaining a warm environment**

- Remove all clothing including diapers, shoes, jewelry**
- Examine for any associated, pre-existing or covert injuries**  
Burn injuries may mask less painful but more lethal injuries
- Treat pain with IN medications and Child Life**
- Use warming measures:** conserve body temperature (hat/blankets)
- Prevent hypothermia and/or cold injury:**  
do not apply ice or cold solutions to the burn injured area/surroundings
- Cover wounds with dry clean linens and dressings**  
Topical antibiotic ointments not indicated if transferring to a burn center  
Burn debridement should be performed at a Burn Center unless wounds are significantly contaminated

**BURNS: Fluid Resuscitation Pearls****ABA guidelines** recommend estimation of 24-hour fluid volume using 2–4 mL/kg per % TBSA burned:

**<30kg: 3 mL/kg LR x %TBSA burn + D5LR or D5 1/2NS at maintenance rate**  
**≥30kg: 2 mL/kg LR x %TBSA burn**

Subtract previously administered fluids. Give half over the first 8 hrs, and remainder over the next 16 hrs.

*Titrate based upon response and urinary output measured via indwelling bladder catheter***e.g. 20 kg child with 40% TBSA Burn:**Total fluid resuscitation in first 24h:  $3 \text{ mL} \times 20 \text{ kg} \times 40 = 2.400 \text{ mL}$ .  $2.400 \text{ mL} / 2 = 1.200 \text{ mL}$ 1200 ml to be given over the first 8 hours; calculated initial rate will be  $1.200 \text{ mL} / 8 \text{ h} = 150 \text{ mL/h}$ .1200 mL over 16 hours: calculated rate  $1200 \text{ mL} / 16 \text{ h} = 75 \text{ mL/h}$



## Perform Secondary Survey

### “AMPLET” Mnemonic:

Allergies, Medications, Past medical and surgical history, Last intake, Events and Environment, Tetanus (tetanus prophylaxis should be considered for all burns).

**Ask for the circumstances of the injury:** Non accidental scalds are a common form of abuse.

Is story consistent with the injury pattern? Does mechanism match developmental stage of child?

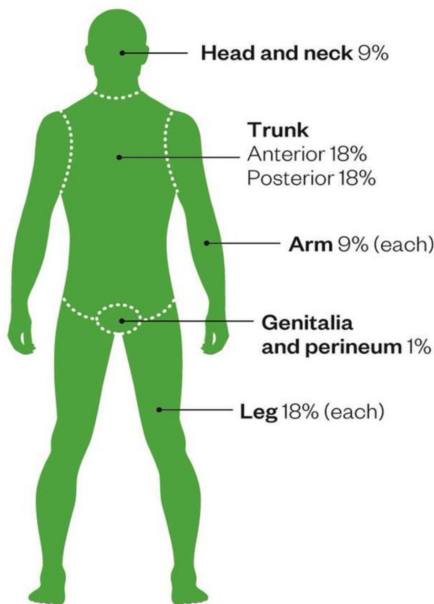
**Document:** photographs are crucial: reporting of child abuse is mandatory in the US. The child’s pediatrician is often a valuable source of information

**Prophylactic IV antibiotics are unnecessary**

**Labs:** CBC, BMP, gas/ glucose, CK, UA. Consider carboxyhemoglobin with inhalational thermal injury.

## Identify total body surface area (TBSA) burned

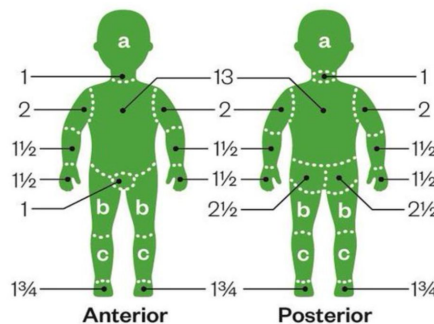
### Wallace rule of nines



### Lund and Browder chart

Relative percentage of body surface area (% BSA) affected by growth

	half of head (a)	half of one thigh (b)	half of one lower leg (c)
0 yr	9½	2¾	2½
1 yr	8½	3¼	2½
5 yr	6½	4	2¾
10 yr	5½	4¼	3
15 yr	4½	4¼	3¼



