DEPARTMENT OF HEALTH

Pediatric Response Resources for Burn Surge Facilities

MINNESOTA BURN SURGE PLAN

CENTER FOR EMERGENCY PREPAREDNESS AND RESPONSE

July 2019

Updated July 2019

Contents

Background

The Minnesota Department of Health has created a Pediatric Surge Toolkit available on the Minnesota Department of Health's website. The Toolkit include a range of materials including: Assessment Tools, Planning Tools and Templates, Education and Training Tools, Exercise Tools and Templates, and Response Tools. The Pediatric Primer is the primary resource for planners and responders for information about Pediatric Surge.

This Attachment to the Minnesota Burn Surge Plan highlights the important intersects of Burn Surge and Pediatric Surge care including:

- Basic Treatment Considerations of Pediatric Patients
- Triage
- Special Airway Considerations for the Pediatric Patient
- Ventilator Management
- Nutrition
- Pediatric Order Set for Burn Patients
- Nurse Driven Fluid Resuscitation Protocol

For more details on pediatric surge planning and response, please reference the Pediatric Surge Toolkit. For more details on burn surge planning and response, please reference the Burn Surge Website.

Basic Treatment Considerations

Children have a larger surface area per unit of body than adults and therefore require relatively more fluid during resuscitation after a burn injury. The head has a higher percentage of Body Surface Area (BSA) compared to the lower extremities.

- The ratio of BSA is highest at birth and decreases as the child grows.
- A larger head surface area contributes to larger heat loss.
- Pediatric skin is thinner and more permeable to toxins.
- Children have limited glycogen stores, which can be rapidly depleted; they should receive a maintenance fluid of D5LR, in addition to resuscitation fluids.

First Aid

- Apply cool tap water for 20 minutes to the burned area to stop the burning process. This is effective up to 3 hours post burn.
- Do not use ice.
- Remove clothing, jewelry and anything constricting.
- After cooling, cover with cling wrap and warm the patient. Elevate limbs.

Vital Signs

Vital signs can be of some help in determining priority, however the normal ranges, by age, are wide, and thus, clinical correlation to the injuries/symptoms is required. Persistent tachycardia or tachypnea exceeding the ranges below, after appropriate analgesia, should prompt a careful evaluation for severe illness/injury.

Table 1: Vital Signs Normal Ranges by Age

Respiratory Rate and Heart Rate Range by Age	Respiration Rate (per minute)	Heart Rate (per minute)
Birth to 1 year (infant)	30 – 60	100 – 160
1 to 3 years (toddler)	24 – 40	90 – 150
3 to 6 years (pre-school)	22 – 34	80 – 140
6 to 12 years	18 – 30	70 – 120

Nutrition

- Nutrition should be considered early in the treatment phase.
- Keep patient NPO (nothing by mouth) until all assessments have been done.
- For any pediatric patient with burns ≥ 20% TBSA, place an enteral feeding tube as early as possible.

Triage

Pediatric patients can be difficult to triage. Pediatric patients with obvious external bleeding or soft tissue wounds and those who are crying uncontrollably are often assigned triage categories higher than justified. When there is a large volume of pediatric patients, JumpSTART, SALT and SMART are 3 methods of appropriate triage for children.

However, the table on the next page may be used in conjunction with clinical assessment and guidance from a Burn Center to determine which patients may be too gravely injured to warrant full resuscitation and support. In all cases, patients should be provided with appropriate medications for comfort even if other interventions are not warranted bases on the prognosis.

Additionally, the Minnesota Department of Health's Science Advisory Team has created Patient Care Strategies for Scarce Resources Situations, which includes a Burn Therapy Resource Card, a Burn Therapy Triage Card, a Pediatric Resource Card, and a Pediatric Triage Card.

Table reflects **SURVIVABILITY**—so 'very high' is an excellent prognosis.

Survivable	Survivable and good outcome expected without requiring initial admission.
Very High	Survival with good outcomes highly expected.
High	Survival and good outcomes expected with limited/short term initial admission and resource allocation (LOS less than or equal to 14 days. 1-2 surgical procedures)
Medium	Survival and good outcomes with aggressive care and comprehensive resource allocation, including initial admission (greater than/equal to 14 days), resuscitation, and multiple surgeries.
Low	Survival and good outcome low even with long-term, aggressive treatment and resource allocation.
Very low	Survival and outcome poor even with unlimited resources.
Expectant	Survival less than 10% even with unlimited, aggressive treatment.

