



**NORTHWEST  
COMMUNITY  
EMERGENCY  
MEDICAL  
SERVICES  
SYSTEM**

# February 2019 Continuing Education



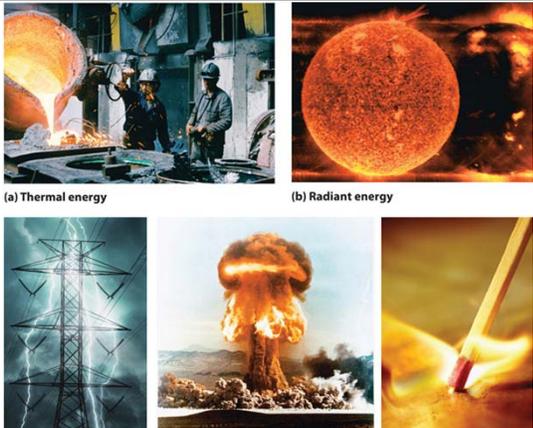
Questions and comments are welcome and should be directed to  
Connie Mattera, MS, RN, EMT-P, EMS Administrative Director

# Thermal Burns

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 Northwest Community EMSS  
 Arlington Heights, IL




First, a message from Matt



(a) Thermal energy      (b) Radiant energy

(c) Electrical energy      (d) Nuclear energy      (e) Chemical energy

## 5 mechanisms causing burns

| Friction   | Radiation  | Chemical  | Electrical   | Thermal   |
|--|--|---|--|---|
| Injuries sustained from a combination of disruption of the dermis and friction-generated heat. | Energy from radio frequency or ionizing radiation (e.g., sun burns and effects of radiation oncology). | Burns from chemicals present a wide range of injury patterns (e.g., distortion of tissue pH, interference of cellular processes, and interference of metabolic pathways). | Electricity is converted into extreme heat as it passes through poorly conducting bodily tissues. Additional injury is caused by electroporation, which is the process by which a current directly injures cell membranes. | Burns produced by direct contact with flame or super-heated materials. Extent of the injury depends on the temperature of the insulating object, duration of contact and the thickness of skin in contact with the heat source. |



Adapted from Rice P, Orsill D. (Jan. 18, 2017.) Emergency care of moderate and severe thermal burns in adults. UpToDate. Retrieved March 27, 2018, from [www.uptodate.com/contents/emergency-care-of-moderate-and-severe-thermal-burns-in-adults](http://www.uptodate.com/contents/emergency-care-of-moderate-and-severe-thermal-burns-in-adults)

# This month, we're focusing on thermal burns



Upon completion, the participant will



- describe A&P relevant to burn injuries.
- determine TBSA burned.
- differentiate depth of burn.
- classify burns by their severity.
- identify appropriate care for pts with moderate to severe burns.
- determine transport priorities and destination for pts with severe burns.

### Epidemiology of burns



1.25 million persons burned / year

Incidence down by 50% in US since 1971 from 10 to 4.2/10,000 persons

| Cause of injury by E-Code  | ED %  | In-pt % |
|--|-------|---------|
| Hot substance or object, caustic or corrosive material or steam  | 58%   | 37.1%   |
| Fire and flames  | 13.8% | 20.6%   |
| Exposure to radiation (radiofrequency radiation, infra-red heaters and lamps, visible and ultraviolet light sources) | 6.1%  | 2.7%    |
| Suicide and self-inflicted injury by burns, fire, scald; or caustic substances, except poisoning                     | 0.2%  | 2.7%    |
| Fireworks  | 1.3%  | 1.7%    |
| Injury undetermined whether accidentally or purposefully inflicted by burns, fire, scald, or caustic substances      | 0.5%  | 1.4%    |
| Explosives accident  | 0.7%  | 1.2%    |
| Poisoning by corrosives and caustics   | 2.5%  | 1.2%    |
| Assault by fire (arson) or hot liquid (scalding)   | 0.3%  | 0.6%    |
| Assault by corrosive or caustic substance  | 0.2%  | 0.1%    |
| Encode N/A   | 16.6% | 30.6%   |

### Admissions to Burn Centers



486,000 receive medical treatment for burn injuries in US annually  
 40,000 hospitalized  
 30,000 most seriously injured go to 128 burn centers  
 Up to 6% life-threatening

### Children



2<sup>nd</sup> leading cause of accidental death  
 34% of all burns  
 < 8 yrs: 20.5%  
 8-18 yrs: 13.4%  
 2,500 die annually  
 10,000 experience severe permanent disability

### Children



Scalds 18 mos – 3 yrs  
 History difficult  
 Greater BSA/kg = larger evaporative surface,  
 ↓ ability to conserve heat  
 ↑ risk for hypothermia  
 Higher fluid needs, less metabolic reserves –  
 ↑ incidence of hypoglycemia

### Elderly risks



Cooking, house fires, unattended cigarettes, scalds  
 1,000 die/yr from home fires

### Considerations in elderly

- ↓ reserve capacity
- ↓ reaction time, poor dexterity, ↓ mobility, impaired senses contribute to injury
- ↑ M&M: preexisting diseases, skin changes, altered nutrition, ↓ ability to fight infection

### Skin functions

- Protects from injury d/t UV radiation, mechanical forces, toxic chemicals, microorganisms
- Thermoregulation
- Sensory perception
- Excretion/secretion
- Produces vitamin D
- Prevents excess fluid loss
- Determines identity**
- Flexible to accommodate movement

### Skin varies in thickness

Soles or palm = 1.5 mm

0.5 mm on the eyelid & behind the ear

### Epidermis

Outermost & thinnest: subdivided into 5 layers  
 No blood vessels, totally dependent on dermis  
 Cells sloughed away continually  
 Outward migration helps to prevent bacterial invasion

### Skin

**Epidermis**

- Horny layer
- Granular layer
- Stratified squamous epithelium
- Basal layer
- Melanocyte
- Langerhans cell

**Dermis**

- Fibroblast
- Elastic fiber
- Collagen fiber
- Dry pocket

Erythema dyschromicum perstans (ConVit 1981), Ashy dermatosis

### Dermis

Collagen & connective tissue  
 Contains fibroblasts, macrophages, mast cells  
 Organelles  
 Primary function: sustain & support epidermis

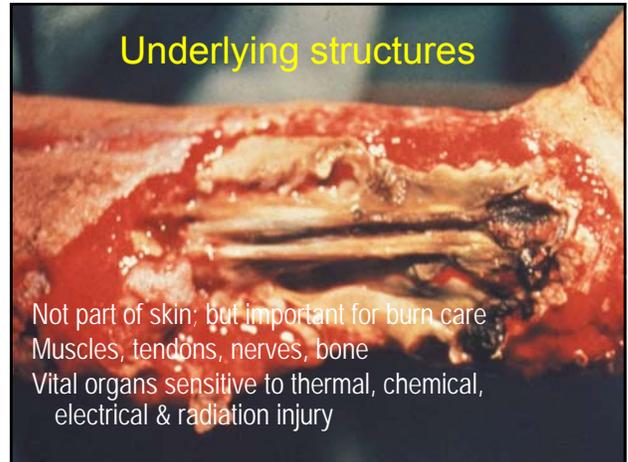
### Subcutaneous layer

Indistinct boundary with dermis  
Loose connective tissue and fat cells  
Provides insulation & energy reserves in infants  
Redistributes as we age  
Not truly a part of integument!



### Underlying structures

Not part of skin; but important for burn care  
Muscles, tendons, nerves, bone  
Vital organs sensitive to thermal, chemical, electrical & radiation injury



### How is skin injured in a burn?

Human skin tolerates 44° C (111° F) w/o injury  
Thermal injury increases rate at which molecules move and collide  
As molecular speed increases, cell components begin to break down



Body tissues are mostly water & do not support combustion

### Pathophysiology

When heated, evaporate water & denature proteins (cell membranes)  
Causes widespread damage



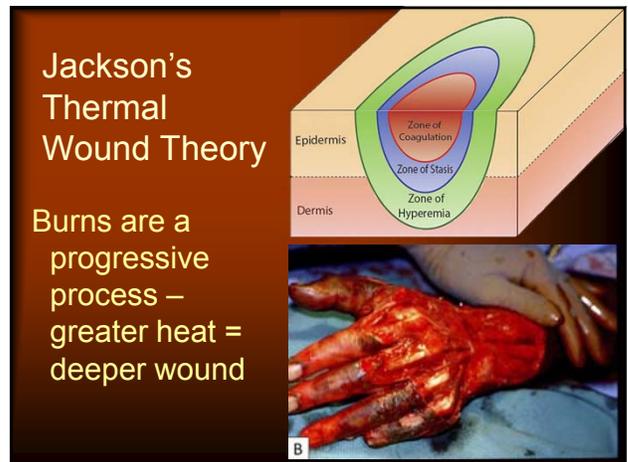
### Injury severity correlations

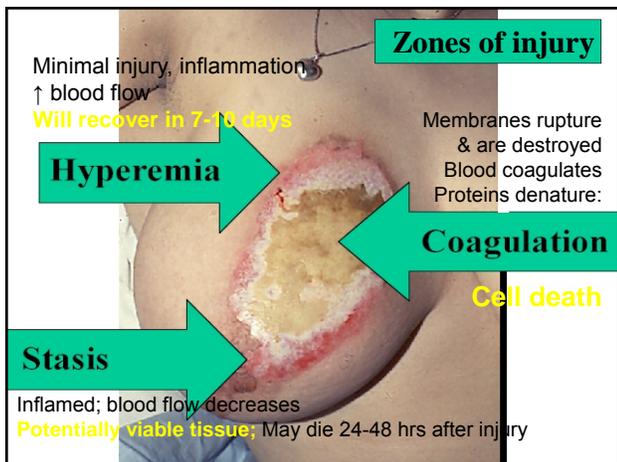
Temperature  
Concentration or amount of heat energy possessed by object or substance  
Ex: Hot air vs. hot oil  
Duration of exposure



### Jackson's Thermal Wound Theory

Burns are a progressive process – greater heat = deeper wound





| THERMAL  |  | BURNS (Adult & Peds) |  | Emergent to Critical<br>Time sensitive |
|--|--|----------------------|--|--|
| <p><b>WOUND CARE per System protocol</b></p> <ul style="list-style-type: none"> <li>• 5000-67 Burns - 40% of Burns - 2% with water or H<sub>2</sub>O for 10 min do not stop</li> <li>• Minimize contamination. Do not touch. Do not use. Do not use. Do not use.</li> <li>• Do not break blisters. Do not use. Do not use. Do not use.</li> <li>• Use appropriate dressings. Do not use. Do not use. Do not use.</li> </ul>  |  |                      |  |  |
| <p><b>RESUSCITATION</b></p> <ul style="list-style-type: none"> <li>• Assess for airway, breathing, circulation, disability, exposure, and glucose.</li> <li>• Assess for hypoxia, hypotension, and hypothermia.</li> <li>• Consider the use of PENTAVIL, NALOXONE, and other medications.</li> </ul>   |  |                      |  |  |
| <p><b>ELECTRICAL LIGHTNING:</b> Decrease damage by no more than 10%.</p> <ul style="list-style-type: none"> <li>• Ensure scene safety. Do not touch. Do not touch.</li> <li>• Assess for airway, breathing, circulation, disability, exposure, and glucose.</li> <li>• Assess for hypoxia, hypotension, and hypothermia.</li> </ul>  |  |                      |  |  |
| <p><b>CHEMICAL:</b> Risk - Type of chemical, concentration, time, duration of exposure, how it was absorbed.</p> <ul style="list-style-type: none"> <li>• Assess for airway, breathing, circulation, disability, exposure, and glucose.</li> <li>• Assess for hypoxia, hypotension, and hypothermia.</li> </ul>  |  |                      |  |  |
| <p><b>BURN CENTER REFERRAL CRITERIA (Adult &amp; Peds)</b></p> <ul style="list-style-type: none"> <li>• Partial thickness burns &gt; 10%</li> <li>• Full thickness burns any age group</li> <li>• Burns involving face, hands, feet, genitalia, perineum, or major joints</li> <li>• Electrical burns (including lightning), chemical burns, radiation injury</li> <li>• Burns that are full thickness or deep partial thickness and require debridement</li> <li>• Burns and concomitant trauma (fractures) in which the burn injury alone requires hospitalization</li> <li>• Burns in patients with pre-existing medical conditions that may complicate the course of the burn or the response to treatment</li> <li>• Burns in patients with significant comorbidities that may complicate the course of the burn or the response to treatment</li> <li>• Burn injury in any who will require surgical debridement, or resuscitation in a burn center</li> </ul> |  |                      |  |  |
| <p><b>Rule of Nines</b></p>  |  |                      |  |  |