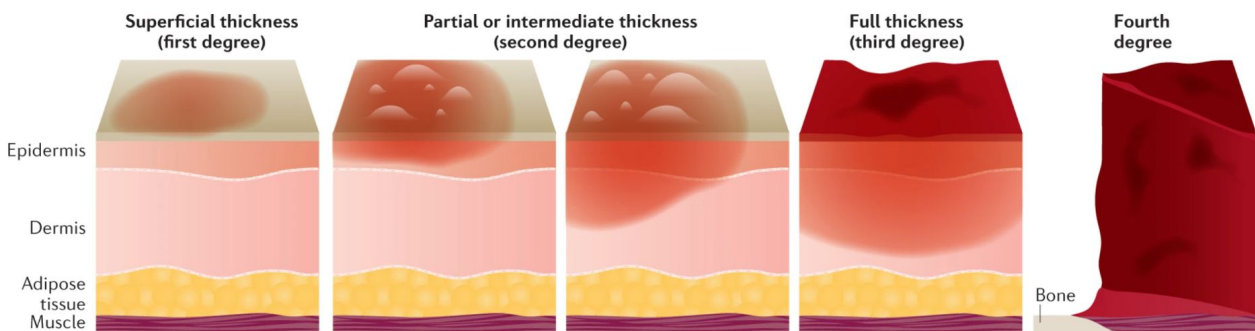
### Palm method

Fingertip to wrist equals 1% of TBSA



Superficial burns are NOT included in TBSA.

## Reference: Burn injury classification



- Superficial thickness (first degree):**
  - Painful
  - Does not blister
  - Does not scar
- Partial or intermediate thickness (second degree):**
  - Superficial partial thickness burns do not require surgery, but may scar and be more painful
  - Deep partial thickness burns require surgery and form more scars and are less painful
  - Blisters and weeps
  - With increasing depth, increased risk of infection
  - With increasing depth, increased risk of scarring
- Full thickness (third degree):**
  - Dry
  - Insensate to light touch and pin prick
  - Small areas will heal with substantial scar or contracture
  - Large areas require skin grafting
  - High risk of infection
- Fourth degree:**
  - Involves muscle or bone
  - Leads to loss of the burned part



**🔥 Perform a thorough physical examination:**

- Evaluate for concomitant injury
- Assess vascular status of extremities and thorax. Circumferential burns may result in vascular compromise and may require escharotomy.



**🔥 Treat pain and anxiety:**

- IN fentanyl, Tylenol suppository, IM Toradol if no IV access.
- Remember nonpharmacologic interventions: reassurance, soothing, distraction, child life specialists.



**🔥 "AMPLET" Mnemonic:**

- Allergies, Medications, Past medical and surgical history, Last intake, Events and Environment, Tetanus (tetanus prophylaxis should be considered for all burns).



**🔥 Ask for the circumstances of the injury:**

- Non accidental scalds are a common form of abuse.
- Is the story consistent with the injury pattern?
- Does the mechanism match the developmental stage of the child?
- Document: photographs are crucial.
- Reporting of child abuse is mandatory in the US. The child's pediatrician is often a valuable source of information.



**🔥 There is no need for prophylactic IV antibiotics.**

**🔥 Labs:** CBC, BMP, gas/ glucose, CK, UA.



**🔥 Determine the total body surface area (TBSA) burned.**

Relative percentage of body surface areas (% BSA) affected by growth

	0 yr	1 yr	5 yr	10 yr	15 yr
a— 1/2 of head	9 1/2	8 1/2	6 1/2	5 1/2	4 1/2
b— 1/2 of 1 thigh	2 3/4	3 1/4	4	4 1/4	4 1/2
c— 1/2 of 1 lower leg	2 1/2	2 1/2	2 3/4	3	3 1/4

**A Rule of 9s:** Used in adults. Less accurate in children as the proportion of body surface area made by anatomic parts, especially the head, varies considerably by age.

**B Lund Browder diagrams** (see previous page)

**Palm method** (fingertip to wrist equals 1% of TBSA)

Superficial burns are NOT included in TBSA.

U.S. Department of Health and Human Services, Public domain, via Wikimedia Commons