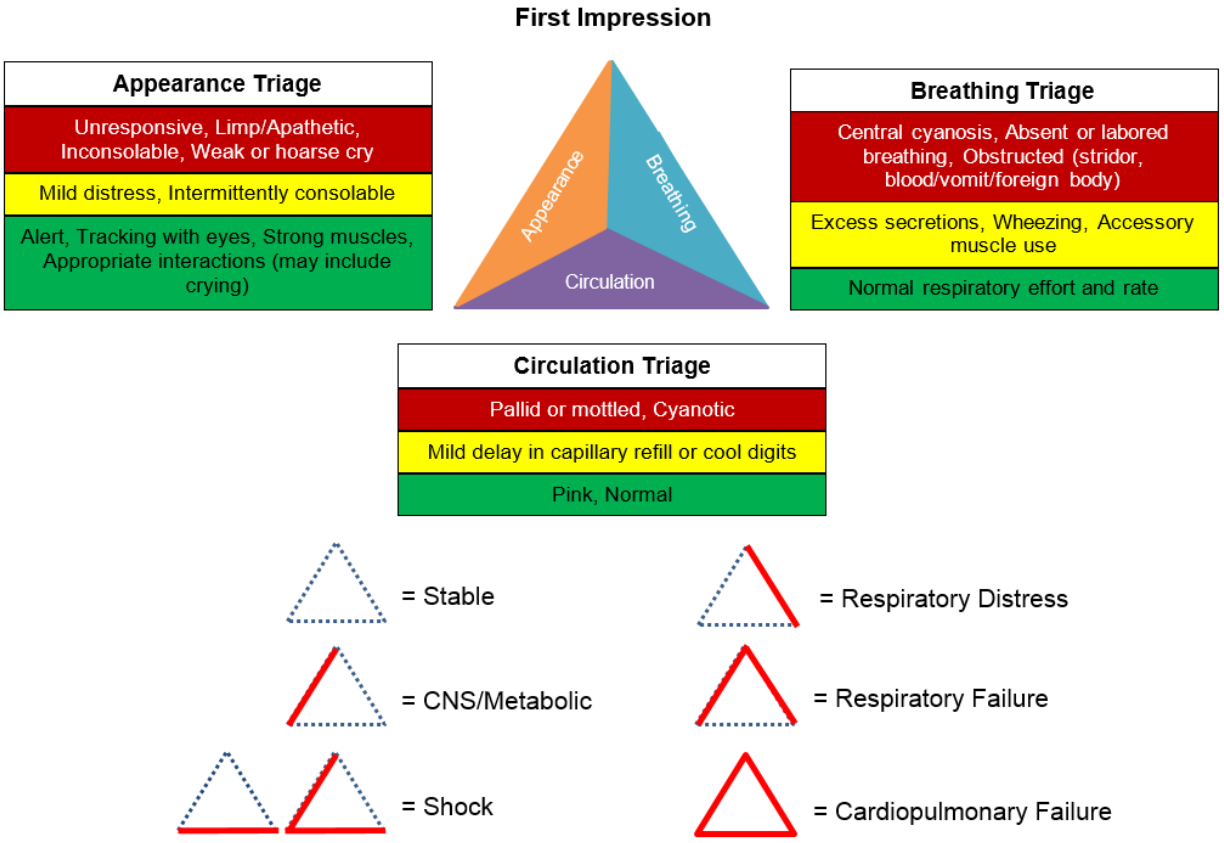
Survival rate by age and total percent of body surface area burned (+10 for inhalation injury)

