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Initial Management of Pediatric Burn Injuries

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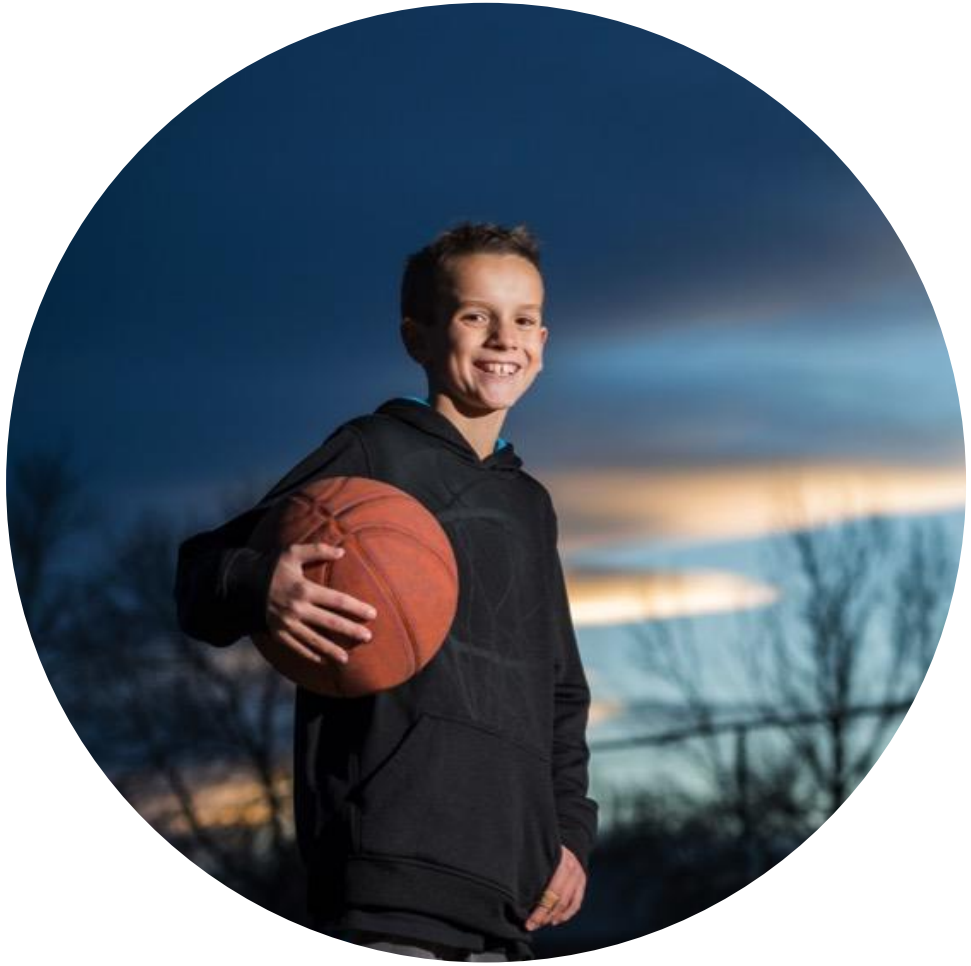
No financial disclosures

Objectives

- Identify the depth and TBSA
- Determine an appropriate disposition
- Discuss initial resuscitation and additional measures necessary for patients with severe burn injuries

Epidemiology of Burns

- 4th most common cause of trauma worldwide
- 11 million per year seek care for burn injuries
- Increased risk of burn injury with lower SES
- 90% of burns occur in lower & middle income countries



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GBD 2013 Collab., Lancet 2015
Norton R, NEJM 2013

Annual Burn Data

- 486,000 sought care for burns
- Majority of burns are small
  - <10% TBSA for 67%
- 3275 deaths related to burns & smoke inhalation
- Estimated 180,000 burn related deaths in low & middle income countries

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ABA 2016 Burn Incidence Fact Sheet

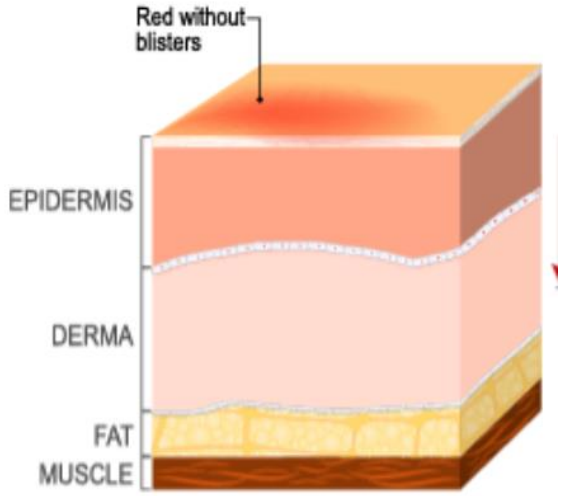
The Burden of Pediatric Burns

- Over 300 pediatric patients are seen in emergency departments every day for burn injuries
- Scald burns predominate in young children, however flame burns become more common in older children and teenagers
- Children's Hospital CO 2023:
  - 70 inpatient admissions
  - 2,238 outpatient visits
  - 186 burn-related procedures