SimBox 3.0

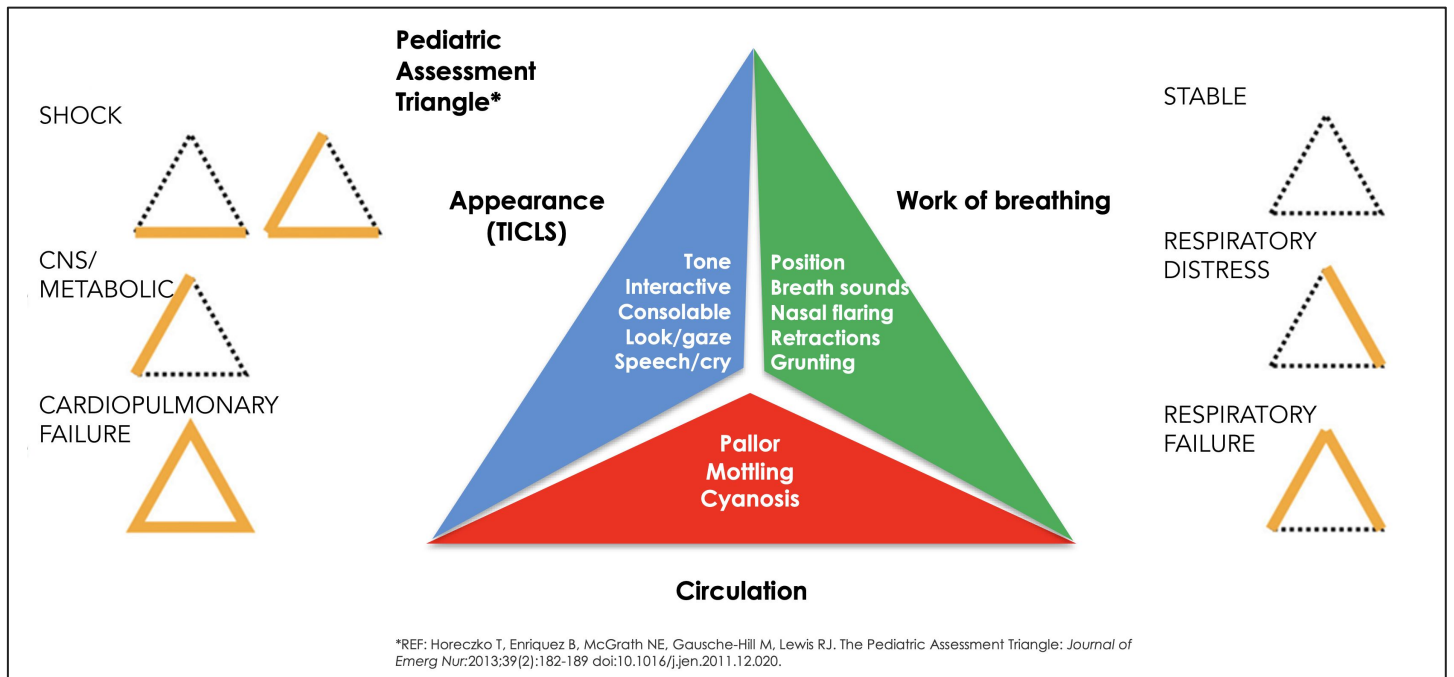
Pediatric Vital Signs/Weight by Age

Age	Weight (kg)	Pulse	Resp	Systolic BP*
Newborn	3	100-180	30-60	60-70
6 mos	7	100-160	30-60	70-80
1 yr	10	100-140	24-40	72-107
2	12	80-130	24-40	74-110
3	15	80-130	24-40	76-113
4	16	80-120	22-34	78-115
5	18	80-120	22-34	80-116
6	20	70-110	18-30	82-117
8	25	70-110	18-30	86-120
10	35	60-100	16-24	90-123
12-15+	40-55	60-100	16-24	90-135

\*BP in children is a late and unreliable indicator of shock



Using the Pediatric Assessment Triangle (PAT)



Pediatric Mental Status Assessment: response to stimuli



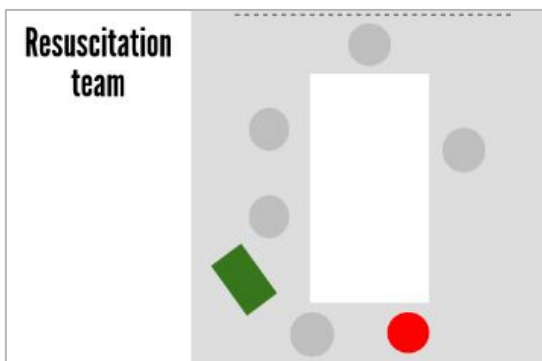


COMPONENTS OF EFFECTIVE TEAMS: TEAMSTEPS IN A NUTSHELL

<https://www.ahrq.gov/professionals/education/curriculum-tools/cusptoolkit/modules/implement/teamworknotes.html>