**Scene size-up**

**Situational awareness/  
dynamic risk assessment**

- (P) Personal and personnel safety
- (E) Environmental hazards
- (N) Number of victims (may evolve)
- (M) Mechanism of injury/nature of illness
- (A) Addl. resources from responder's agency
- (N) Need for outside resources/agencies



### MOI with burn?

Did patient jump from height to escape flames?  
<http://www.dailymail.co.uk/news/peoplesdaily/article-3370354/Shocking-moment-fireman-engulfed-FLAMES-forced-jump-window-apartment-s-trying-extinguish.html>



### COOL: Stop burning process

Remove from source; extinguish, remove burning or contaminated clothing  
Cool synthetic materials that retain heat



Cool PT burn < 10% or FT burn < 2% for 10 minutes



Cooling larger areas may cause hypothermia

**NO!**

### A: Airway

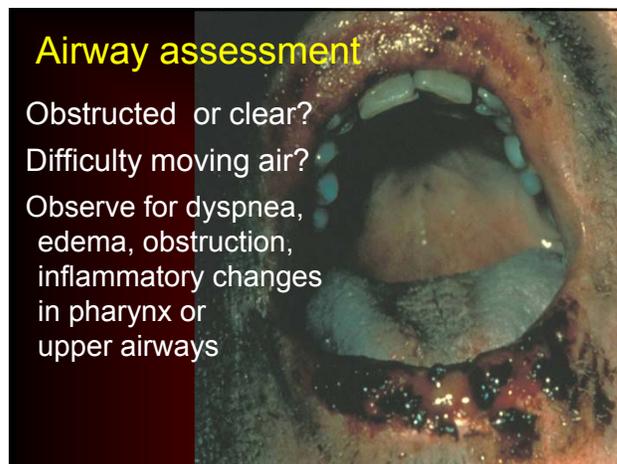


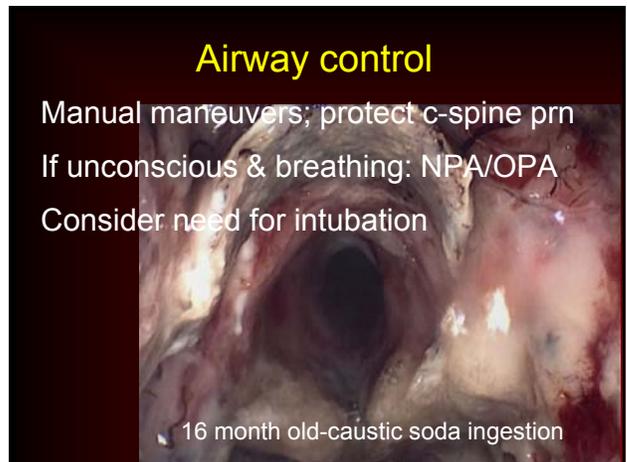
Airway impairment is significant risk if exposed to smoke, fire gases, or has facial burns

JYC

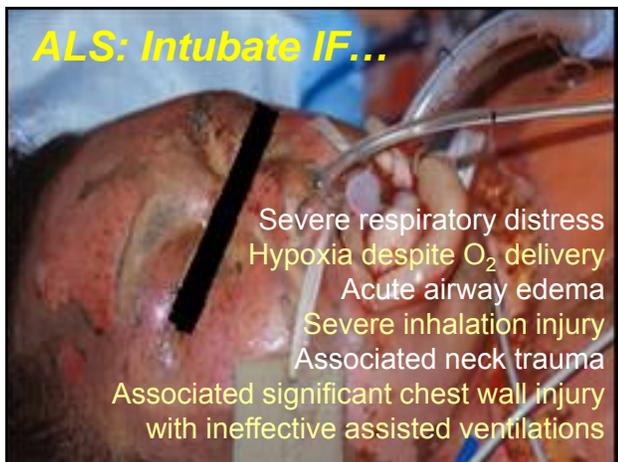
### Airway assessment

Obstructed or clear?  
Difficulty moving air?  
Observe for dyspnea, edema, obstruction, inflammatory changes in pharynx or upper airways





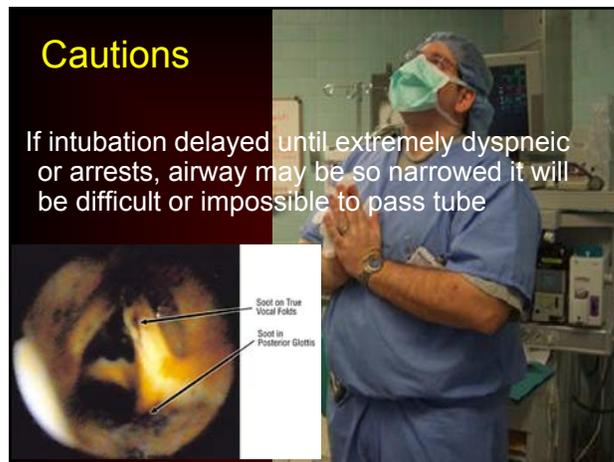
**ALS: Intubate IF...**



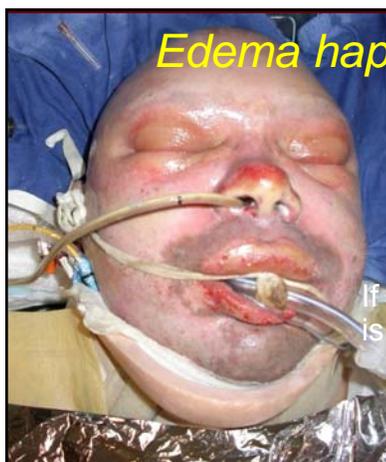
- Severe respiratory distress
- Hypoxia despite O<sub>2</sub> delivery
- Acute airway edema
- Severe inhalation injury
- Associated neck trauma
- Associated significant chest wall injury with ineffective assisted ventilations

**Cautions**

If intubation delayed until extremely dyspneic or arrests, airway may be so narrowed it will be difficult or impossible to pass tube



**Edema happens fast!**



Use largest ET tube that will go through cords

If airway diameter is narrowed by 1/2, resistance ↑ by 16 fold!

**Cannot intubate?  
Cannot ventilate?**



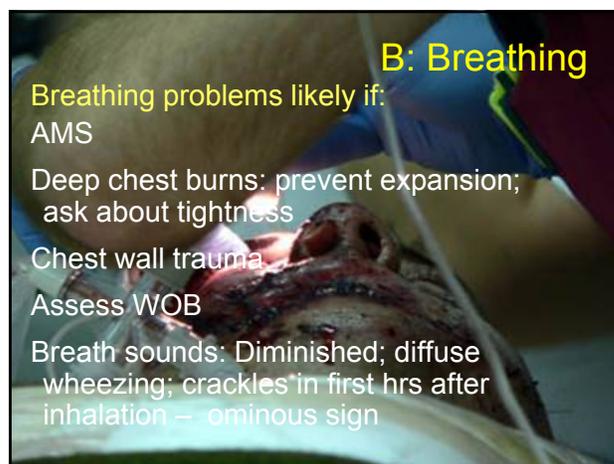
Hospital will insert NG/OG ASAP to keep stomach decompressed  
EMS may transport if placed

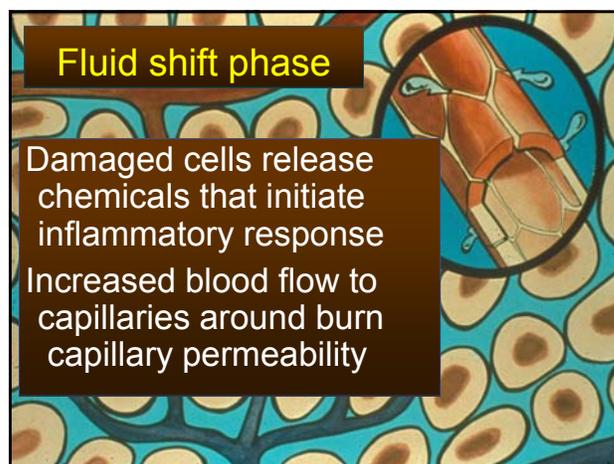
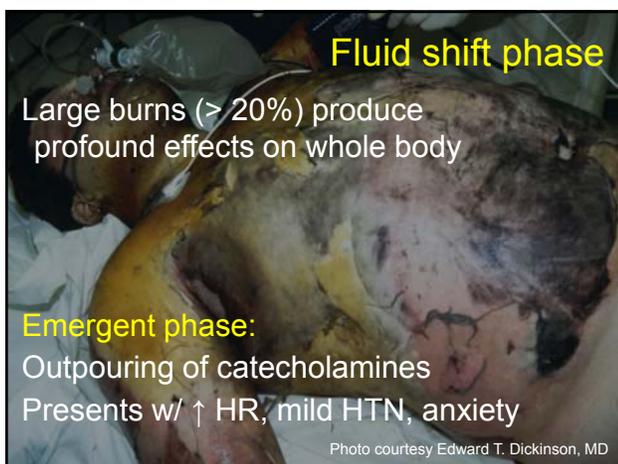
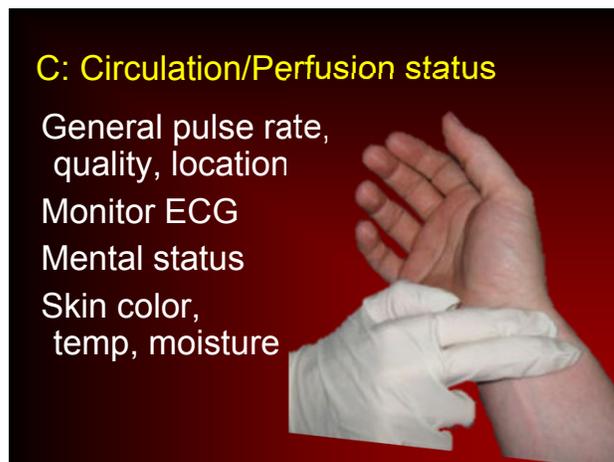


**B: Breathing**

Breathing problems likely if:

- AMS
- Deep chest burns: prevent expansion; ask about tightness
- Chest wall trauma
- Assess WOB
- Breath sounds: Diminished; diffuse wheezing; crackles in first hrs after inhalation – ominous sign





**Monitor ECG if:**

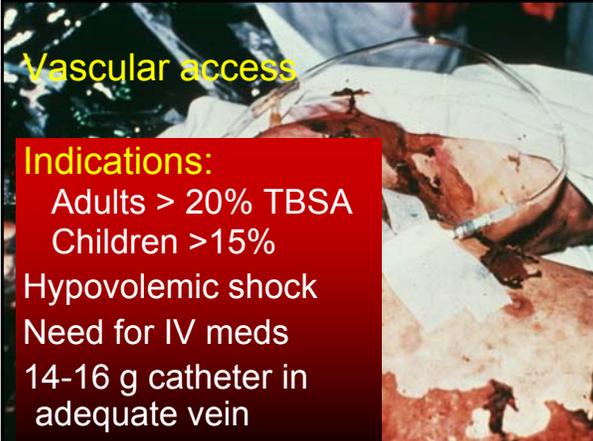
- Hypoxic
- Dysrhythmia
- Exposure to smoke or electric shock
- Try to put leads on unburned skin



**Vascular access**

**Indications:**

- Adults > 20% TBSA
- Children > 15%
- Hypovolemic shock
- Need for IV meds
- 14-16 g catheter in adequate vein



**No IV sites?**  
**IO- great but let's do it right!**

<https://www.youtube.com/watch?v=xcalV0B8GTQ>



**Hemostatic resuscitation goals**

- Carefully manage IV fluids
- Avoid fluid creep - Maintain circulating volume while avoiding complications of aggressive crystalloids (lung water, edema)
- Also linked to abdominal compartment syndrome
- Prevent the lethal triad