Assessing the Burn

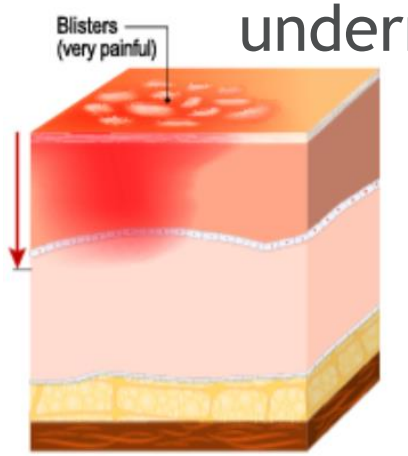
Superficial Burn

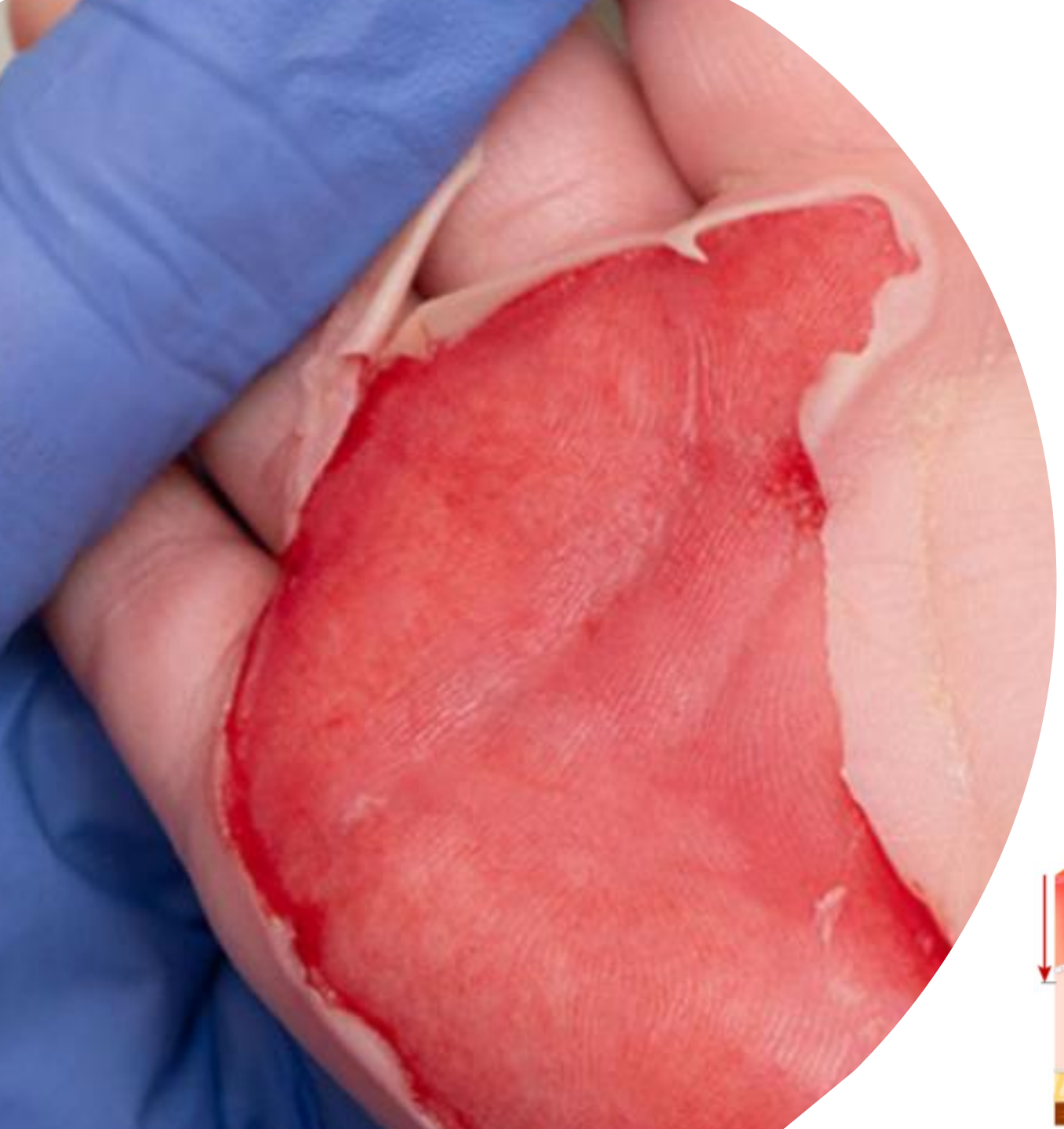
- 1st degree burns
- Examples: Sunburns, contact burns with blanching redness with intact skin



Partial Thickness Burn

- 2nd degree burns
- Can be classified as superficial and deep partial thickness
- Key features: Blistering skin, wet, pink appearance underneath, painful to touch





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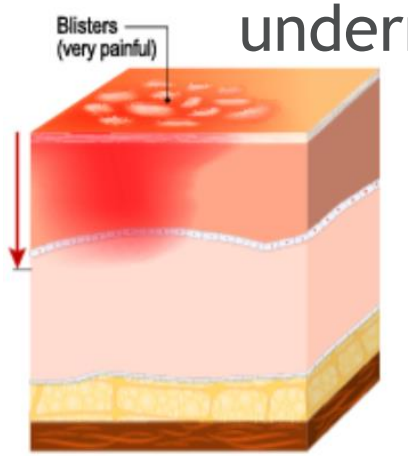
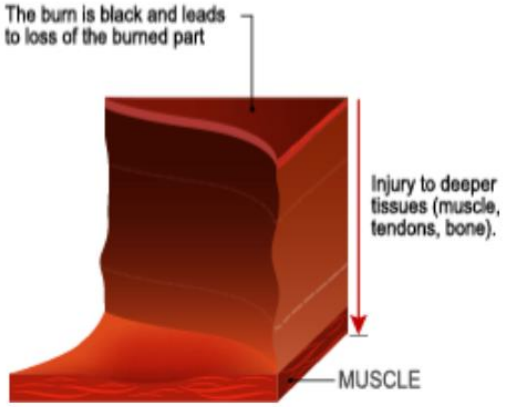


Full Thickness Burn

- 3rd degree burns
- Most often require skin grafting and excision of non-viable skin
- Key features: White or black, leathery, insensate