Age	0 -10%	11 – 20%	21 -30%	31 - 40%	41 - 50%	51 - 60%	61 - 70%	71 - 80%	81 - 90%	91+%
< 2 years	**Very High**	**Very High**	**Very High**	**High**	**Medium**	**Medium**	**Medium**	**Low**	**Low**	**Very Low**
2 - 5 years	**Survivable**	**Very High**	**Very High**	**High**	**High**	**High**	**Medium**	**Medium**	**Low**	**Low**
5 - 19 years	**Survivable**	**Very High**	**Very High**	**High**	**High**	**High**	**Medium**	**Medium**	**Low**	**Low**
20 - 29 years	**Survivable**	**Very High**	**Very High**	**High**	**High**	**Medium**	**Medium**	**Low**	**Low**	**Very Low**
30 - 39 years	**Survivable**	**Very High**	**Very High**	**High**	**Medium**	**Medium**	**Medium**	**Low**	**Low**	**Very Low**
40 - 49 years	**Survivable**	**Very High**	**Very High**	**Medium**	**Medium**	**Medium**	**Low**	**Very Low**	**Very Low**	**Expectant**
50 - 59 years	**Survivable**	**Very High**	**Very High**	**Medium**	**Medium**	**Low**	**Very Low**	**Very Low**	**Expectant**	**Expectant**
60 - 69 years	**Very High**	**Very High**	**Medium**	**Medium**	**Low**	**Very Low**	**Very Low**	**Expectant**	**Expectant**	**Expectant**
70+ years	**Very High**	**Medium**	**Medium**	**Low**	**Very Low**	**Expectant**	**Expectant**	**Expectant**	**Expectant**	**Expectant**

Assessment

Pediatric Assessment Triangle

Advanced Pediatric Life Support (APLS) uses the Pediatric Assessment Triangle (PAT) (below), for a quick initial assessment of the pediatric patient. The only threat not addressed by the PAT is a finding of penetrating injury to the chest or abdomen, which should categorize the patient as 'Red' or critical—these may be subtle and should be looked for carefully in the setting of any explosion.

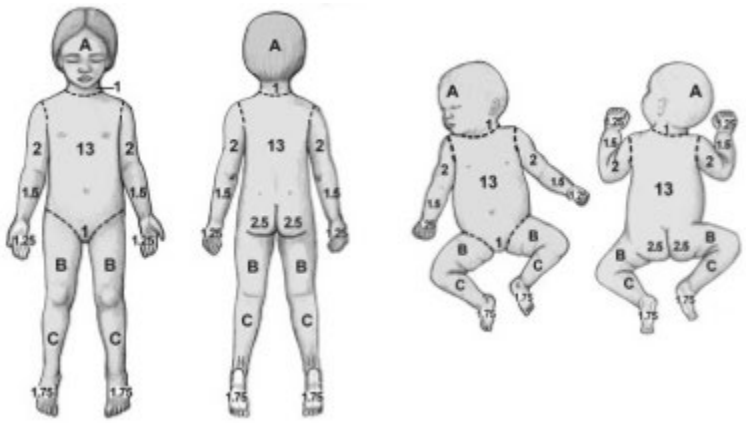


Lund-Browder Chart for determining Total Body Surface Area

The Lund-Browder chart is the gold standard for measurement of Total Body Surface Area (TBSA) and the most accurate tool for pediatric use. It compensates for the change of body shape as humans grow.

Directions: Locate the patient's age in the chart on the next page. Identify the areas that are covered by burns. Add the percentage of each area to obtain TBSA. Ignore simple erythema. *Use the TBSA to determine the patient's required fluid resuscitation (see Nurse Driven Fluid Resuscitation Protocol at end of this document).*

		Percentage of Body								
Area		0-1 year	1-4 year	5-9 year	10-14 year	15 year	Adult	Superficial	Deep	Total %
Anterior (front)	Head (A)	9.5	8.5	6.5	5.5	4.5	See Adult Response Resource Set			
	Neck	1	1	1	1	1				
	Trunk	13	13	13	13	13				
	Genitalia	1	1	1	1	1				
	R. upper arm	2	2	2	2	2				
	L. upper arm	2	2	2	2	2				
	R. lower arm	1.5	1.5	1.5	1.5	1.5				
	L. lower arm	1.5	1.5	1.5	1.5	1.5				
	R. hand	1.25	1.25	1.25	1.25	1.25				
	L. hand	1.25	1.25	1.25	1.25	1.25				
	R. thigh (B)	2.75	3.25	4	4.25	4.5				
	L. thigh (B)	2.75	3.25	4	4.25	4.5				
	R. lower leg (C)	2.5	2.5	2.75	3	3.25				
	L. lower leg (C)	2.5	2.5	2.75	3	3.25				
	R. foot	1.75	1.75	1.75	1.75	1.75				
	L. foot	1.75	1.75	1.75	1.75	1.75				
Posterior (back)	Head (A)	9.5	8.5	6.5	5.5	4.5				
	Neck	1	1	1	1	1				
	Post. Trunk	13	13	13	13	13				
	R. buttock	2.5	2.5	2.5	2.5	2.5				
	L. buttock	2.5	2.5	2.5	2.5	2.5				
	R. upper arm	2	2	2	2	2				
	L. upper arm	2	2	2	2	2				
	R. lower arm	1.5	1.5	1.5	1.5	1.5				
	L. lower arm	1.5	1.5	1.5	1.5	1.5				
	R. hand	1.25	1.25	1.25	1.25	1.25				
	L. hand	1.25	1.25	1.25	1.25	1.25				
	R. thigh (B)	2.75	3.25	4	4.25	4.5				
	L. thigh (B)	2.75	3.25	4	4.25	4.5				
	R. lower leg (C)	2.5	2.5	2.75	3	3.25				
	L. lower leg (C)	2.5	2.5	2.75	3	3.25				
	R. foot	1.75	1.75	1.75	1.75	1.75				
	L. foot	1.75	1.75	1.75	1.75	1.75				
							Total			