Medscape® www.medscape.com

IVF for EMS: Warm NS

- <5 yrs: 125 mL/hr
- 6-13 yrs: 250 mL/hr
- ≥14 yrs: 500 mL/hr

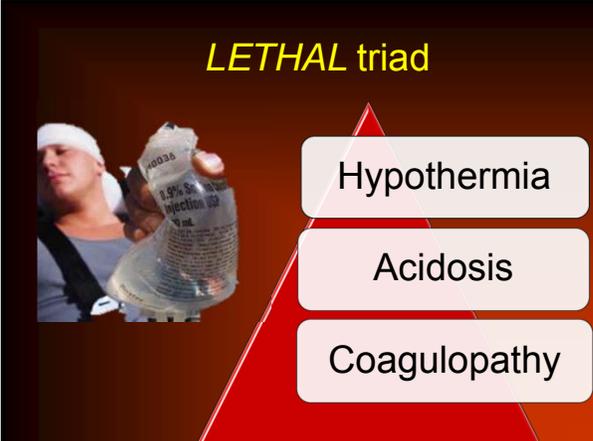
**Burn formulas at hospital:**

2-4 mL X % TBSA X kg; ½ in first 8 hrs

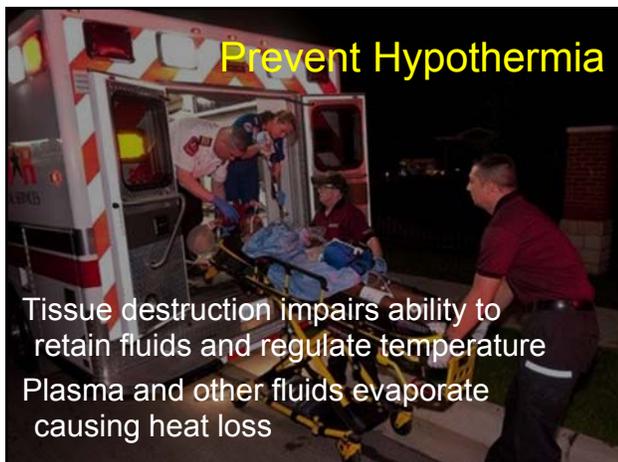


**LETHAL triad**

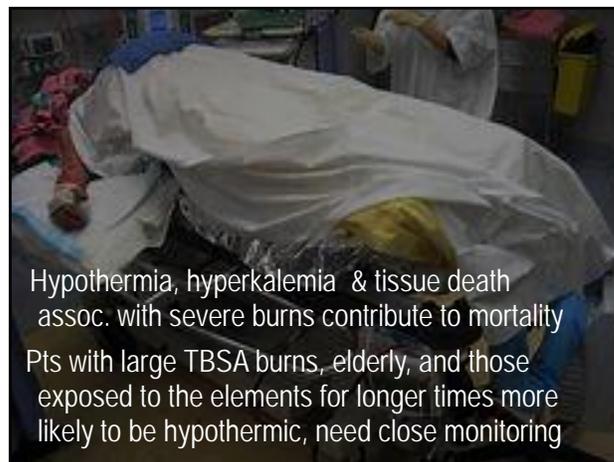
- Hypothermia
- Acidosis
- Coagulopathy



### Prevent Hypothermia



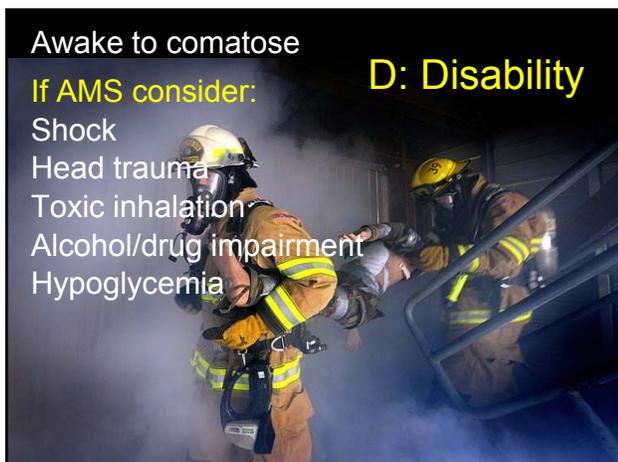
Tissue destruction impairs ability to retain fluids and regulate temperature  
Plasma and other fluids evaporate causing heat loss



Hypothermia, hyperkalemia & tissue death assoc. with severe burns contribute to mortality  
Pts with large TBSA burns, elderly, and those exposed to the elements for longer times more likely to be hypothermic, need close monitoring

### D: Disability

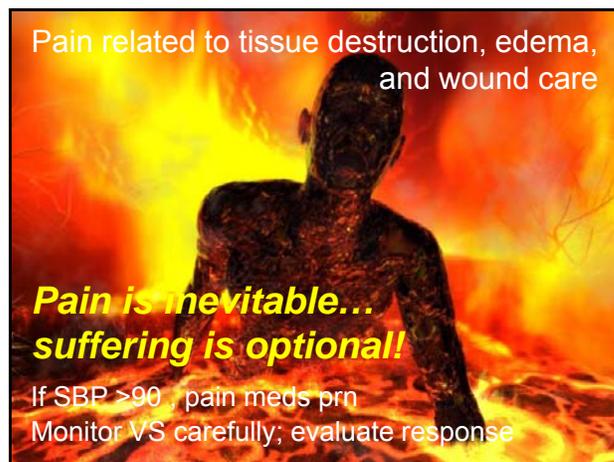
Awake to comatose  
If AMS consider:  
Shock  
Head trauma  
Toxic inhalation  
Alcohol/drug impairment  
Hypoglycemia



### Pain is inevitable... suffering is optional!

Pain related to tissue destruction, edema, and wound care

If SBP >90, pain meds prn  
Monitor VS carefully; evaluate response



Give until pain tolerable, max dose given, or SE evident (ETCO<sub>2</sub>)  
Monitor VS carefully; evaluate response

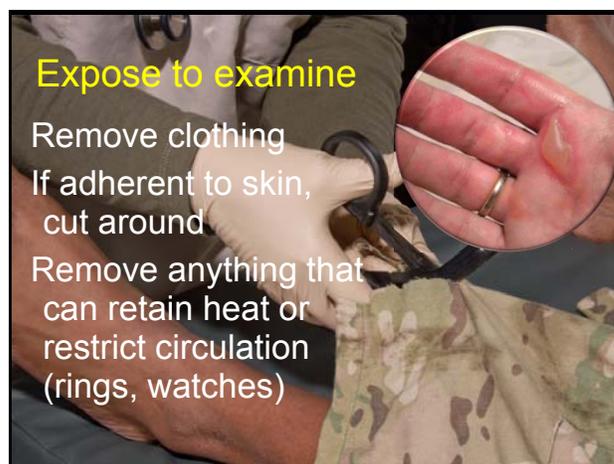
### PAIN



FENTANYL Citrate Injection, USP  
100 mcg Fentanyl/2 mL (50 mcg/mL) (0.05 mg/mL)  
WARNING: May be habit forming. For IV use only.

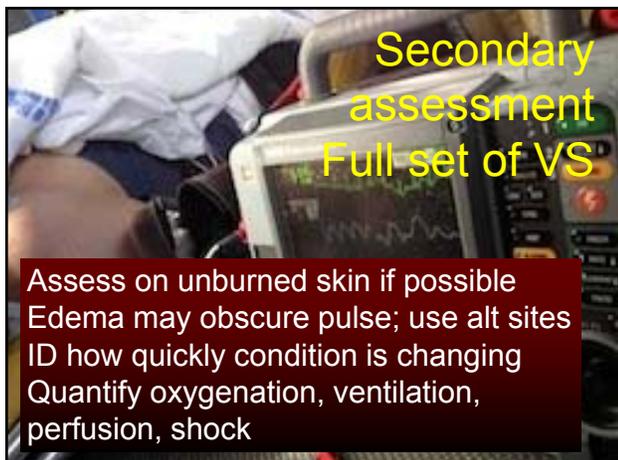
### Expose to examine

Remove clothing  
If adherent to skin, cut around  
Remove anything that can retain heat or restrict circulation (rings, watches)



### Secondary assessment Full set of VS

Assess on unburned skin if possible  
Edema may obscure pulse; use all sites  
ID how quickly condition is changing  
Quantify oxygenation, ventilation, perfusion, shock



Place cuff on unburned skin if possible  
Dressing over burn under cuff if no healthy skin available



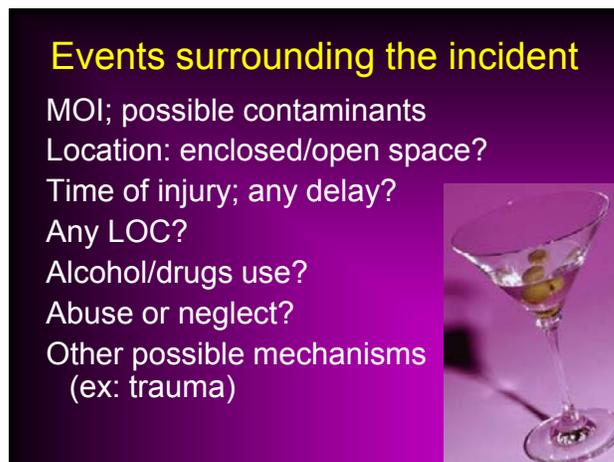
### SAMPLE history

Allergies: Sulfa?  
Meds: Implications for wound healing: Steroids, aspirin, epinephrine, antibiotics



### Events surrounding the incident

MOI; possible contaminants  
Location: enclosed/open space?  
Time of injury; any delay?  
Any LOC?  
Alcohol/drugs use?  
Abuse or neglect?  
Other possible mechanisms (ex: trauma)



### Case 1

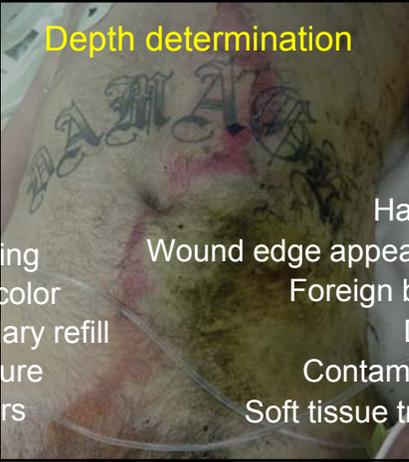


HOSTED AT  
NOTHINGTOXIC.COM

### Case 2

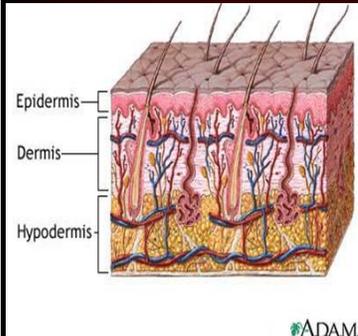


### Depth determination



|                  |                       |
|------------------|-----------------------|
| Pain             | Hair loss             |
| Swelling         | Wound edge appearance |
| Skin color       | Foreign bodies        |
| Capillary refill | Debris                |
| Moisture         | Contaminants          |
| Blisters         | Soft tissue trauma    |

### How is depth determined?

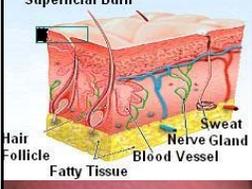


Superficial  
 Partial thickness  
 Full thickness

|                                      |  |
|--------------------------------------|--|
| <b>Superficial</b>                   | <ul style="list-style-type: none"> <li>• Appearance: Dry, red</li> <li>• Tactile perception: Painful regardless of stimulation</li> <li>• Blanching: Blanches with pressure</li> </ul>               |
| <b>Superficial partial thickness</b> | <ul style="list-style-type: none"> <li>• Appearance: Moist, red, blistering</li> <li>• Tactile perception: Painful regardless of stimulation</li> <li>• Blanching: Blanches with pressure</li> </ul> |
| <b>Deep partial thickness</b>        | <ul style="list-style-type: none"> <li>• Appearance: Wet/waxy, patchy/white/red, blistering</li> <li>• Tactile perception: Pressure only</li> <li>• Blanching: No blanching</li> </ul>               |
| <b>Full thickness</b>                | <ul style="list-style-type: none"> <li>• Appearance: Waxy, white/grayish/charred, leatherized</li> <li>• Tactile perception: None</li> <li>• Blanching: No blanching</li> </ul>                      |
| <b>Fourth degree</b>                 | <ul style="list-style-type: none"> <li>• Similar to full thickness except that charred tissue may slough away, exposing burned muscle, bones, or other deeper structures</li> </ul>                  |

Adapted from Rice P, Orsini D. (Jan. 18, 2017.) Emergency care of moderate and severe thermal burns in adults. UpToDate. Retrieved March 27, 2018, from www.uptodate.com/contents/emergency-care-of-moderate-and-severe-thermal-burns-in-adults.