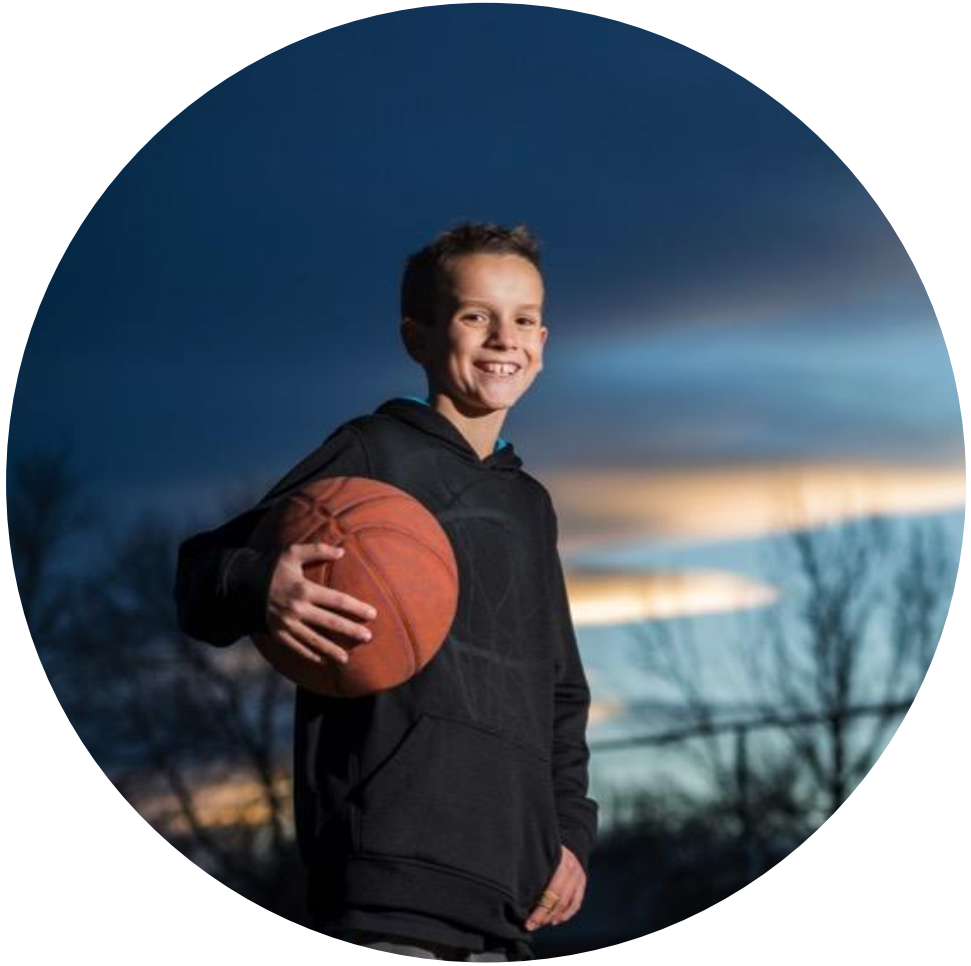
Context Clues to Determine Depth

- Burn depth is related to temperature and duration of exposure
- Flame burns are high risk for causing deep injuries
- Contact burns where a child touches a hot object are often limited, whereas a child who falls onto a hot object or hot objects falling onto a child are usually deeper
- Burns from hot grease and melted sugar are often deeper than those caused by other hot liquids
- Abusive burn injuries have a higher potential to be deep

Estimating TBSA

Size is important

- Total Body Surface Area (TBSA) burned correlates with:
  - Hospital admission
  - Fluid resuscitation required
  - Interventions for pain control
  - Complications
  - Mortality
- ONLY include partial and full thickness burns in the calculation

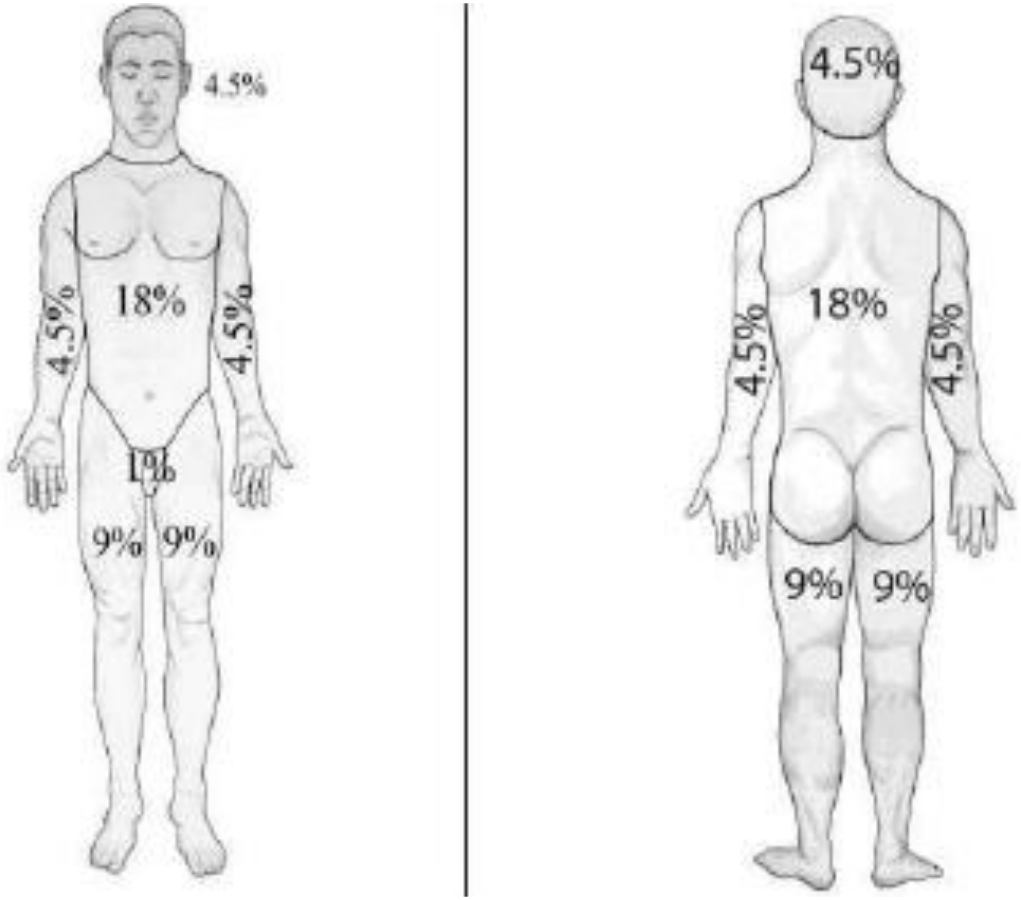


Rule of Nines

- 9% Head & Neck
- 18% Anterior torso to pubis/groin crease
- 18% Posterior torso to inferior buttocks
- 9% Anterior/Posterior Upper Extremity
- 9% Anterior Lower Extremity
- 9% Posterior Lower Extremity
- 1% Genitalia