Special Airway Considerations for the Pediatric Patient

Airway

Anatomical differences to be aware of:

- The tongue is relatively large compared with the oropharynx, which may create an obstruction
- The larynx is higher and more anterior in the neck, the vocal cords are at a more antero-caudal angle
- The epiglottis is omega shaped and soft
- The narrowest portion of the airway is the cricoid ring, not the vocal cords
- Significant burns to the nasal passage of infants < 6 months can cause airway compromise due to obligatory nose breathing

Intubation

Early intubation, if airway control is needed, is vital to prevent a future difficult intubation scenario. Age and height-based estimations are **not** always accurate—always be prepared with a range of equipment sizes, especially for airway interventions.

Emergent

- Burns to mouth and/or nose
- Stridor, wheezing, respiratory distress, hypoxia
- Altered mental status with inability to protect airway

Urgent Evaluation

- Carbonaceous sputum
- Facial burns
- Cough with distress, stridor or hypoxia
- Prolonged closed space heat exposures
- Burns >20% TBSA

Ventilator Management

Children are more susceptible to barotrauma when placed on mechanical ventilation and have higher minute ventilation per kilogram and higher respiratory rate when compared to adults. Due to this, children may absorb more toxins that may be present during a burn surge incident. Furthermore, chemical agents often are heavier than air, which means that they settle close to the ground in the air space used by children. Finally, burn patients undergoing fluid resuscitation typically require higher ventilator pressures.

See Initial Ventilator Settings on next page.

Initial Ventilator Settings

	<10 kg	10-40 kg	>40 kg
Mode	Pressure Control	Pressure Control	Pressure Control
Rate	40	28	16
PIP	15-20 cm H_2O	15-20 cm H_2O	20 cm H_2O
PEEP	5-8 cm H_2O	5-8 cm H_2O	5-8 cm H_2O
FiO_2	100%	100%	100%
Inspiratory time	0.3 seconds	0.7 seconds	1 second

Pediatric Order Set for Burn Patients

MINNESOTA BURN SURGE FACILITIES

DISCLAIMER: These materials were developed by the Minnesota State Burn Centers—Hennepin County Medical Center and Regions Hospital—in conjunction with the Minnesota Department of Health. ***They are recommendations for patients being treated for burns at a Burn Surge Facility.*** If, at any time a provider or nurse needs to consult with a Burn Center, please contact them. All prescribing providers at the BSF have authority to prescribe treatment they deem appropriate in their facility.

INSTRUCTIONS: These are recommended orders by Minnesota State Burn Centers for the treatment of burn patients. Prescribing providers at the BSFs should check the boxes on orders they deem appropriate for patient care. If the BSF has electronic order entering, the appropriate staff member should enter all checked orders into the electronic medical system. If, at any time a provider or nurse needs to consult with a Burn Center, please contact them.