COMMUNICATION	LEADERSHIP	SITUATION MONITORING	MUTUAL SUPPORT
<b>SBAR</b> Situation Background Assessment Recommendation	<b>BRIEF</b> Planning, setting the tone	<b>STEP</b> Status of pt Team Members Environment Progress toward goal	<b>TASK ASSISTANCE</b> Awareness of team work load
<b>CALL OUT</b> Sharing critical information with the team	<b>HUDDLE</b> Ad-hoc planning or updates	<b>"I'M SAFE"</b> <i>Tool for self evaluation</i> Illness Medication	<b>FEEDBACK</b> Providing information for purpose of team improvement
<b>CHECK BACK</b> Loop Closure**	<b>DEBRIEF</b> Exchange of information to inform team of performance and effectiveness	Stress Alcohol/Drugs Fatigue Eating + Elimination	<b>ADVOCACY &amp;                      ASSERTION</b> Advocating for patient in case of a disagreement with decision maker
<b>HANDOFF</b> I PASS the BATON Introduction Patient Assessment Situation Safety Concern Background Actions Timing Ownership Next Cognitive Aid @DrM_Kou			<b>2 CHALLENGE RULE</b> Information conflict regarding patient safety
			<b>DESC Script</b> <i>Tool for personal conflict*</i> Describe situation Express your concern Suggest an alternative Consensus statement
			<b>CUS STATEMENT</b> I'm concerned I'm uncomfortable This is a safety issue
			<b>COLLABORATION</b> Working toward a common mission

CRISIS RESOURCE MANAGEMENT: CRM and the Shared Mental Model:



CRM (established by the airline industry) is based upon team leadership and defining clear roles for team members. Closed loop communication when used by all team members reduces errors and improves safety through:

- Addressing team members by name when assigning tasks.
- Giving confirmation when tasks are acknowledged or completed.

A shared mental model allows a team to anticipate the plan for patient care and what equipment or medications might be needed.



Thank you for participating in the simulation.

Please complete the facilitator and participant surveys by clicking on the links or scanning the QR codes below:

## Facilitator Survey



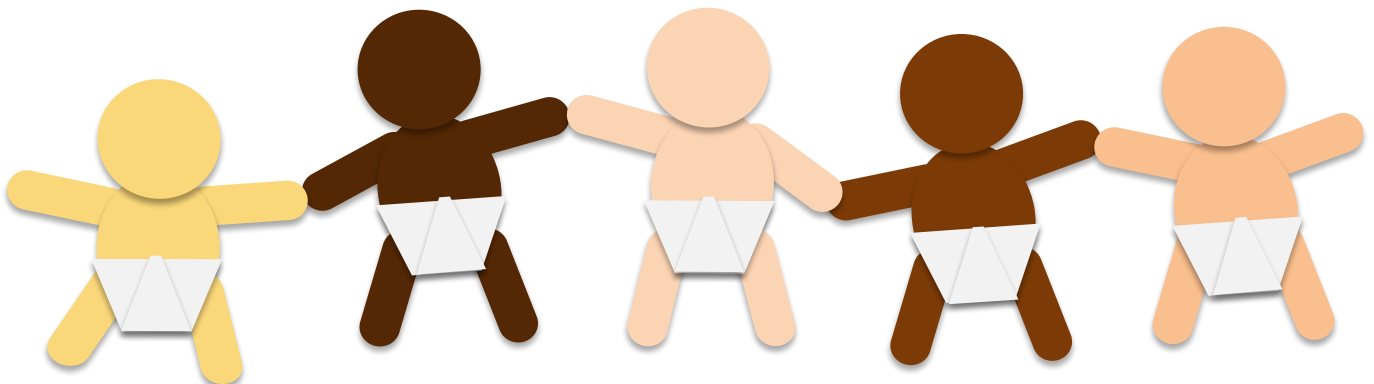
## Participant Survey



Posted: Dec 2021 Updated: December 2024

Authors: Alexandria Georgadarellis, Jason Bresky, Elizabeth Sanseau, Maybelle Kou, Marc Auerbach, Megan Petrucelli, Alisa Savetamal, Michael Goldman, Mark Cicero, Sofia Athanasopoulou.

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Shaw KN & Bachur RG. (2021). Burns. In Fleisher & Ludwig's Textbook of Pediatric Emergency Medicine. Wolters Kluwer.

Subcommittee on Advanced Trauma Life Support (ATLS) of the American College of Surgeons (ACS), Committee on Trauma, 1987-1988. (1989). Advanced trauma life support course for physicians. Chicago, Ill. :Committee on Trauma, American College of Surgeons.

[Prevention – American Burn Association](#)

**Videos:**

[Burns 101 Assessment](#)

["Fluid Resuscitation for Burn Injuries" by Robert Sheridan, MD for OPENPediatrics](#)

**Literature:**

[Burn Care for Children | Pediatrics In Review](#)

[Pediatric burn injuries treated in US emergency departments between 1990 and 2006](#)

[Critical care of the burn patient: the first 48 hours](#)

[Pain Management in Pediatric Burn Patients: Review of Recent Literature and Future Directions](#)

**Note:**

Written and/or verbal consent was obtained for the use of the videos and pictures included in this booklet and respective video.