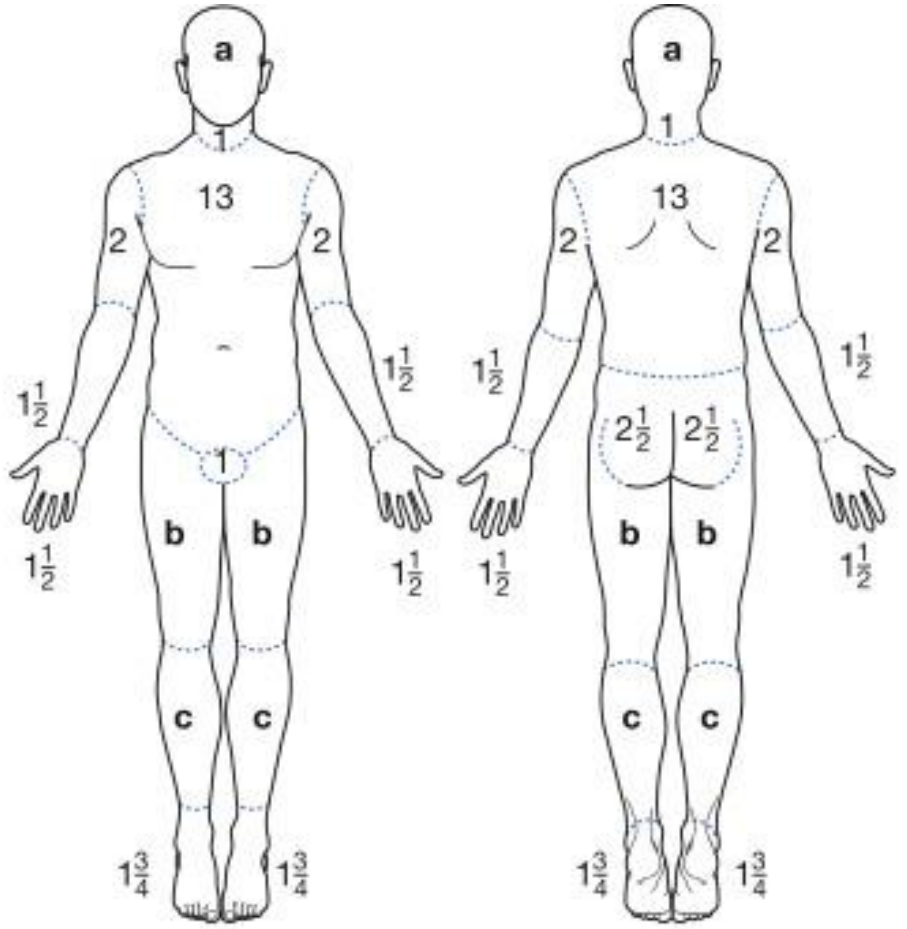
Caveats:

ONLY for adult sized teenagers



Lund-Browder Chart

- Constant body surface area percentages for the torso and upper extremities
- Age adjusted body surface area percentages for the head and lower extremities



	Age in years					
	0	1	5	10	15	Adult
a - ½ of head	9½	8½	6½	5½	4½	3½
b - ½ of one thigh	2¾	3¼	4	4¼	4½	4¾
c - ½ of one leg	2½	2½	2¾	3	3¼	3½

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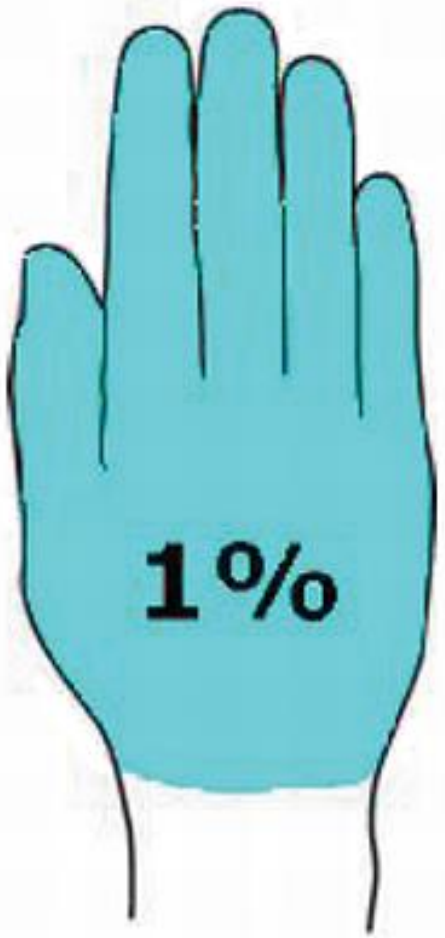
Palm & Fingers Method

- Excellent method for smaller burns
- Child's hand & fingers is equivalent to 1% TBSA
- Provide proportionality in children that are atypically large or small for age