On Admission:

☐ Height and Dry Weight

☐ Record amount of fluid patient has received

☐ Calculate Modified Parkland Formula (See Nurse Driven Resuscitation Protocol) and obtain order for IVF

☐ ABO Rh and Antibody Screen (Type & Screen)

☐ Tetanus toxoid 0.5 mL IM now (if > 5 years since last immunization)

☐ Albumin, Prealbumin

☐ AST, ALT, Triglycerides, Bilirubin

☐ Basic Metabolic Panel, Magnesium, Phosphorous

☐ Blood Gas, Arterial (Inhalation injury/ Intubated)

☐ Blood Gas, Venous, if unable to obtain ABG (Inhalation injury/Intubated)

☐ Carbon Monoxide, Blood (Inhalation injury/Intubated)

☐ Hemogram with Platelets

☐ Lactate

☐ UA

☐ Ethanol Level and Drugs of Abuse Screen

☐ Urine Pregnancy Screen for females ages 10-55 years if not already done

Standing Orders:

Consults

☐ **Call the referring Burn Center daily for assistance with pain medications, sedation, wound care, nutrition, and other questions.**

HCMC: 1-(800) 424-4262 or 612-873-4262

Regions Hospital: 1-(800) 922-BURN (2876)

Vital Signs and Monitoring

☐ Vital signs Q1 hour x 8 hrs, then Q4 hrs

☐ Pediatric Early Warning Score (PEWS) Q1 hour

☐ Continuous Cardiac Monitoring on patients with ≥ 10% TBSA

☐ Continuous Pulse Oximetry

Wound Care

☐ Wash wounds daily with soap and water

☐ Apply dressings per Burn Center recommendation

Oxygen Therapy

☐ Oxygen Therapy as needed to maintain SpO_2 ≥ 92%

☐ Carbon Monoxide inhalation patients: 100% humidified O_2 x 4 hours

Lines/Drains

☐ IV access

☐ Nasogastric/Orogastric Tube to Low Continuous Suction for intubated patients

☐ Indwelling Urethral Catheter Insertion and Maintenance for ICU patients

IV Fluid Resuscitation

☐ Titrate IVF per UOP (See Nurse Driven Fluid Resuscitation Protocol)

☐ D5LR IV maintenance infusion in addition to Nurse Driven Fluid Resuscitation Protocol (consider in patients <1-year-old to prevent hypoglycemia)

Activity

☐ Bedrest—Turn Q2 hours

☐ Spinal Precautions until cleared

☐ Up in chair

☐ Ambulate with Assistance

☐ Elevate effected extremities

Nursing Assessment and Interventions

☐ Weigh Patient Daily

☐ Strict Intake and Output (every 1 hour for ICU patients, every 4 hours for others)

☐ Peripheral Pulse Checks Q1 hour (Circumferential Burns)

☐ Bladder Pressure Assessment Q4 hours if TBSA ≥ 10% until resuscitation is complete

☐ Fingerstick/Blood Glucose Monitoring AC & HS (Maintain Fasting Serum Glucose [FSG] between 90-150)

☐ Fingerstick/Blood Glucose Monitoring Q4 hours (Maintain FSG between 90-150)

☐ Oral Care for Intubated Patients every 2 hours with peroxide or Chlorhexidine Gluconate (CHG)

Nutrition

☐ Pediatric Diet

☐ Infant Diet

☐ Customized Diet (i.e. renal, diabetic, cardiac): _____

Medications

Pain/Sedation/Wound Care

Please contact a Burn Surgeon at HCMC or Regions Hospital for assistance with pain medications, sedation, wound care, and other questions.

HCMC: 1-(800) 321-BURN (2876)

Regions Hospital: 1-(800) 922-BURN (2876)

Gastrointestinal

☐ Chemical GI prophylaxis and Bowel regimen per hospital policy

Vitamins

For patients age less than 1 year

☐ Pediatric multiple vitamin with C (POLY-VI-SOL) 1 mL **enteral** BID

☐ Ascorbic acid (VITAMIN C) 250 mg **enteral** BID

☐ Zinc sulfate (ORAZINC) 110 mg **enteral** daily for 14 days

For patients 1-2 years of age

☐ Pediatric multiple vitamin (MULTI-DELYN) 2.5 mL **enteral** BID for 14 days

☐ Ascorbic acid (VITAMIN C) 250 mg **enteral** BID

☐ Zinc sulfate (ORAZINC) 110 mg **enteral** daily for 14 days

For patients age great than 2 years

☐ Pediatric multiple vitamin (MULTI-DELYN) 5 mL **enteral** BID for 14 days

☐ Ascorbic acid (VITAMIN C) 500 mg **enteral** BID

☐ Zinc sulfate (ORAZINC) 110 mg **enteral** daily for 14 days

Miscellaneous

☐ Carboxymethylcellulose (REFRESH PLUS) 0.5% eye gtt 1-2 drop(s) in both eyes Q4 hrs