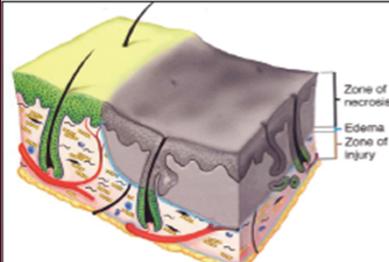
### Superficial Burn




Epidermis & outer dermis  
 Skin red, blanches and refills  
 Warm, may be moist  
 Locally painful  
 Usually no blisters

### Partial thickness

Deeper in dermis - greater destruction  
 Skin contact  
 Hot liquids  
 Explosions producing flash burns  
 Hot grease



IAFF/ABA, 2007

### Partial thickness S&S

Edema  
 Hairs intact  
 Red, cap refill intact  
 Moist, often blisters  
 Extreme pain  
 Risk of infection  
 Can convert to FT  
 Heals w/o grafting  
 Scar or changed appearance



Full thickness burns

Photo courtesy Edward T. Dickinson, MD

**Full thickness burns**  
Destroys epidermis + dermis including area that produces new skin cells

**Third-Degree Burn (Full-Thickness)**  
Characteristic: No remaining viable dermis.  
Zone of necrosis

IAFF/ABA, 2007



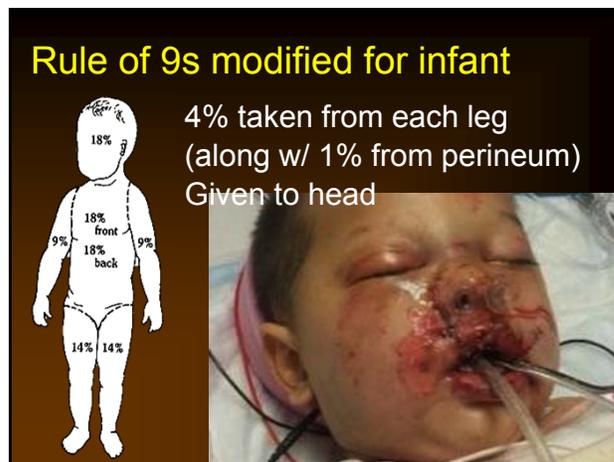
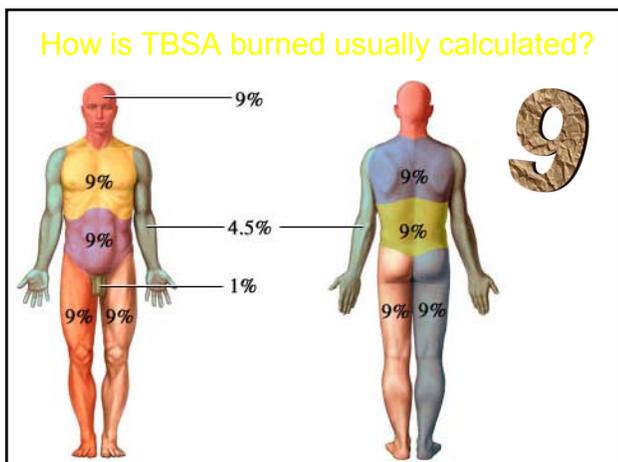
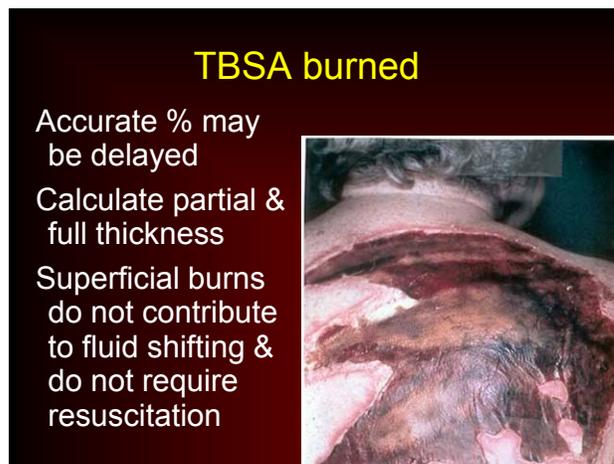
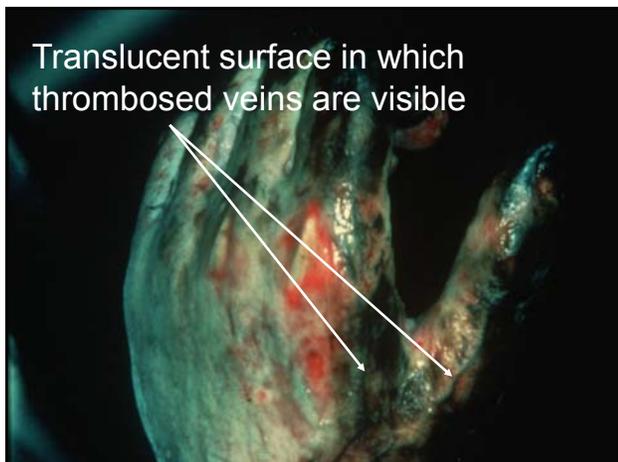
White

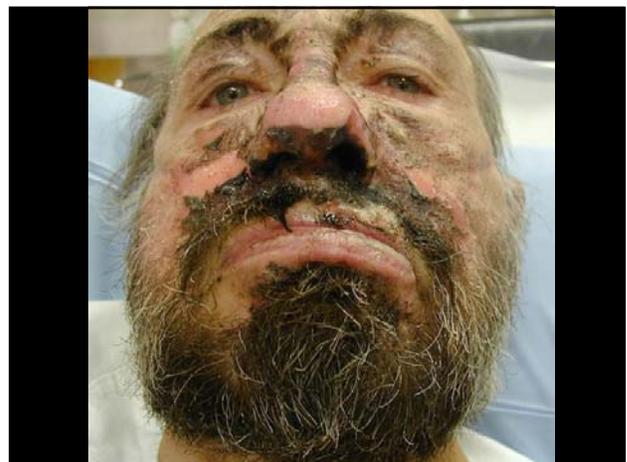
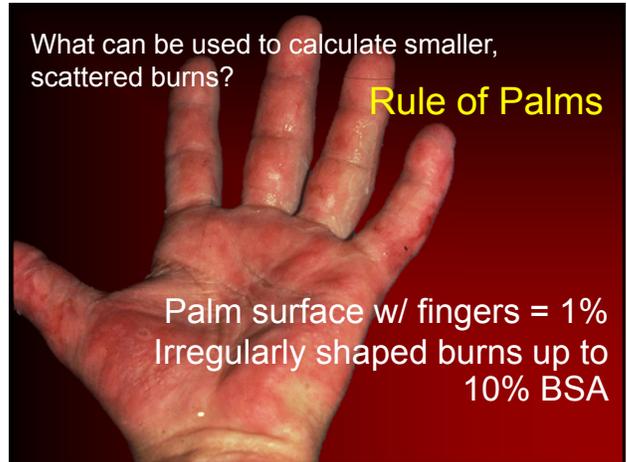
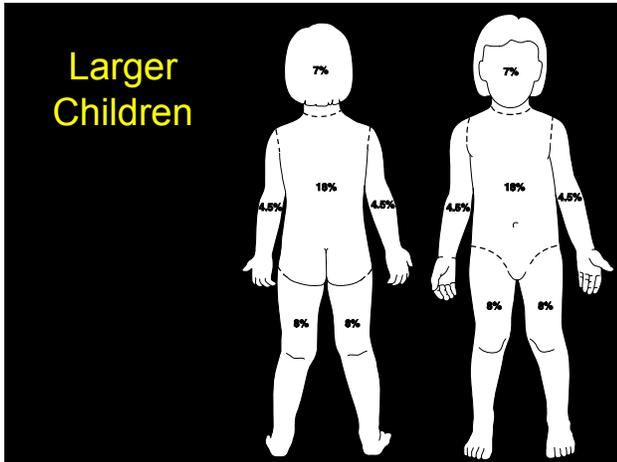


Brown/leathery



Dry - sweat glands destroyed









### Criteria for burn center referral

PT > 10% in ages  
Full thickness any age group  
Face, hands, feet, perineum, or major joints  
Inhalation injury  
Chemical burns; electrical/lightning burns  
Children; Suspected child abuse  
Pre-existing disorders that could complicate mgt, prolong recovery  
Concomitant trauma; burn poses greatest risk  
Pts require special social, emotion or rehab intervention



### ABA classifications: Minor Burn

Superficial:  
BSA < 50%  
PT: BSA < 15%  
FT: BSA < 2%



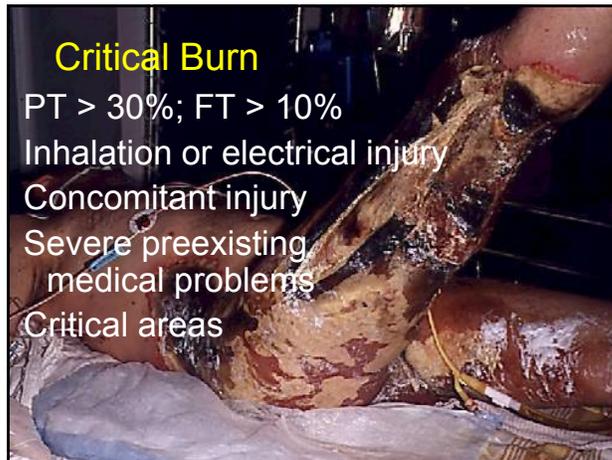
### Moderate Burn

Superficial > 50%  
PT < 30%; FT < 10%  
No complications  
No hands, face, feet, perineum  
No electrical or inhalation injury  
No other trauma or PMH



### Critical Burn

PT > 30%; FT > 10%  
Inhalation or electrical injury  
Concomitant injury  
Severe preexisting medical problems  
Critical areas



### Why critical?





### Exposure time for severe burn

| Water Temperature | Time to 3rd Degree Burn      |
|-------------------|------------------------------|
| 155° F            | 1 second                     |
| 148°              | 2 seconds                    |
| 140°              | 5 seconds                    |
| 133°              | 15 seconds                   |
| 127°              | 1 minute                     |
| 124°              | 3 minutes                    |
| 120°              | 5 minutes                    |
| 100°              | Safe temperature for bathing |



### Trauma Triage / Transport Criteria (adult & peds)

Trauma pts should be taken directly to the TC most appropriately equipped and staffed to handle their injuries, as defined by the Region's trauma system (below). EMS should bypass facilities not designated as appropriate destinations, even if those facilities are closest to the incident (ACS-COT, 2014). See appendix for listing of all TCs in Regions 8, 9, & 10. If local agency concerns oppose using these triage & transport criteria, EMS personnel should contact OLMC for orders.

Meets Level I criteria & is >30 min from a Level I, may go to closest Level II for stabilization  
 Meets Level I or II criteria & is >30 min from a TC, may go to closest non-TC for stabilization or assess need for helicopter.