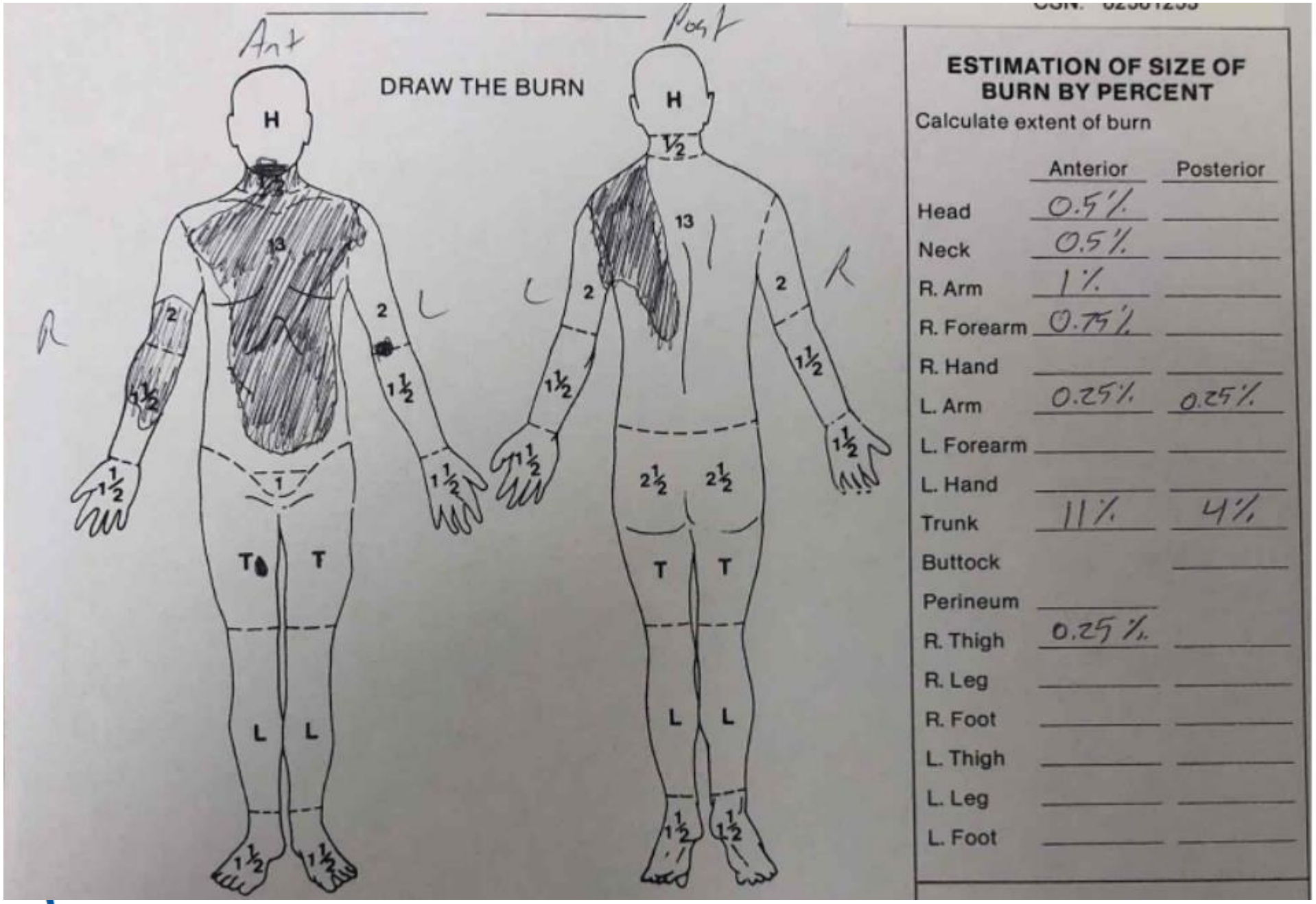


http://www.ambonsall.com/images/Palm.png

Determination of TBSA Prior to Debridement

- Burn depth can be difficult to determine prior to debridement
- Extent of burn can be under or over estimated if no attempt at debridement
- If clinically appropriate, burn debridement should be performed prior to TBSA determination
- If not clinically appropriate (severe burns, clinically unstable, insufficient resources), then estimate the TBSA prior to debridement
    - Seek expert consultation when appropriate

- Estimated TBSA 6-7%
- Planned debridement and dressing change with discharge from ED & outpatient follow-up



- TBSA 18.5%
- Ultimately, 10.75% TBSA required skin grafting
- 17 day inpatient stay
- 4 OR procedures

Making a Treatment Plan

Categorization of Burns

- Minor burns
  - <10% TBSA
  - Do not require fluid resuscitation
  - Can be managed in inpatient or outpatient settings
  - Consideration given to ability to tolerate oral intake, pain control, socioeconomic factors
  - Burns >5% often require pain/anxiety and sometimes nutritional management for burn care that supersedes options available in clinic and should be considered for admission

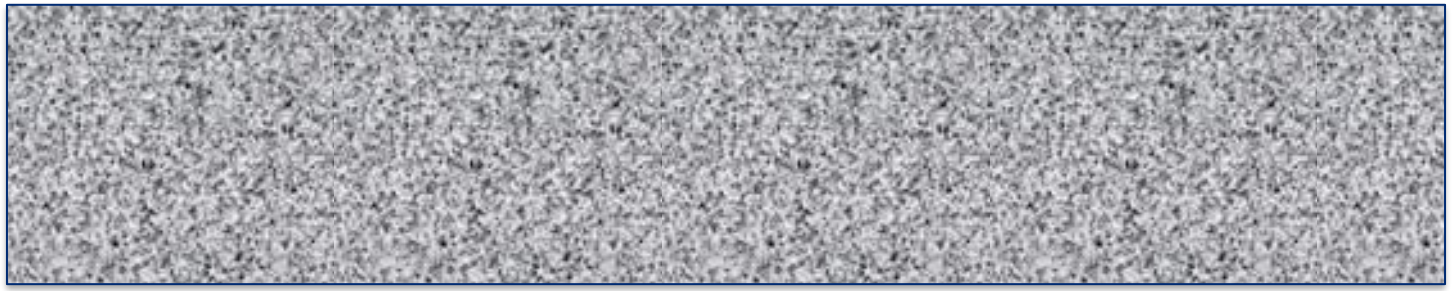
Categorization of Burns

- Moderate burns
  - 10-20% TBSA
  - Do not require fluid resuscitation
  - May require maintenance IV fluids or enteral feedings depending on body areas affected
  - Usually require more aggressive pain & sedation for burn care which is often done in a procedural environment
  - Require admission for burn care

Severe Burns (TBSA >20%)

- Referral to a burn center and immediate arrangements for transfer
- Initiate IV fluid resuscitation
- Foley placement
- Pre-transfer dressing application
- Adequate pain control

Dressing the Burn

Containment Layer		Band-Net (Optional)
Absorptive Gauze		Kerlix
Conforming Gauze		Kling gauze
Contact Layer		Bacitracin + Adaptic/Xeroform/ Vaseline Gauze
Burn		

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It's OK to tape dressings to dressings
AVOID taping dressings to the skin!