☐ Carboxymethylcellulose (REFRESH PLUS) 0.5% eye gtt 1-2 drop(s) in both eyes Q4 hrs PRN periorbital burns

Daily Labs/Imaging

☐ Blood Gas, Arterial (Inhalation injury/ Intubated)

☐ Blood Gas, Venous, if unable to obtain ABG (Inhalation injury/Intubated)

☐ Hemogram with Platelets

☐ Basic Metabolic Panel

☐ XR Portable Chest 1 View daily (Intubated)

Nurse Driven Fluid Resuscitation Protocol

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Burn Center Contact Information

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Indications for Fluid Resuscitation

- Children with >15% Total Body Surface Area (TBSA)
- Inhalation Injury
- Electrical Injury

Burn Diagram should be completed by Admitting Provider

- Determine TBSA using the Lund Browder method (see above) or the Wallace Rule of Nines.[1]

Initial Fluid Resuscitation Calculations for Burns

1. **Modified Parkland Formula → 24 hour total**

Patient Weight (kg)	
TBSA (%)	

2 mL x _____ kg x _____% burn = _____ mL = 24-hr total[2]

2. **Calculate Hourly Resuscitation Volumes**

Half (½) of the 24-hour total should be given in the *first eight (8) hours*.

24-hr total _____ mL ÷ 2 = _____ mL ÷ 8 hrs = _____ mL/hr

The other half (½) of the 24-hour total should be given over the *remaining sixteen (16) hours*.

24-hr total _____ mL ÷ 2 = _____ mL ÷ 16 hrs = _____ mL/hr

3. **Obtain a provider order for fluids and titration. Have provider DOUBLE CHECK all calculations.**

[1] The Lund Browder method is the gold standard of practice to determine TBSA.

[2] 24-hour fluid total is a starting point **only**. Titrate fluids based on urine output (see page 13).

Example Pediatric Fluid Resuscitation Calculations

Patient Weight	TBSA	Calculation	Estimated 24-hour Resuscitation Total	Fluid Type
8 kg	20%	2 mL x 8 kg x 20%	320 ml	D5LR
	40%	2 mL x 8 kg x 40%	640 ml	D5LR
	60%	2 mL x 8 kg x 60%	960 ml	D5LR
	80%	2 mL x 8 kg x 80%	1280 ml	D5LR
10 kg	20%	2 mL x 10 kg x 20%	400 ml	LR
	40%	2 mL x 10 kg x 40%	800 ml	LR
	60%	2 mL x 10 kg x 60%	1200 ml	LR
	80%	2 mL x 10 kg x 80%	1600 ml	LR
20 kg	20%	2 mL x 20 kg x 20%	800 ml	LR
	40%	2 mL x 20 kg x 40%	1600 ml	LR
	60%	2 mL x 20 kg x 60%	2400 ml	LR
	80%	2 mL x 20 kg x 80%	3200 ml	LR
30 kg	20%	2 mL x 30 kg x 20%	1200 ml	LR
	40%	2 mL x 30 kg x 40%	2400 ml	LR
	60%	2 mL x 30 kg x 60%	3600 ml	LR
	80%	2 mL x 30 kg x 80%	4800 ml	LR
40 kg	20%	2 mL x 40 kg x 20%	1600 ml	LR
	40%	2 mL x 40 kg x 40%	3200 ml	LR
	60%	2 mL x 40 kg x 60%	4800 ml	LR
	80%	2 mL x 40 kg x 80%	6400 ml	LR
50 kg	20%	2 mL x 50 kg x 20%	2000 ml	LR
	40%	2 mL x 50 kg x 40%	4000 ml	LR
	60%	2 mL x 50 kg x 60%	6000 ml	LR
	80%	2 mL x 50 kg x 80%	8000 ml	LR