**Hemodynamic instability:** Sustained hypotension [SBP < 90 (adults) / < 70 (peds)] on 2 consecutive measurements, 5 min apart. Attempt to keep scene time ≤ 10 minutes for time-sensitive patients; document reasons for delay.

| Step 1<br>Physiologic criteria   | Time sensitive pt  | Level I<br>Trauma Center | Nearest Trauma Center<br>Level I or II | Nearest hospital<br>Trauma or non-trauma center |
|--|--|--------------------------|--|---|
| Glasgow Coma Score   | 13 or less (assoc. w/ head trauma)                         |                          | 14 - 15                                | 14 - 15   |
| *systolic BP   | < 90 (adults) / < 70 (peds)                                |                          | ≥ 90 (adults) / ≥ 70 (peds)            |   |
| Respiratory rate   | < 10 or > 29 (< 20 infant) or need for ventilatory support |                          | 10 - 29 (≥ 20 infant)                  |   |
| <b>Step 2: Anatomic Criteria</b>   |  |                          |  |   |
| All penetrating skulls/eyes/neck   |  |                          |  |   |
| <b>Step 4: Special pt. populations:</b> NO physiologic/anatomic criteria above; consider transport to closest trauma or specialty center                                     |  |                          |  |   |
| <b>Age: Caveats in elderly:</b> Risk of injury & death increases > age 55  |  |                          |  |   |
| <ul style="list-style-type: none"> <li>SBP &lt; 110 might represent shock after age 65</li> <li>Low-impact MOI (ground-level falls) might result in severe injury</li> </ul> |  |                          |  |   |
| <b>Children age &lt; 15 yrs</b> who meet criteria of steps 1 through 3 above should be triaged preferentially to pediatric-capable trauma centers if one is available.       |  |                          |  |   |
| <b>Anticoagulation and bleeding disorders:</b> Pts with head injury are at high risk for rapid deterioration   |  |                          |  |   |
| <b>Burns:</b> (Severe) Without trauma MOI: consider transport directly to burn center (OLMC); all mod-severe w/ trauma MOI go to nearest TC                                  |  |                          |  |   |
| <b>Pregnancy:</b> Fetal gestational age ≥ 20 weeks (fundus level with navel or above) even if they lack criteria of Steps 1 thru 3 above.                                    |  |                          |  |   |
| <b>EMS provider judgment</b> (injury from large animal)  |  |                          |  |   |





### Conditions associated w/ burn injuries

- Trauma
- Soft tissue injuries
- Musculoskeletal injuries
- Blast injuries
- Airway compromise
- Respiratory compromise
- Child abuse



### Danger of eschar

- May tighten over wound like a tourniquet
- Restricts blood flow
- Increases pressure in compartment

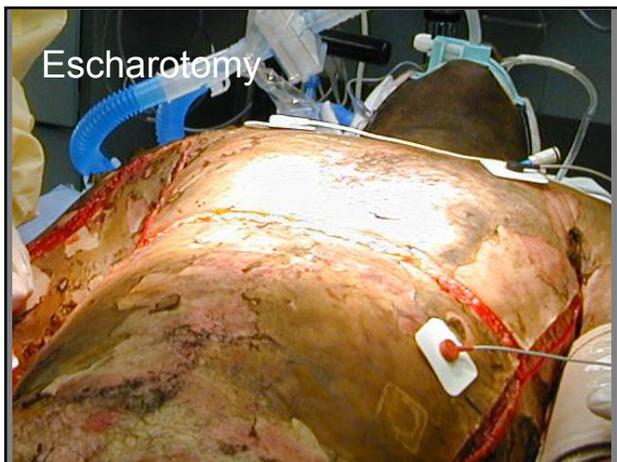


### S&S impaired circulation

- Cyanosis
- Impaired cap refill
- Progressive neuro deficits:
  - paresthesias,
  - deep tissue pain
- May need Doppler to obtain pulses



### Escharotomy



### Fasciotomy





### Major effects of burn trauma

- Local: pain, swelling
- Hypothermia
- CV & Pulmonary systems
- Infection
- Endocrine system
- GI; renal dysfunction
- CNS dysfunction
- GI complications
- CNS; hematologic systems



### ReCell



### ReCell

MPR  
Du Has Han PharmD  
September 21, 2018

#### RECELL System Approved to Treat Severe Burns



A small sample of the patient's own skin is immersed in an Enzyme solution in the RECELL System, producing Spray-On Skin Cells.

AVITA Medical announced that the Food and Drug Administration (FDA) has approved the Premarket Approval (PMA) application to market the RECELL Autologous Cell Harvesting Device to treat thermal burns in patients aged ≥18 years.

The RECELL System is intended for use at the point of care by trained healthcare professionals. It can be used alone for treating partial-thickness burns, or in combination with autografting to treat full-thickness burns.

A small sample of the patient's own skin is immersed in the Company's proprietary Enzyme solution in the RECELL System, which separates the skin cells to produce Spray-On Skin Cells in as little as 30 minutes. The resulting Regenerative Epidermal Suspension (RES) includes keratinocytes, fibroblasts, and melanocytes, which are involved in wound healing. The RES is then sprayed directly on the burn wound, covering the entire wound bed. The RECELL System can prepare enough RES to treat a wound up to 80 times the size of the donor's skin sample.

<https://www.youtube.com/watch?v=a1Ua4EaxW9U>

# Prevention is KEY!





**Desired outcomes on all patients**

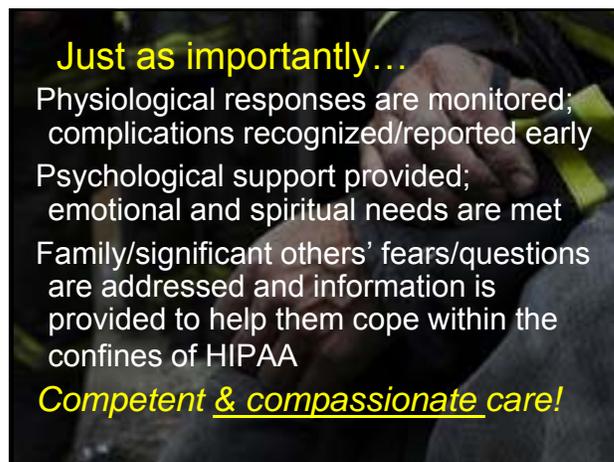
- Patent airway & adequate tissue oxygenation maintained at all times
- Hyper & hypocarbia prevented
- Adequate perfusion achieved/maintained
- Life threats are resuscitated
- Target temp is achieved/maintained
- Pain is minimized



**Just as importantly...**

- Physiological responses are monitored; complications recognized/reported early
- Psychological support provided; emotional and spiritual needs are met
- Family/significant others' fears/questions are addressed and information is provided to help them cope within the confines of HIPAA

**Competent & compassionate care!**

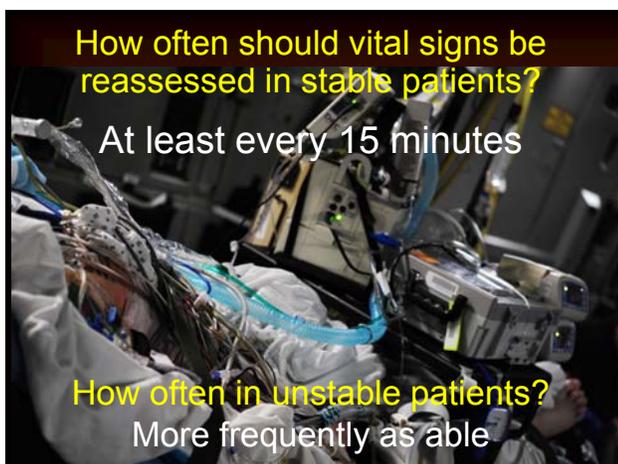


**How often should vital signs be reassessed in stable patients?**

At least every 15 minutes

**How often in unstable patients?**

More frequently as able



The present moment is the only moment available to us, and it is the door to all moments.

Thich Nhat Hanh



**Imperative:**  
Exemplary EMS practice = Exemplary patient experience

CASE 1

Incident Number: [Redacted]  
Call #: [Redacted]



NWCEMSS Paramedic [Redacted]

**Patient Information**

Age: 12 Years

Gender: Male  
Weight: 49.9 kg

**Call Type/Location/Disposition**

Call Type: Burns / Explosion

Incident Number: [Redacted]

Call Sign: A15

Unit Disp.: [Redacted]

Enroute: [Redacted]

At Scene: [Redacted]

At Patient: [Redacted]

Depart: [Redacted]

Arrive Dest.: [Redacted]

Transfer of Care: [Redacted]

Disposition: Treat & Transport ALS by this unit

**Other Agencies On Scene**

Other EMS or Public Safety Agencies at Scene

Type of Other Service at Scene

[Redacted] Department

Law

**Patient Condition**

| Complaint Type  | Complaint   | Duration  |
|-----------------|---|-----------|
| Chief (Primary) | superficial burns to back of left hand              | 5 Minutes |
| Chief (Primary) | 2nd degree burn to small finger left hand           | 5 Minutes |
| Chief (Primary) | Full thickness burns to three fingers on right hand | 5 Minutes |
| Chief (Primary) | Superficial burns under and above left eye          | 5 Minutes |

Primary Symptom: Pain

Barriers to Patient Care: None

Alcohol/Drug Use: No indicated drug/alcohol use

Date/Time of Symptom Onset: [Redacted] 2018 18:55:58

**Provider Impression**

Protocols Used

Initial Medical Care (8 / 9)

Protocol Age Category

General

Primary Impression: Burn

Secondary Impression: Acute pain

Initial Patient Acuity: Emergent / Yellow

Final Patient Acuity: Unchanged

**Narrative**

[Redacted] and [Redacted] dispatched for a 12 year old male with burns to his face and hands. Upon arrival EMS found patient ambulatory on scene A&Ox4 with a GCS=15 complaining of burns to his hands and face with pain. Patient stated that he lit a fire with rubbing alcohol in a sewer pipe under an underpass. Patient then threw two cans of hairspray into the fire and someone else threw a full lighter into the fire at the same time. Patient stated that he was standing near the end of the pipe when the cans exploded and fire hit the patient. Patient was able to walk to ambulance without incident where ALS care continued. Patient had superficial burns to both above and below his left eye. He had no visual deficits and patients eyes were PERL. Patient had no burns to his airway and had no airway obstructions. Patient also had full thickness burns to his right 2nd, 3rd, 4th fingers and thumb. EMS dressed and bandaged right hand. Patient had 2nd degree burns to his left 5th finger and superficial burns to the back of his left hand. Patients entire head of hair was singed so were both of his eyelids. Upon trauma assessment, patient had no other burns or injuries. EMS applied towels with sterile water to patients head. EMS administered 55mcg of fentanyl IN. OLMC contacted with report and transport hospital. [Redacted] gave no further medical orders and ordered transportation to Loyola hospital. Patient was transferred to Loyola hospital ED and patient care was transferred to Loyola hospital nursing staff without incident. - [Redacted]

**Past Medical History**

Medication

Patient Denies Medications

Dosage

Route

Current Medication Comments

**Patient Medications**

**Medication Allergies**

Medication Allergy Comments

Medication Allergies

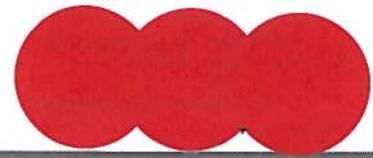
Pt Denies Rx Allergies

Medical History: Patient Denies PMH

Destination Patient Transfer of Care Date/Time: [Redacted] 2018 19:45:05

Date Printed: [Redacted] 2018 15:46

Incident #: [Redacted]



Assessments

Assessment Summary

10/01/2018 19:00:58

| Location                             | Description                             | Detailed Findings<br>Details |
|--------------------------------------|---|------------------------------|
| Head                                 | Burn-Redness                            | Hair burnt                   |
| Face                                 | Burn-Redness<br>Pain                    |                              |
| Eye<br>Bilateral:<br>Left:<br>Right: | Reactive<br>Reactive<br>Reactive        |                              |
| Hand                                 |   |                              |
| Finger-2nd (Index)-Right:            | Burn-Blistering<br>Pain                 |                              |
| Finger-3rd (Middle)-Right:           | Burn-Blistering<br>Pain                 |                              |
| Finger-4th (Ring)-Right:             | Pain                                    |                              |
| Finger-5th (Smallest)-Left:          | Burn-Blistering<br>Pain                 |                              |
| Hand-Dorsal-Left:                    | Pain                                    |                              |
| Thumb-Right:                         | Burn-Redness<br>Burn-Blistering<br>Pain |                              |