Fluid Resuscitation

Earlier is better…

- Early fluid resuscitation after a severe burn injury can reduce multiorgan failure and mortality

Table 4
Percent positives in each attribute[a]

Time to fluid resuscitation (h)	Incidence of sepsis (%)	Renal failure (%)	Deaths with cardiac arrest (%)	Mortality (%)
0–2	12 (10/83)	14 (12/83)	13 (2/16)	14 (12/83)
2–4	50 (14/28)*	54 (15/28)*	90 (9/10)*	61 (17/28)*
4–12	77 (17/22)*	59 (13/22)*	100 (8/8)*	91 (20/22)*

[a] Values presented as percentages with number of positives/total in parentheses.
* Significant difference versus <2 h at $P<0.001$.

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RE Barrow et al. Resuscitation 2000

Initial Fluid Rates

- Initiated during the primary survey for burns ≥20%
- “Starter” rate until accurate TBSA calculation has been performed
- Avoids over & under resuscitation problems
- TRACK ALL FLUIDS ADMINISTERED

Initial Fluid Resuscitation Rates
Lactated Ringers

1	2	3
≤5 years old	6-12 years old	≥13 years old
125 mL/hr	250 mL/hr	500 mL/hr

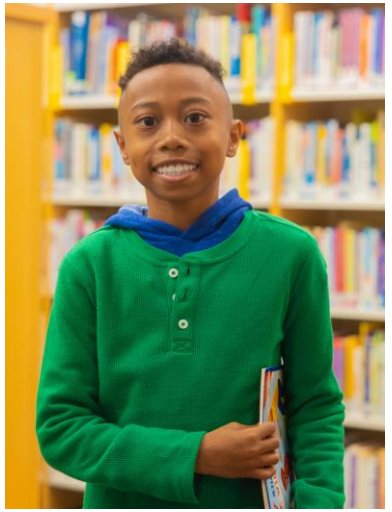
D5LR should be administered to pediatric patients ≤12 years at a maintenance rate

Pediatric Maintenance IV Fluid Rates

4 mL/kg for the first 10 kg

2 mL/kg for the next 10 kg

1 mL/kg for each kg over 20 kg



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Continue the Assessment

- Complete the primary survey and address any threats to life
- Start IV resuscitation at the initial fluid rate
- Reassess vitals
- Start and complete the secondary survey
- As part of the secondary survey, assess the entire body for burns
- Quantify the burn using an appropriate scale

Adjusted Fluid Rate

Adult & Teenager (≥13 years old):

- **2** mL LR x TBSA x weight (kg)

Pediatric:

- **3** mL LR x TBSA x weight (kg)
- D5LR should be administered to pediatric patients ≤12 years at a maintenance rate

Any age with high voltage electrical burn:

- **4** mL LR x TBSA x weight (kg)

Adjusted Fluid Rate

Administration:

- ½ total volume given within 8 hours after burn injury
- ½ remaining volume given the next 16 hours after burn injury
- Be sure to account for fluids given prior arrival
- If already six or more hours post-burn or if fluids administered already exceed resuscitation goals, collaborate with the burn center to determine alternative endpoints

A Word About Boluses

- AVOID fluid boluses whenever possible except to treat hemodynamic instability
- AVOID treating with medications at doses that may induce hemodynamic instability
- Boluses interrupt the steady progression of resuscitation and often lead to over-resuscitation over the next 24 hours