Types of IV Fluid

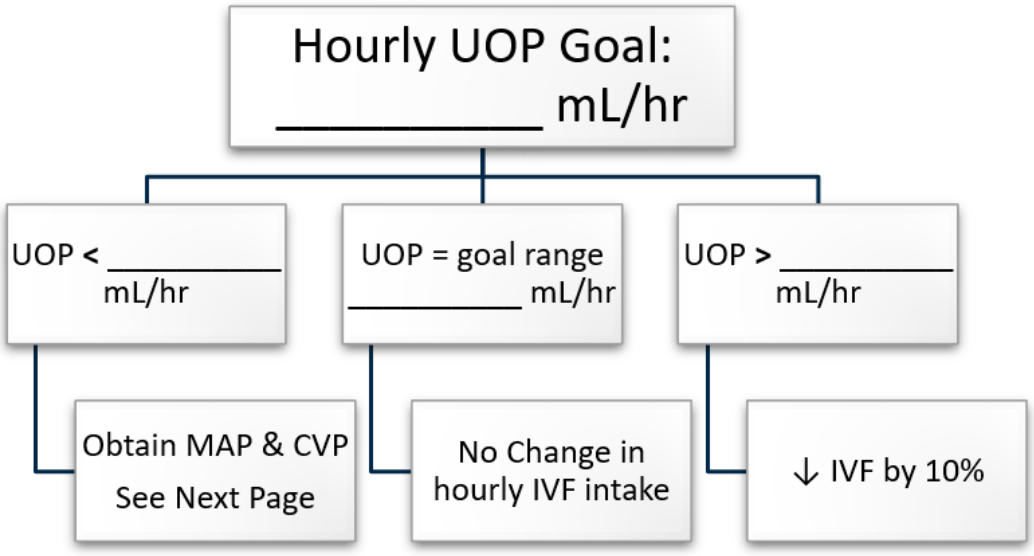
- Recommended **crystalloid** is **Lactated Ringer's or D5 Lactated Ringer's** for small patients.
- Administer **colloid (FFP or Albumin)** once the patient has received **100 mL/kg** of **total IVF** (including pre-admission). Colloid should be given over 8 hours.
- **NO crystalloid boluses** (Normal saline, half-normal saline, Lactated Ringer's, D5W, or D5NS).

Titrate IV fluids to Hourly Urine Output (UOP)

Hourly fluid volume should include *ALL* IV fluids
(sedation, medication, vasopressors, electrolyte replacement, etc.)

- **Electrical Injury ONLY**
  - **Child**: keep UOP **2 mL/kg/hr** until urine is *clear and yellow*
- **Other Burn Injuries** (circle appropriate goal range and fill in chart below)

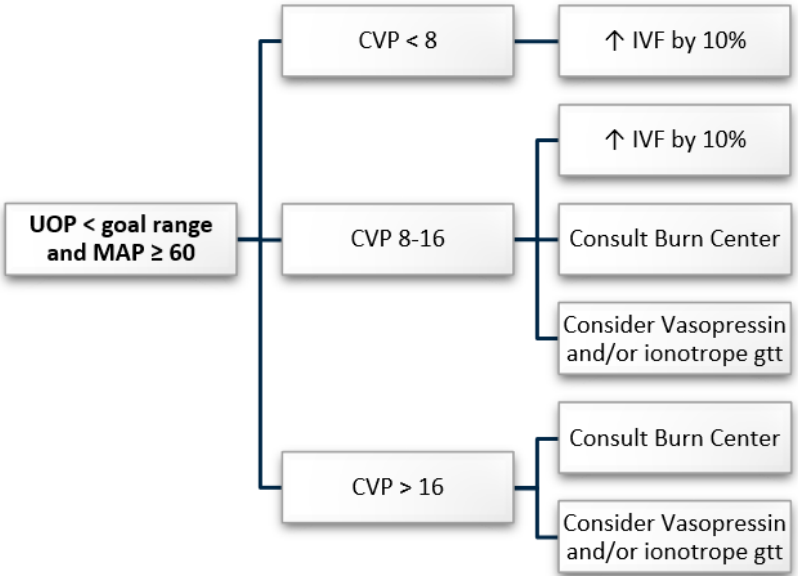
Weight (kg)	UOP Goal Range (mL/hr)	Weight (kg)	UOP Goal Range (mL/hr)
≤ 5 kg	5—8 mL/hr	40—44 kg	15—20 mL/hr
6—10 kg	5—10 mL/hr	45—54 kg	15—25 mL/hr
11—15 kg	8—15 mL/hr	55—64 kg	20—30 mL/hr
16—20 kg	12—20 mL/hr	65—74 kg	20—35 mL/hr
21—25 kg	11—25 mL/hr	75—84 kg	25—40 mL/hr
26—30 kg	13—30 mL/hr	85—99 kg	25—45 mL/hr
31—35 kg	15—35 mL/hr	> 100 kg	30—50 mL/hr
36—39 kg	18—39 mL/hr		