Normal Findings

Skin; Mental Status; Neurological; Eye (); Neck; Chest/Lungs; Hip (Hip-Left, Hip-Right); Back/Spine ( Back-General, Cervical-Left, Cervical-Midline, Cervical-Right, Crush Injury, Lumbar-Left, Lumbar-Midline, Lumbar-Right, Sacral-Left, Sacral-Midline, Sacral-Right, Thoracic-Left, Thoracic-Midline, Thoracic-Right );

Not Done

|  |
|--|
|  |
|--|

Vitals

| Time     | PTA | Cross | Position     | AVPU  | BP     | MAP | Method             | Pulse | Strength | Rhythm  | Resps | Effort | SpO2        |
|----------|-----|-------|--------------|-------|--------|-----|--------------------|-------|----------|---------|-------|--------|-------------|
| 19:03:11 | No  |       | Semi-Fowlers | Alert | 134/80 | 98  | Cuff - Auscultated | 116   | Strong   | Regular | 20    | Normal | 96 Room Air |
| 19:13:33 | No  |       | Semi-Fowlers | Alert | 134/77 | 96  | Cuff - Auscultated | 114   | Strong   | Regular | 20    | Normal | 97 Room Air |
| 19:24:58 | No  |       | Semi-Fowlers | Alert | 137/80 | 99  | Cuff - Automated   | 114   | Strong   | Regular | 20    | Normal | 99 Room Air |
| 19:35:58 | No  |       | Semi-Fowlers | Alert | 118/62 | 81  | Cuff - Automated   | 111   | Strong   | Regular | 20    | Normal | 98 Room Air |

| Time     | PTA | GCS Motor          | GCS Verbal   | GCS Eye                 | GCS | GCS Qual                   | BG     | Temp        | Pain        | Stroke         |       |             |
|----------|-----|--------------------|--------------|-------------------------|-----|----------------------------|--------|-------------|-------------|----------------|-------|-------------|
|          |     |                    |              |                         |     |                            | BG H/L | Temp Method | ETCO2 Score | Pain Type      | Score | Stroke Type |
| 19:03:11 | No  | 6 - Obeys commands | 5 - Oriented | 4 - Opens spontaneously | 15  | Accurate with no influence |        |             | 9           | Numeric (0-10) |       |             |
| 19:13:33 | No  | 6 - Obeys commands | 5 - Oriented | 4 - Opens spontaneously | 15  | Accurate with no influence |        |             | 9           | Numeric (0-10) |       |             |
| 19:24:58 | No  | 6 - Obeys commands | 5 - Oriented | 4 - Opens spontaneously | 15  | Accurate with no influence |        |             | 6           | Numeric (0-10) |       |             |
| 19:35:58 | No  | 6 - Obeys commands | 5 - Oriented | 4 - Opens spontaneously | 15  | Accurate with no influence |        |             | 6           | Numeric (0-10) |       |             |

Interventions

Destination Patient Transfer of Care Date/Time: 10/01/2018 14:05

Date Printed: 12/06/2018 15:46

Incident

| Time                | Medication | Medications |        |  | Response | PTA | Medication | Comments |
|---------------------|------------|-------------|--------|--|----------|-----|------------|----------|
|                     |            | Route       | Dosage |  |          |     |            |          |
| 10/01/2018 19:15:47 | Fentanyl   | IN          | 55 mcg |  | Improved | No  |            |          |

| Time                | Name                           | Location | Size of Equipment | Attempts | Response | Success | Procedure Comments |
|---------------------|--------------------------------|----------|-------------------|----------|----------|---------|--------------------|
|                     |                                |          |                   |          |          |         |                    |
| 10/01/2018 19:05:58 | Wound - Application of bandage |          |                   | 1        |          | No      |                    |

**EKG**

| Date/Time Vital Signs Taken | Cardiac Rhythm / Electrocardiography (ECG) | ECG Type | Method of ECG Interpretation |
|-----------------------------|--|----------|------------------------------|
| 19:03:11                    | Sinus Tachycardia                          | 4 Lead   | Human Interp                 |
| 19:13:33                    | Sinus Tachycardia                          | 4 Lead   | Human Interp                 |
| 19:24:58                    | Sinus Tachycardia                          | 4 Lead   | Human Interp                 |
| 19:35:58                    | Sinus Tachycardia                          | 4 Lead   | Human Interp                 |

**Cardiac Arrest**

Cardiac Arrest: No

**Patient Transport/Positioning**

Destination/Transferred To, Name: Loyola University MC Reason for Choosing Destination: On-Line Medical Control Type of Destination: Hospital ED Hospital Capability: Burn Center

**Hospital Team Activations**

Destination Team Pre-Arrival Alert or Activation: None Date/Time of Destination Prearrival Alert or Activation:

**Injury Information**

Cause of Injury: Contact with hot air and other hot gases

Mechanism of Injury: Burn

Work-Related Illness/Injury: No

**Unit Personnel**

**Crew Members**

| License Level | Role   |
|---------------|--|
| EMT-Paramedic | Scene - Primary Caregiver, Transport - Primary Caregiver           |
| EMT-Paramedic | Scene - Secondary Caregiver, Driver - Response, Driver - Transport |
| EMT-Basic     | Fire Company, Scene - Secondary Caregiver                          |
| EMT-Paramedic | Fire Company, Scene - Secondary Caregiver                          |
| EMT-Paramedic | Fire Company, Scene - Secondary Caregiver                          |
| EMT-Paramedic | Fire Company, Scene - Secondary Caregiver                          |

Destination Patient Transfer of Care Date/Time: 19:45:05

Printed: 12/06/2018 15:46

Incident #

CASE 2

Incident Number: [Redacted]  
Call #: [Redacted]

NWCEMSS Paramedic Student v1.1

Patient Information

Age: 26 Years

Gender: Male  
Weight: 72.6 kg

Call Type/Disposition

Call Type: Burns / Explosion

Incident Number: [Redacted]

Call Sign: A8

Unit Disp.: [Redacted]

Enroute: [Redacted]

At Scene: [Redacted]

At Patient: [Redacted]

Depart: [Redacted]

Arrive Dest.: [Redacted]

Transfer of Care: [Redacted]

Disposition: Treat & Transport ALS by this unit

Patient Condition

| Complaint Type                                  | Complaint                                       | Duration   |
|---|---|------------|
| Chief (Primary)                                 | Burn Injury                                     | 15 Minutes |
| Primary Symptom: Injury                         | Barriers to Patient Care: None                  |            |
| Other Symptoms: Pain                            | Alcohol/Drug Use: No indicated drug/alcohol use |            |
| Date/Time of Symptom Onset: [Redacted] 13:26:00 |   |            |

Provider Impression

| Protocols Used              | Protocol Age Category   |
|-----------------------------|---|
| Initial Trauma Care (8 / 9) | General   |
| Primary Impression: Burn    | Initial Patient Acuity: Emergent / Final Patient Acuity: Improved<br>Acuity: Yellow |

Narrative

[Redacted] and [Redacted] dispatched for the pt. with burn injuries. Upon arrival, 26 y.o. male pt. was found A&Ox4 standing in a warehouse with coworkers present. Pt. had pants around his ankles, and stated he had an e-cigarette in his pocket which exploded spontaneously. Crew noted several palm-sized burns varying from 2nd to 3rd degree to the pt's right upper thigh left inner thigh, and buttocks. Burns appeared charred with Crew irrigated burns with saline and wrapped with plastic wrap. Pt. stated pain was 6/10, but also stated he had some numbness to the center of the burns. Skin appeared black and charred. Pt. stated his pants caught fire after the explosion, but he was able to remove them quickly after stopping, dropping, and rolling. No other signs of trauma noted. Burns appeared to cover approx. 5% body area. 18 g. IV established in pt's left AC, and fentanyl administered for pain. Pt. moved to [Redacted] via stretcher on left side in position of comfort. Pt. denied head, neck, back, and chest pain, as well as dizziness, nausea, weakness, vomiting, and loss of consciousness. While en route, pt. stated pain was improving. [Redacted] OLMC was contacted and advised with no orders. Upon arrival, pt. care transferred to [Redacted] in room [Redacted].

Past Medical History

| Medication                             | Dosage | Route | Current Medication Comments        |
|--|--------|-------|------------------------------------|
| Patient Denies Medications             |        |       |                                    |
| Medication Allergies                   |        |       |                                    |
| Medication Allergy Comments            |        |       |                                    |
| No Known Drug Allergy                  |        |       |                                    |
| Medical History: Patient Denies PMH    |        |       |                                    |
| Medical History Obtained From: Patient |        |       | Advance Directives: Not Applicable |

Assessments

Destination Patient Transfer of Care Date/Time: [Redacted] 14:03:00

Date Printed: 12/06/2018 15:40

Incident #: [Redacted]

**Assessment Summary**

| Location  | Description   | Detailed Findings Details |
|---|---|---------------------------|
| <b>Mental Status</b>  | Oriented-Event<br>Oriented-Person<br>Oriented-Place<br>Oriented-Time<br>Normal Baseline for Patient |                           |
| <b>Eye</b><br>Bilateral:  | Reactive<br>PERRL   |                           |
| <b>Upper Leg</b><br>Leg-Upper-Left:<br>Leg-Upper-Right:   | Burn-Charring<br>Burn-Redness<br>Burn-Charring<br>Burn-Redness                                      |                           |
| <b>Normal Findings</b>  |   |                           |
| Skin; Neurological; Head; Face; Eye (Bilateral); Neck; Shoulder (Shoulder-Left, Shoulder-Right); Chest/Lungs; Abdomen (Generalized); Pelvis; Hip (Hip-Left, Hip-Right); Knee (Knee-Left, Knee-Right); Lower Leg (Leg-Lower-Left, Leg-Lower-Right); Ankle (Ankle-Left, Ankle-Right); Upper Arm (Arm-Upper-Left, Arm-Upper-Right); Elbow (Elbow-Left, Elbow-Right); Forearm (Forearm-Left, Forearm-Right); Back/Spine (Back-General); |   |                           |
| <b>Not Done</b>   |   |                           |
|   |   |                           |

**Vitals**

| Time     | PTA | C          | Position     | AVPU  | BP     | MAP | Method             | Pulse | Strength | Rhythm  | Resps | Effort | SpO2         |
|----------|-----|------------|--------------|-------|--------|-----|--------------------|-------|----------|---------|-------|--------|--------------|
| 13:42:00 | No  | [REDACTED] | Semi-Fowlers | Alert | 146/92 | 110 | Cuff - Auscultated | 98    | Strong   | Regular | 18    | Normal | 100 Room Air |
| 13:57:00 | No  | [REDACTED] | Semi-Fowlers | Alert | 140/88 | 105 | Cuff - Automated   | 78    | Strong   | Regular | 18    | Normal | 100 Room Air |

| Time     | PTA | GCS Motor          | GCS Verbal   | GCS Eye                 | GCS Qual                      | BG BG H/L | Temp Temp Method | Pain ETCO2 Score | Pain Type      | Stroke Score | Stroke Type |
|----------|-----|--------------------|--------------|-------------------------|-------------------------------|-----------|------------------|------------------|----------------|--------------|-------------|
| 13:42:00 | No  | 6 - Obeys commands | 5 - Oriented | 4 - Opens spontaneously | 15 Accurate with no influence |           |                  | 6                | Numeric (0-10) |              |             |
| 13:57:00 | No  | 6 - Obeys commands | 5 - Oriented | 4 - Opens spontaneously | 15 Accurate with no influence |           |                  | 4                | Numeric (0-10) |              |             |

**Interventions**

| Time                | PTA        | C          | Medication    | Route | Dosage | Response | PTA | Medication Comments |
|---------------------|------------|------------|---------------|-------|--------|----------|-----|---------------------|
| 10/18/2018 13:42:00 | [REDACTED] | [REDACTED] | Normal saline | IV    | 10 mL  | Improved | No  |                     |
| 10/18/2018 13:43:00 | [REDACTED] | [REDACTED] | Fentanyl      | IV    | 70 mcg | Improved | No  |                     |

**Procedures**

| Time                | Name            | Location         | Size of Equipment | Attempts | Response | Success | Procedure Comments |
|---------------------|-----------------|------------------|-------------------|----------|----------|---------|--------------------|
| 10/18/2018 13:42:00 | IV - Peripheral | Antecubital-Left | 18                | 1        |          | Yes     |                    |