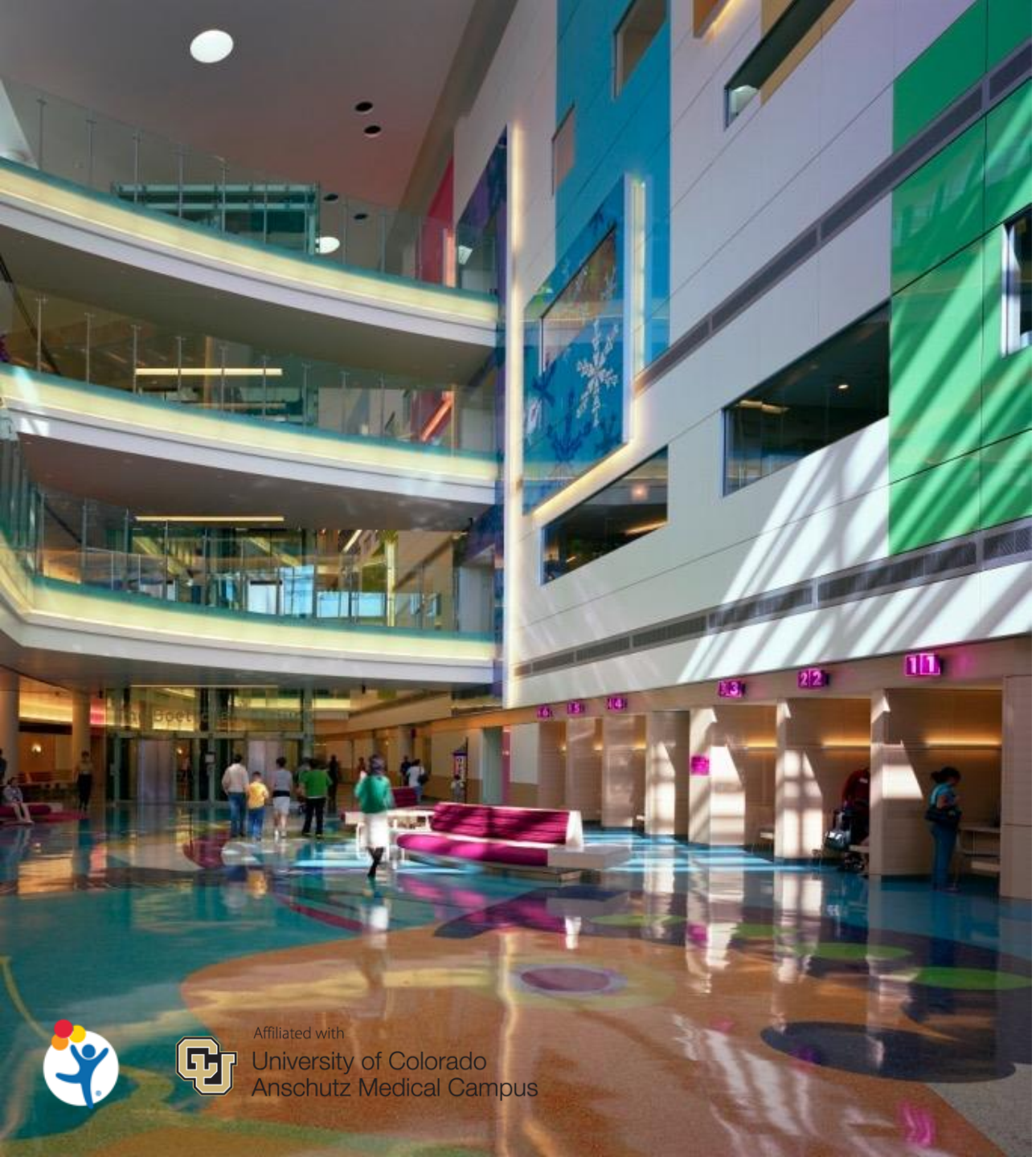
Monitoring Resuscitation

- A foley catheter is mandatory for patients with TBSA ≥20% undergoing fluid resuscitation
- Goal urine output after initiation of resuscitation:
  - Children: 0.5-1 cc/kg/hr (or 30mL/hr if over 30 kg)
  - Adults & teens: 0.5 cc/kg/hr (or 30-50 mL/hr)
- Fluid resuscitation rate should be based on ideal body weight

Managing Low/High UOP

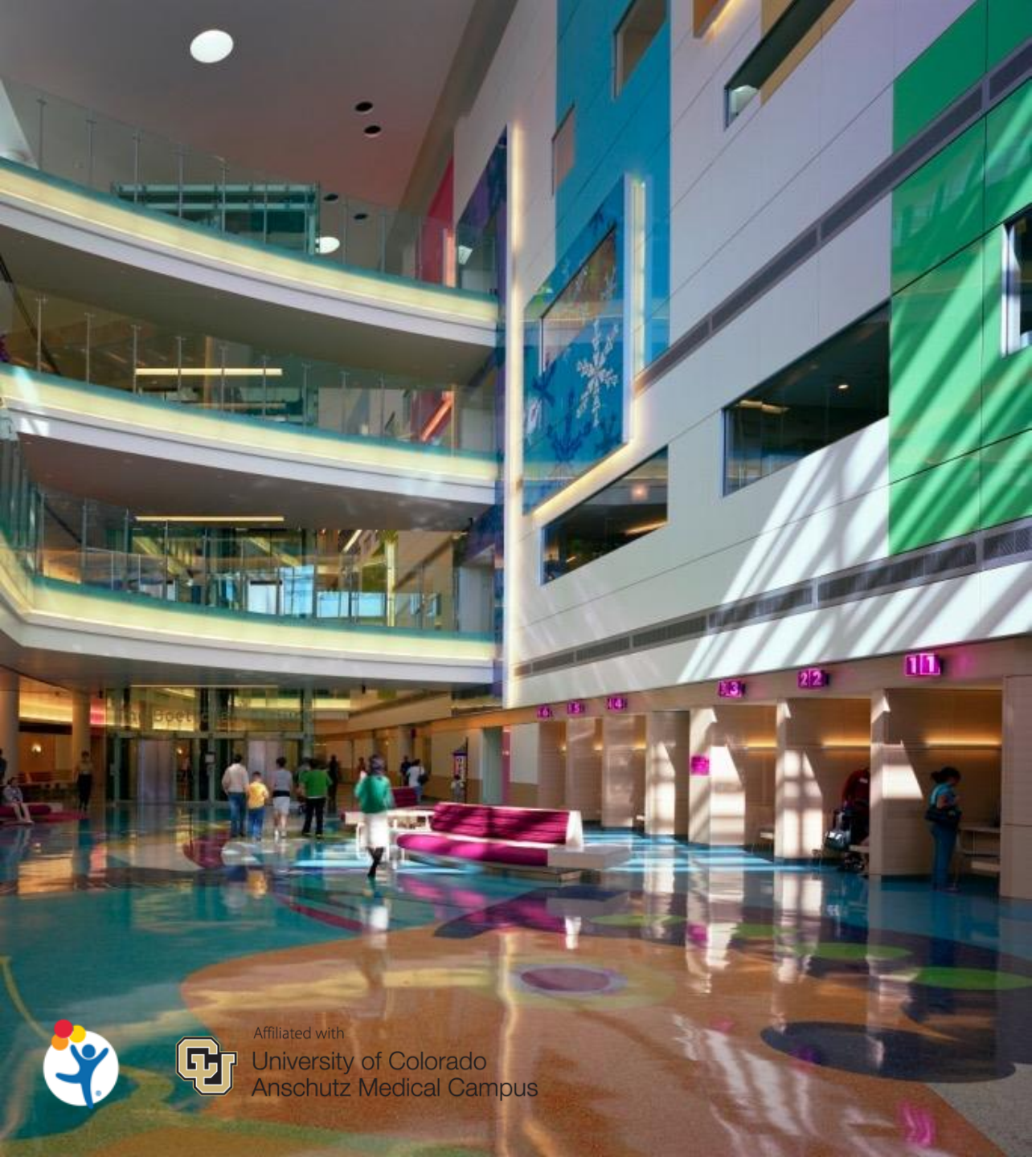
- For low UOP less than predicted
  - Confirm that the foley catheter is not obstructed
  - Increase RESUSCITATION fluid by 10%
  - Do NOT adjust maintenance fluid rate
- For high UOP greater than desired
  - Decrease RESUSCITATION fluid by 10%
  - Do NOT adjust maintenance fluid rate
- After 8 hours, if persistent low UOP is a problem, consider 5% albumin administration
  - 2 g/kg over 24 hours as an infusion