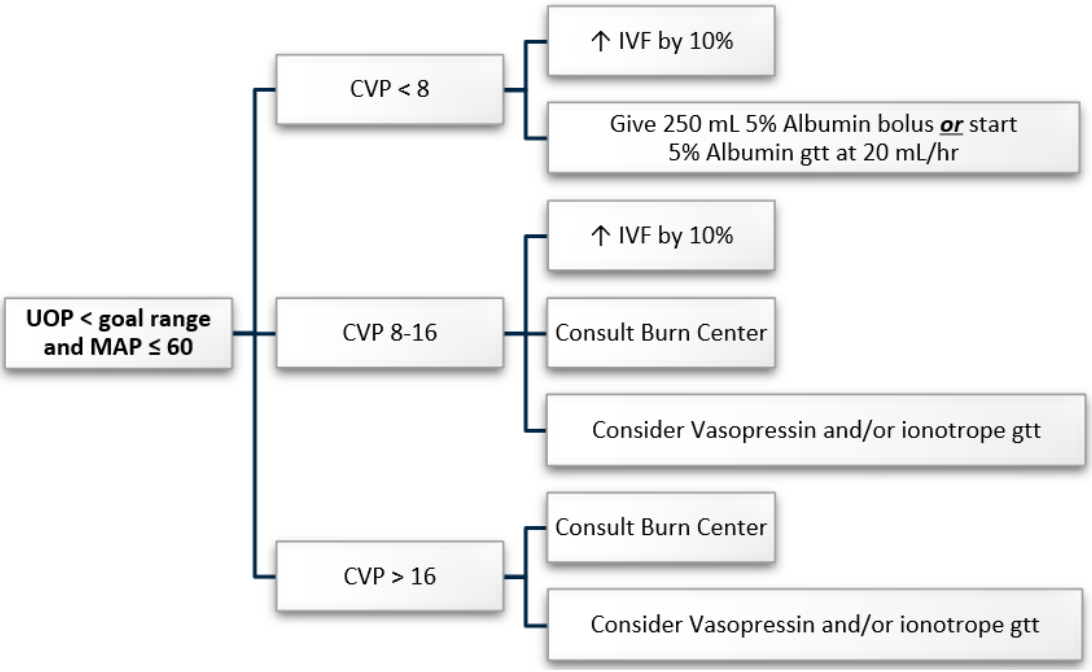


- **To <u>de</u>crease IVF by 10%**
  - Total Hourly IVF x 10% = _____ mL
  - Total Hourly IVF ***– 10%*** = New Total Hourly IVF
- **To <u>in</u>crease IVF by 10%**
  - Total Hourly IVF x 10% = _____ mL
  - Total Hourly IVF ***+ 10%*** = New Total Hourly IVF

When UOP is Less Than Goal Range

- **Obtain MAP and CVP on patient**





Clinical Manifestations of Dehydration

	Mild (<5%)	Moderate (5-10%)	Severe (>10%)
Heart Rate	Normal	Slightly increased	Rapid, weak
Systolic Blood Pressure	Normal	Normal to orthostatic >10 mmHg change	Hypotension
Urine Output	Decreased	Moderately decreased	Marked decrease, anuria
Mucous Membranes	Slightly dry	Very dry	Parched
Anterior Fontanel	Normal	Normal to Sunken	Sunken
Tears	Present	Decreased, eyes sunken	Absent, eyes sunken
Skin	Normal turgor	Decreased turgor	Tenting
Skin Perfusion	Normal capillary refill (<2 seconds)	Capillary refill slowed (2-4 seconds); skin cool to touch	Capillary refill delayed (>4 seconds); skin cool, mottled, gray

Burn Patient Inputs and Outputs Tracking Record

Patient Name:		**Date/Time of Injury:**	
Mod. Parkland Formula:	mL/hr in first 8 hrs mL/hr over 16 hrs	**Initial Fluid Rate:**	mL/hr
		Switch from crystalloid to colloid[3] when patient receives: 100 mL x _____ kg = _____ mL	
Patient Weight (kg):	kg	**Goal Range Hourly UOP:**	mL

		Intake (mL)							
Date	**Time**	Continuous IVF	Medications	Drips (gtt)	Transfusions	Other	**Total Fluid**	**Urine Output**	**Action**

[3] See page 15