**Cardiac Arrest**

Cardiac Arrest: No

Therapeutic Hypothermia Initiated: No

**Patient Transport/Positioning**

Destination Patient Transfer of Care Date/Time: [REDACTED]

Date Printed: 12/06/2018 15:40

Incident #: [REDACTED]

Incident Number:  
Call #: [REDACTED]

Destination/Transferred To, Name: [REDACTED] Reason for Choosing Destination: Closest Facility

Type of Destination: Hospital ED

Hospital Capab: [REDACTED]

**Injury Information**

Cause of Injury: Explosion of unspecified explosive materials

Mechanism of Injury: Burn

Work-Related Illness/Injury: Unknown

**Unit Personnel**

Crew Members

| Crew Member | License Level | Role                                      |
|-------------|---------------|---|
| [REDACTED]  | EMT-Paramedic | Fire Company, Scene - Secondary Caregiver |
| [REDACTED]  | EMT-Paramedic | Fire Company, Scene - Secondary Caregiver |
| [REDACTED]  | EMT-Basic     | Fire Company, Scene - Secondary Caregiver |
| [REDACTED]  | EMT-Paramedic | Scene - Primary Caregiver                 |
| [REDACTED]  | EMT-Paramedic | Scene - Primary Caregiver                 |

Destination Patient Transfer of Care Date/Time: [REDACTED] 03:00

Date Printed: 12/06/2018 15:40

Incident #: [REDACTED]

## Deb's story

On April 16, 2016, I was raking leaves and burning them. The wet ones were not burning so I added gasoline (dumb I know but I had done it many times before). I went and got my daughter so she could man the garden hose in case of any instances. I was facing parallel to the leaves when I lit them with my face turned away. There was a large whoosh and boom and I felt heat and saw the red of the flames in front of my face. I immediately brought my arm in toward me and turned away. My daughter hit me with the hose though I was not on fire. My fit bit on the left wrist was fine as was the phone I had with me. My clothes were not burned or even singed.

I immediately told my daughter to put the fire out and went up into the shower to cool my burns. I sat in there for what seemed like a long time and the skin on my right arm was sloughing off. I knew it wasn't good but had no idea how bad it was. My daughter got me some clothes and I had her drive me to the ED which is only about 10 min from my residence. I kept a cool rag on the right arm as it was starting to hurt. I initially had no pain.

Got to the ED and the nurse walked in and then out. All I saw was red on both arms, both legs, my upper chest and felt some heat on the right side of my face. An IV was established and the doc came into see me. He tried using the rules of 9's using his hand but I told him I figured it at about 20%. They transferred me to Loyola's burn unit. I spent one night in the step down unit then was moved to Burn ICU for 19 days.

Initially, Loyola debrided me by taking the sloughing skin off of my legs. They said it was good they could do it in one sheet. I do not remember my arms as they increased pain medication as I started to yell.

I remember having bandages around my face though I never saw my face. Every day I would be bathed and they would debris me. They would medicate me with morphine first then right before oxycodone. After a few days they needed to add fentanyl right beforehand due to the screaming in pain. Bandages were changed every day and physical and occupational therapy started pretty quick as well. At one point, I had a feeding tube as I was not consuming enough calories and a Foley catheter as well as I couldn't get out of bed for the first 5 days or so. By then the bandages were off my face and legs for the most part. The right leg took longer to heal.

Eventually, my legs were healing well along with my left arm but my right was not. A Xenograph was done shortly before I was released to aid in the healing. I had OT and PT everyday and it was hard to do a lot of small motor skills. They put a large tube around my toothbrush so I could brush my own teeth.

The diagnosis was 23% TBSA burns, mostly partial thickness (second degree) but the right arm is thought to have been full thickness (3<sup>rd</sup> degree) circumferential.

I have spent months doing occupational therapy (OT) so I could get back to normal skills and have done amazingly well according to my OT and burn doctor. I had home health care for the first 2 months home. A Nurse would come daily to help me shower and debride. In fact, we found that there was a staple left in my Xenograph which we just pulled out by hand. The sun was very scary for me and I would wear big hats and sunscreen every time I went out of the house. I had to be very care with my right arm especially because I would easily develop blisters. If they broke, they had to be bandaged and several had to be cauterized to get them to close back up. My skin was extremely delicate.

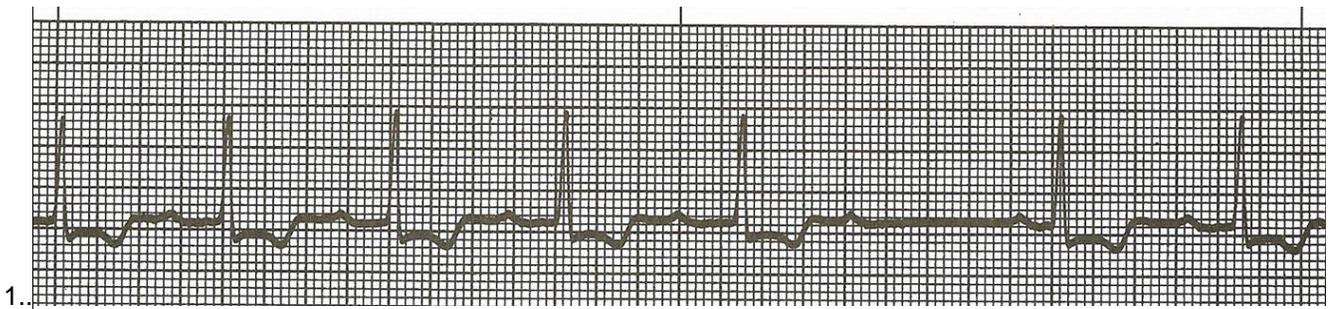
Now it is not so bad and I use sunscreen when I am out all the time. SPF 50 as recommended by the Burn Unit. I also found some scar cream—Advosil that helps my scars heal better and works wonderfully with PT.

The months following my burns, I worked hard as some may know to get back to work. But that was not in the cards for me. I was able to pass every PT test multiple times and completed all but 1-2 skills test for the FD. I wasn't able to chop the 4x4 hole in the allotted time but I was able to chop it. I am able to do pretty much everything I did before, though there are still some issues with the supination on the right wrist.

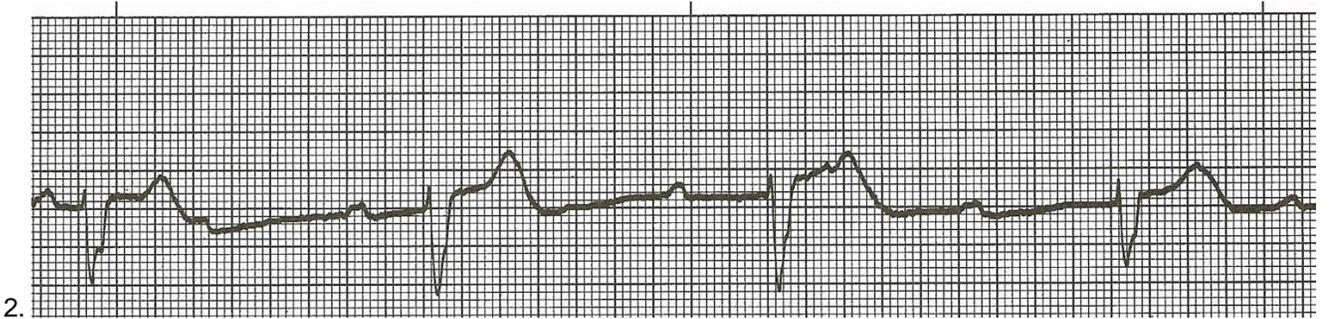
A year after my burn, I had scar release surgery to release that right wrist and little finger for grip strength. Both were successful but my pinkie will never be fully straight again. I continue PT weekly to help with the adhesions. They will continue for up to 3 years s/p burns. I am lucky my PT worked with the Maricopa burn unit in Arizona and with the Phoenix Fire Department. She had me doing firefighter skills like crawling with an air pack on and planks with the air pack within 3 months. She now does a procedure called the Graston technique to help with the adhesions under the skin and it is helping a lot.

I had to relearn a lot of things and I may do some things differently now, but I am back to probably 98% physically and am much more mentally strong now. I was blessed to have a great family and friends that were with me throughout everything. My daughter did all my bandaging once home health stopped until I didn't need any more bandaging.

My left hand is now getting injections of pigment to help return the color to be more natural and not so red. It is called paramedical tattooing or paramedical micropigmentation. It is relatively new and seems to be working well for my left hand.



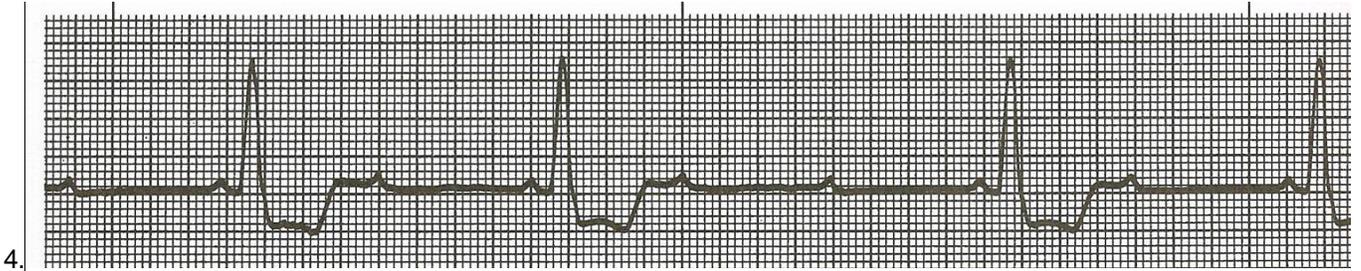
1. Identify the rhythm: \_\_\_\_\_



2. Identify the rhythm: \_\_\_\_\_



3. Identify the rhythm: \_\_\_\_\_



4. Identify the rhythm: \_\_\_\_\_

5. Which rhythm has the following characteristics (circle all the correct answers)

|  |    |       |        |    |
|--|----|-------|--------|----|
| More Ps than QRSs?                                       | 1° | 2° MI | 2° MII | 3° |
| P-P interval regular (All Ps march out)?                 | 1° | 2° MI | 2° MII | 3° |
| P-R interval constant?                                   | 1° | 2° MI | 2° MII | 3° |
| P-R interval variable with no pattern?                   | 1° | 2° MI | 2° MII | 3° |
| P-R interval progressively lengthens before dropped QRS? | 1° | 2° MI | 2° MII | 3° |
| R-R interval constant (QRSs regular)                     | 1° | 2° MI | 2° MII | 3° |

**NWC EMSS Lab Skill Performance Record**  
**INTRAOSSIOUS ACCESS USING EZ IO**

|       |  |
|-------|--|
| Name: | 1 <sup>st</sup> attempt: <input type="checkbox"/> Pass <input type="checkbox"/> Repeat |
| Date: | 2 <sup>nd</sup> attempt: <input type="checkbox"/> Pass <input type="checkbox"/> Repeat |

A patient presents unconscious in septic shock. You are asked to assemble the equipment and achieve venous access via the IO route using an EZ-IO driver.