Disposition



Burn Center Transfer Criteria

- Partial thickness burns >10% TBSA
- Burns involving the face, hands, feet, genitalia, perineum, & major joints
- Third degree burns of any size
- Electrical burns (including lightening)
- Chemical burns
- Inhalation injury (with or without cutaneous burns)
- Burn injury in patients with significant pre-existing medical comorbidities
- Any patient with burns & trauma
- All pediatric burns may benefit from burn center referral due to pain, dressing change needs, rehabilitation, patient/caregiver needs, and assessment for non-accidental trauma

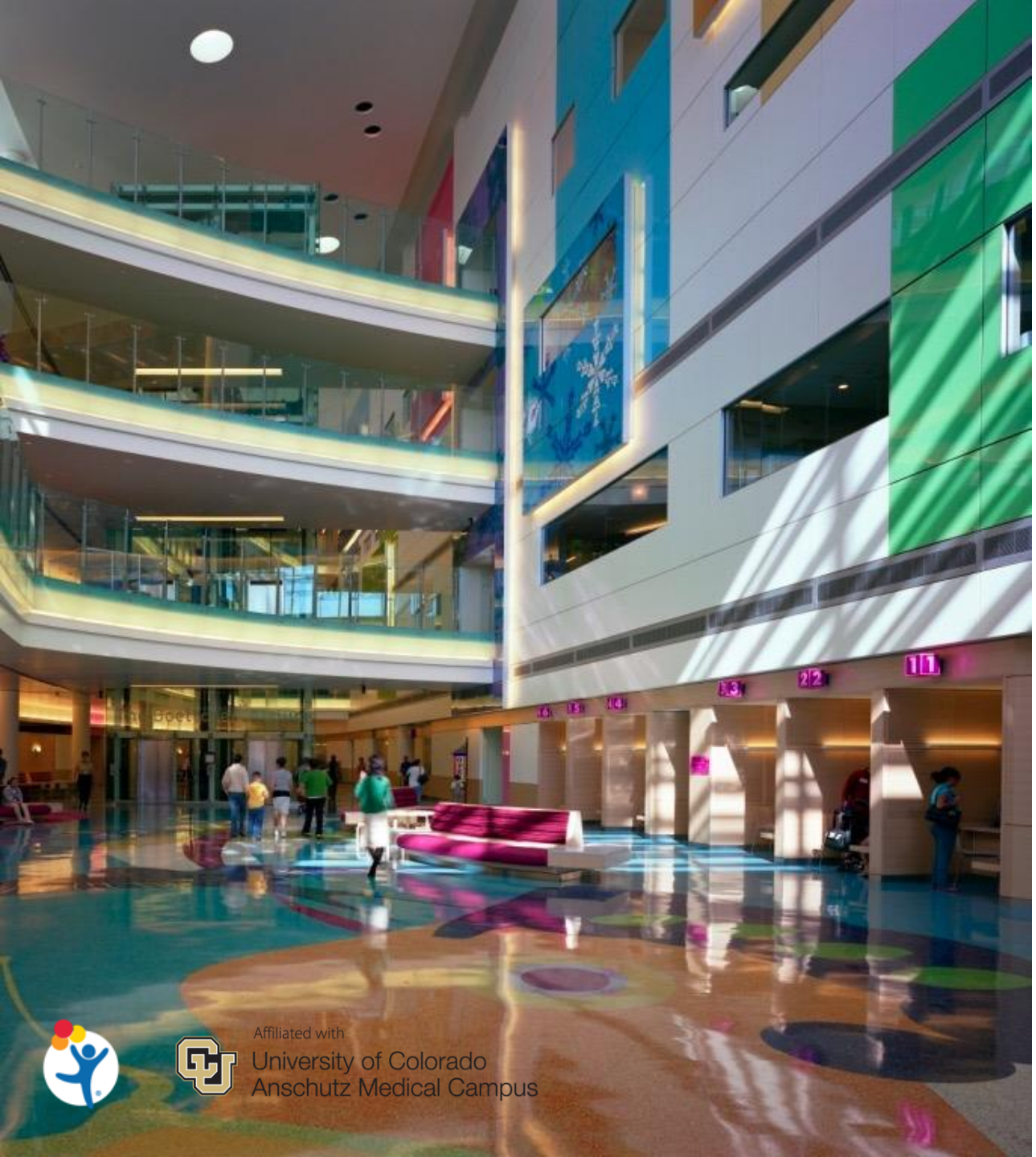


Burn Center Transfer Decision

- Immediate transfer:
  - Continuous pain management
  - Complex dressing care
  - Airway management
  - Fluid resuscitation
  - Enteral feeding
  - Patients with concern for abuse or comorbid trauma
- Patients with small burns (even if deep) can follow up in clinic with an appropriate dressing
- Uncertainty? Contact the burn surgeon

Objectives

- Identify the depth and TBSA
- Determine an appropriate disposition
- Discuss initial resuscitation and additional measures necessary for patients with severe burn injuries



The Difference of a Pediatric Burn Center

- Provide psychosocial support to the patient and family throughout the continuum of care
- Ability to provide intranasal analgesic and anxiolytic medications during outpatient and inpatient burn care
- Availability of pediatric EM and anesthesia specialists to provide sedation for burn care in the ED and operative environments
- Same team cares for the patient from the inpatient to the outpatient and aftercare environment
- Continued follow-up for patients requiring assessment and management of burn scars and contractures

Children's Hospital Colorado
Burn Team

Team Members

- Burn surgeons
- Burn physician’s assistant
- Burn nurses
- Burn technician
- Occupational/Hand therapists
- Physical therapists
- Child life specialists
- Child psychologist
- Social worker
- Medical photography
- Family health navigator

How to Reach Us

OneCall
Connection is about to get easier

720-777-3999

- Admissions/Transfers
- Phone consultation with a surgeon
- Telephoto image sharing

Children's Hospital Colorado Burn Center

720-777-6604

- Established patients
- New patients scheduling initial appointment (not for provider referrals)

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References

- Advanced Burn Life Support Provider Manual. American Burn Association, 2022 update
- RE Barrow et al. Early fluid resuscitation improves outcomes in severely burned children. Resuscitation 2000.
- Burn incidence fact sheet. Chicago: American Burn Association
- GBD 2013 Mortality and Causes of Death Collaborators. Lancet 2015;385:117-71

Questions?