| <b>Performance standard</b>  | <b>Attempt 1 rating</b> | <b>Attempt 2 rating</b> |
|--|-------------------------|-------------------------|
| 0 Step omitted (or leave blank)<br>1 Not yet competent: Unsuccessful; required critical or excess prompting; marginal or inconsistent technique<br>2 Successful; competent with correct timing, sequence & technique, no prompting necessary   |                         |                         |
| <b>*Verbalizes indications for IO infusions</b><br><input type="checkbox"/> Unstable pt urgently needing IV fluids or critical life-saving meds, esp. if circulatory collapse; difficult, delayed, or impossible venous access; or conditions preventing venous access at other sites. May be used prior to IV attempt in cardiac arrest (medical/trauma).<br><input type="checkbox"/> States total # of attempts per site (bone) (1)<br><input type="checkbox"/> Benefits of proximal humerus: Greater flow; ave. flow rate of 5 L/hour under pressure for humerus, 1 L/hour for tibia; reach the heart with medication or fluid in three seconds   |                         |                         |
| <b>*Verbalizes CONTRAINDICATIONS for IO infusions at first selected site (use alternate sites)</b><br><input type="checkbox"/> Fracture of the bone selected for IO infusion<br><input type="checkbox"/> Infection at selected site<br><input type="checkbox"/> Previous significant ortho procedure at or near insertion site (joint replacement, IO within 48 hrs, prosthetic devices)<br><input type="checkbox"/> Pre-existing condition (tumor near site, severe osteoporosis or other bone abnormality; severe PVD)<br><input type="checkbox"/> Excessive tissue; absence of adequate anatomical landmarks (obesity, tissue edema)  |                         |                         |
| <b>Prepare patient:</b> If pt. conscious, advise of emergent need for procedure  |                         |                         |
| <b>* Select appropriate IO needle set; prepare and assemble equipment</b><br><input type="checkbox"/> EZ-IO driver <input type="checkbox"/> IV NS; reg. drip tubing <input type="checkbox"/> Pressure infuser bag <input type="checkbox"/> PPE/Sharps container<br><input type="checkbox"/> 2 luer lock syringes w/ sterile NS to prime connect tubing & flush IO: 10 mL (adults), 2-5 mL (infant/child)<br><input type="checkbox"/> Conscious pt: 2% IV Lidocaine(100 mg/5 mL) preservative & epinephrine free<br><input type="checkbox"/> Extension set or EZ Connect tubing <input type="checkbox"/> Skin prep: Chlorhexidine (CHG 2%)/(IPA 70%)<br><input type="checkbox"/> EZ-IO® needle sets:<br>o 45 mm (Yellow) proximal humerus; ≥40 kg with excessive tissue over insertion site<br>o 25 mm (Blue) >3 kg<br>o 15 mm (Pink) 3-39 kg (children)<br><input type="checkbox"/> Arrow® EZ-Stabilizer® Dressing <input type="checkbox"/> IV Pressure infuser for 1000 mL IV bag<br><b>Flow rate:</b> Due to anatomy of IO space, flow rates slower than per IV cath. A 10mL NS rapid bolus/flush w/ syringe, improves flow rates. Attach a pressure infuser device around bag of IVF. |                         |                         |
| <b>* BSI: Universal precautions: gloves and eye protection; perform hand hygiene</b>   |                         |                         |
| <b>* Attach pressure infuser to IVF bag; prime IV tubing; inflate pressure infuser to 300 mmHg</b>   |                         |                         |
| <b>* Prepare EZ-IO driver and needle set:</b><br><input type="checkbox"/> Inspect needle set packaging to ensure sterility, check expiration date on package<br><input type="checkbox"/> Attach sterile NS filled syringe to EZ-Connect® extension tubing; prime tubing (requires 1 mL; leave at least 9 mL NS in syringe); leave syringe attached to EZ Connect tubing; set unclamped<br><input type="checkbox"/> Remove safety cap from needle, attach to driver (magnetized), momentarily power drill – do not touch needle   |                         |                         |
| <b>* LOCATE INSERTION SITE:</b> Position pt and palpate site(s) to identify appropriate anatomical landmarks and needed needle size. proximal medial tibia (cardiac arrest); proximal humerus  |                         |                         |
| <b>* Cleanse site using CHG/IPA prep; allow to air dry 30 sec. Use clean, “no touch” technique, maintaining asepsis.</b>   |                         |                         |
| <b>* Stabilize extremity with non-dominant hand;</b><br><input type="checkbox"/> Proximal humerus – Adult: Aim the needle at a 45° angle to the anterior plane and posteromedially<br><input type="checkbox"/> Tibia: Aim needle at a 90° angle to the bone<br><input type="checkbox"/> *With other hand, hold driver w/ needle connected. Push needle tip through skin and rest tip against bone directly over insertion site. The 5 mm mark on the needle must be visible above the skin for confirmation of adequate needle length. If not visible, consider alternative site for insertion or a longer needle.<br><input type="checkbox"/> Activate driver by depressing trigger on handgrip. Proximal humerus: drill gently through bone cortex (2 cm) until hub is against the skin in an adult. Tibia: Advance needle ~1-2 cm after entry into the medullary space or until needle set hub is close to the skin   |                         |                         |

| <p style="text-align: center;"><b>Performance standard</b></p> <p>0 Step omitted (or leave blank)<br/> 1 Not yet competent: Unsuccessful; required critical or excess prompting; marginal or inconsistent technique<br/> 2 Successful; competent with correct timing, sequence &amp; technique , no prompting necessary</p>  | <p style="text-align: center;"><b>Attempt<br/>1 rating</b></p> | <p style="text-align: center;"><b>Attempt<br/>2 rating</b></p> |
|--|--|--|
| <p><b>ALLOW DRIVER AND NEEDLE to DO the WORK;</b> maintain gentle steady, consistent, pressure on driver.</p> <p><input type="checkbox"/> <b>If driver seems to fail, lighten pressure on driver</b></p> <p><input type="checkbox"/> If pt &lt;40 kg: do NOT push – gently guide to avoid penetration through posterior bone</p> <p><input type="checkbox"/> <b>If driver fails: Insert manually using gentle twisting motion</b></p>  |  |  |
| <p>* Once inserted, hold hub in place and pull driver straight off of hub</p>  |  |  |
| <p><input type="checkbox"/> Continue to hold hub and remove stylet by rotating counterclockwise. Place directly in sharps container. NEVER return used stylet to the EZ-IO needle set.</p> <p><input type="checkbox"/> Needle should feel firmly seated in bone (do not rock needle) (1<sup>st</sup> sign of confirmation)</p> <p><input type="checkbox"/> Place EZ stabilizer dressing over the hub</p>   |  |  |
| <p><input type="checkbox"/> *Connect primed EZ Connect tubing to hub; firmly secure by twisting clockwise</p> <p><input type="checkbox"/> Pull tabs off of EZ stabilizer dressing to expose adhesive and secure to skin</p> <p><input type="checkbox"/> Attempt to aspirate blood or bone marrow (w/ syringe attached to primed EZ Connect tubing (2<sup>nd</sup> confirmation test). Prevent needle movement – do not attach syringe directly to IO catheter. If successful, do not remove more than 1 mL.</p> <p><input type="checkbox"/> Inability to aspirate blood is NOT a reliable indicator of unsuccessful placement</p>  |  |  |
| <p><b>Conscious/responsive pts (before NS flush):</b> Remove NS syringe on connecting tubing and replace w/ lidocaine syringe. Prime extension set with lidocaine (1 mL).</p> <p><input type="checkbox"/> <b>LIDOCAINE 2% 1 mg/kg (max 50 mg)(2.5 mL) <i>slow IO over 2 min BEFORE NS flush</i></b>, unless contraindicated. Allow lidocaine to dwell in IO space 60 sec. Flush with 5 to 10 mL NS.</p> <p><input type="checkbox"/> If needed; Adult: slowly give an additional <u>0.5 mg/kg (max 20 mg)</u> IO over 60 seconds</p>  |  |  |
| <p><input type="checkbox"/> *<b>ALL:</b> Flush w/ at NS: Adult 10 mL; Child: 5 mL; infant 2 mL</p> <p><input type="checkbox"/> Observe for swelling around site. Consider 2<sup>nd</sup> attempt to aspirate after NS flush.</p> <p><input type="checkbox"/> <b>If placement in doubt:</b> leave needle in place w/ connecting tubing &amp; syringe attached (for ED to evaluate placement) &amp; attempt IO on alternate site, or IV</p>  |  |  |
| <p><input type="checkbox"/> *Attach IV tubing to EZ connect tubing, and begin infusion. Frequently reassess pressure (300 mmHg) in infuser device. Re-inflate as IVF is administered.</p> <p><input type="checkbox"/> *Calculate appropriate fluid challenge volume if indicated.</p>  |  |  |
| <p><input type="checkbox"/> Secure tubing to extremity with tape. If proximal humerus: Secure arm in place across the abdomen.</p>   |  |  |
| <p>Apply wristband to pt w date &amp; time (reminds hospital to remove w/in 24 hours).</p>   |  |  |
| <p>* Monitor IO site, fluid infusion rate, and pt condition. Verbalizes at least 1 complication of IO access.</p>  |  |  |
| <p><b>Critical Criteria - Check if occurred during an attempt</b></p> <p><input type="checkbox"/> Failure to take or verbalize appropriate BSI precautions prior to performing IO puncture</p> <p><input type="checkbox"/> Failure to identify the correct insertion site and/or correct size needle</p> <p><input type="checkbox"/> Failure to stabilize the limb/site</p> <p><input type="checkbox"/> Failure to insert needle through skin and to rest on bone prior to inserting into the bone</p> <p><input type="checkbox"/> Pushing down too hard on the driver and slowing needle insertion</p> <p><input type="checkbox"/> Twisting driver when removing from needle hub</p> <p><input type="checkbox"/> Failure to give lidocaine into IO line prior to fluid infusion if responsive</p> <p><input type="checkbox"/> Rocking needle in bone to confirm placement</p> <p><input type="checkbox"/> Contaminates equipment or site without appropriately correcting the situation</p> <p><input type="checkbox"/> Failure to assure correct needle placement or detect early signs of infiltration]</p> <p><input type="checkbox"/> Failure to successfully establish IO infusion within 2 attempts during 6 minute time limit</p> <p><input type="checkbox"/> Failure to properly dispose/verbalize disposal of blood-contaminated sharps immediately in proper container at the point of use</p> <p><input type="checkbox"/> Uses or orders a dangerous or inappropriate intervention</p> |  |  |

**Scoring:** All steps must be independently performed in correct sequence with appropriate timing and all starred (\*) items must be explained/ performed correctly in order for the person to demonstrate competency. Any errors or omissions of these items will require additional practice and a repeat assessment of skill proficiency.

**Rating: (Select 1)**

- Proficient:** The paramedic can sequence, perform and complete the performance standards independently, with expertise and to high quality without critical error, assistance or instruction.
- Competent:** Satisfactory performance without critical error; minimal coaching needed.
- Practice evolving/not yet competent:** Did not perform in correct sequence, timing, and/or without prompts, reliance on procedure manual, and/or critical error; recommend additional practice

## Finding insertion sites:

### Proximal Tibia

- Extend patient's leg
- Palpate insertion site ~2 cm medial to the tibial tuberosity or ~3 cm below the patella and ~2 cm medially along the flat aspect of the tibia

### Proximal Humerus

- Place patient's hand over abdomen (elbow adducted and humerus internally rotated)
- Place palm on the patient's shoulder anteriorly to identify the "ball" under the palm as the general target area
- Place ulnar aspect of rescuer's hand on upper arm vertically along the anterior axillary line
- Place ulnar aspect of rescuer's other hand vertically along midline of upper arm (see illustration below)
- Place thumbs together over arm – identify vertical line of insertion on proximal humerus
- Palpate deeply as you climb superiorly up surgical neck of humerus
- Feel for a golf ball – where T meets ball is the surgical neck
- Insertion site on most prominent aspect of greater tubercle of humerus (1-2 cm above surgical neck)

### Small children - caveats

#### Consider tissue density over the landmark desired)

- **Proximal Tibia** - If NO tuberosity is present, insertion is located ~4 cm below patella and then medial along the flat aspect of the tibia. If the tuberosity IS present, the insertion site is ~2cm medial to the tibial tuberosity along the flat aspect of the tibia. Carefully feel for the "give" or "pop" indicating penetration into the medullary space.
- **Proximal Humerus** – See above; plus *The proximal humerus may be difficult or impossible to palpate in children < 5 years of age as the greater tubercle has not yet developed. In these cases the insertion will most likely be a shaft insertion.*

### Complications of IO access

- Assesses for any signs of extravasation of medications or fluids into the soft tissue from a misplaced IO device (can lead to compartment syndrome)
- Fractures caused by the intraosseous insertion (rare)
- Osteomyelitis is uncommon and has not been associated with marked morbidity or mortality. Generally associated with poor aseptic technique, leaving the IO device in place for more than 24 hours, and multiple IO attempts at the same site.
- Fat embolus is a theoretical risk of IO insertion but has not been reported in humans.

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