Project: Ghana Emergency Medicine Collaborative

Document Title: Burns: Management and Survivability

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Patient EH


STOP, DROP, ROLL

- 69 year-old woman.
- History of emphysema and CVA.
- Lighting candles at home due to loss of electricity.
- Clothing accidentally lit on fire.
- Attempted to put out fire by rolling on ground.

U.S. Navy photo by Mass Communication Specialist 2nd Class Tucker M. Yates, Wikimedia Commons

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OSH Records

- Initially evaluated at an outside hospital.
- Noted to be A&Ox3, breathing spontaneously, and had a hoarse raspy voice.
- On physical exam
  - carbonaceous sputum and fluid in her mouth and nostrils
  - singeing of her nose hairs.
- Intubated for airway control using RSI.

OSH Records

- Resuscitation initiated with NS.
- Started on Fentanyl and Versed gtts.
- Transferred to University Hospital via helicopter given extent of burns.

Vitals

- BP 119/71
- HR 74
- RR 14
- SaO2 100% BVM
- Temp 36.1

Primary Survey

- Airway – protected by ETT; placement verified with ETCO2.
- Breathing – breath sounds present bilaterally; chest expansion symmetrical.
- Circulation – peripheral pulses 2+; abdomen soft; pelvis stable.
- Disability – GCS 3T. Sedated and paralyzed prior to arrival; by report GCS 15 prior to sedation/intubation.
- Exposure – predominantly full thickness burns to lower face, chest, back, and lower extremities. TBSA 75%.

- **Emergent procedures**: None
- **FAST:** not performed
- **X-rays:** No pneumothorax; ET tube in proper position above carina.

Focused Secondary Survey

- GENERAL: Intubated, sedated.
- HEENT: Pupils 2 mm, minimally reactive to light bilaterally. Mucous membranes with soot in nostrils and oropharynx. 7.5 ET tube in place. Singed hair.
- SKIN: Full-thickness burns over chest and back. Burns to buttocks extending to the perineum. Full-thickness burns to anterior legs to the level of knees, and posterior legs to the ankle. Sparing of anterior shins, bilateral upper extremities including axilla.

Labs

- ABG 7.13/56/57/19
  - Carboxyhemoglobin 9.0
  - Lactate 1.5
  - HCT 50.3
- INR 1.0
- ETOH (-)
- UDS (+) for opiates, benzos, and cannabinoids

Hospital Course

- Patient was admitted to the BICU.
- Given patient's grim prognosis, the patient was transitioned to comfort care.
- This patient expired in the TBICU approximately 13 hours after arrival.

Objectives

- Determine TBSA and care of minor burns in the ED.
- When to transfer to a burn center.
- Fluid resuscitation in burns, including difficult to resuscitate protocol.
- Assessment and treatment of inhalation injuries.
- Mortality prediction in burn injuries.

Pre-hospital Care

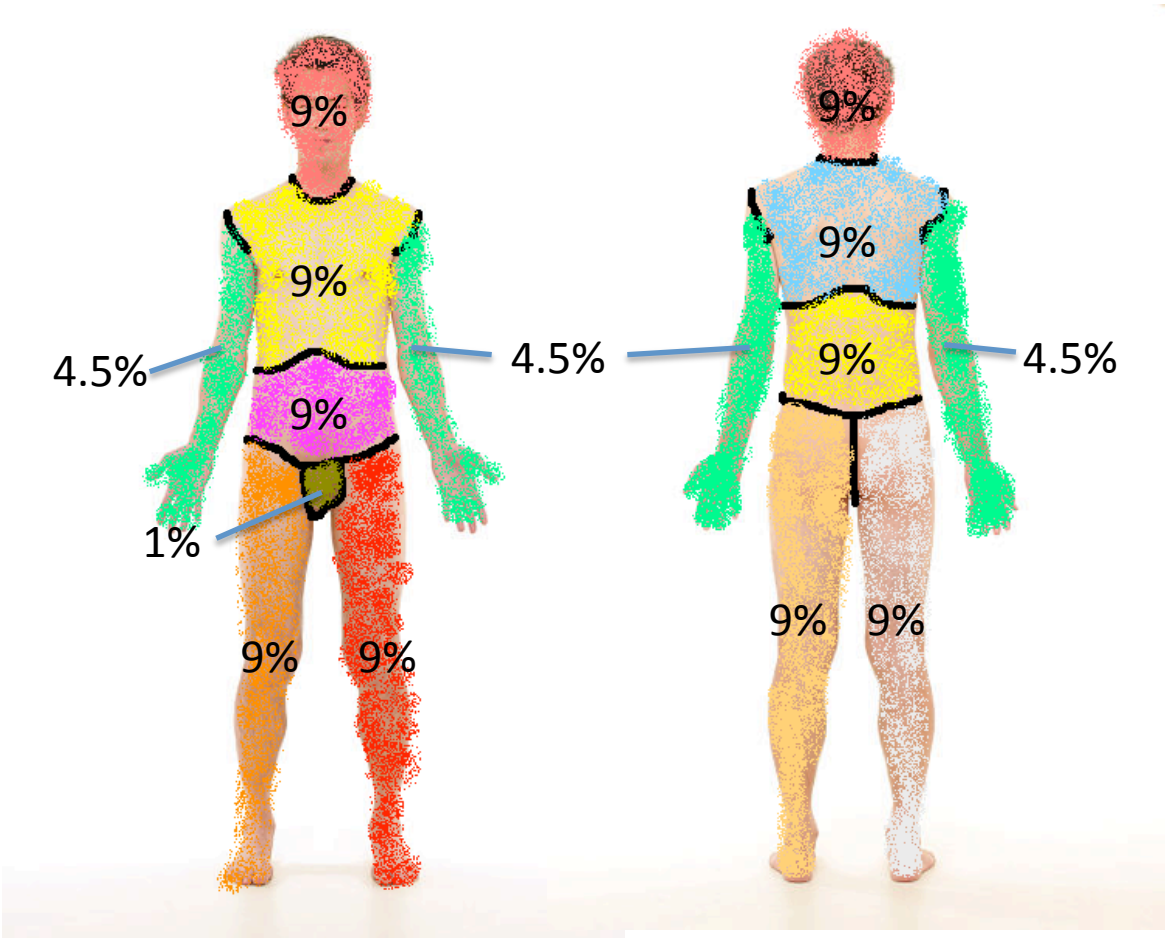
- Stop the burning process
  - Remove all clothing and jewelry
  - Keep the patient warm
- Provide oxygen if evidence of respiratory distress
- Transport to closest hospital or burn center

Initial Assessment

- First things first:
  - A: Airway
  - B: Breathing
  - C: Circulation
  - D: Disability
  - E: Exposure

http://www.traumaburn.org/referring/index.shtml

Rule of Nines



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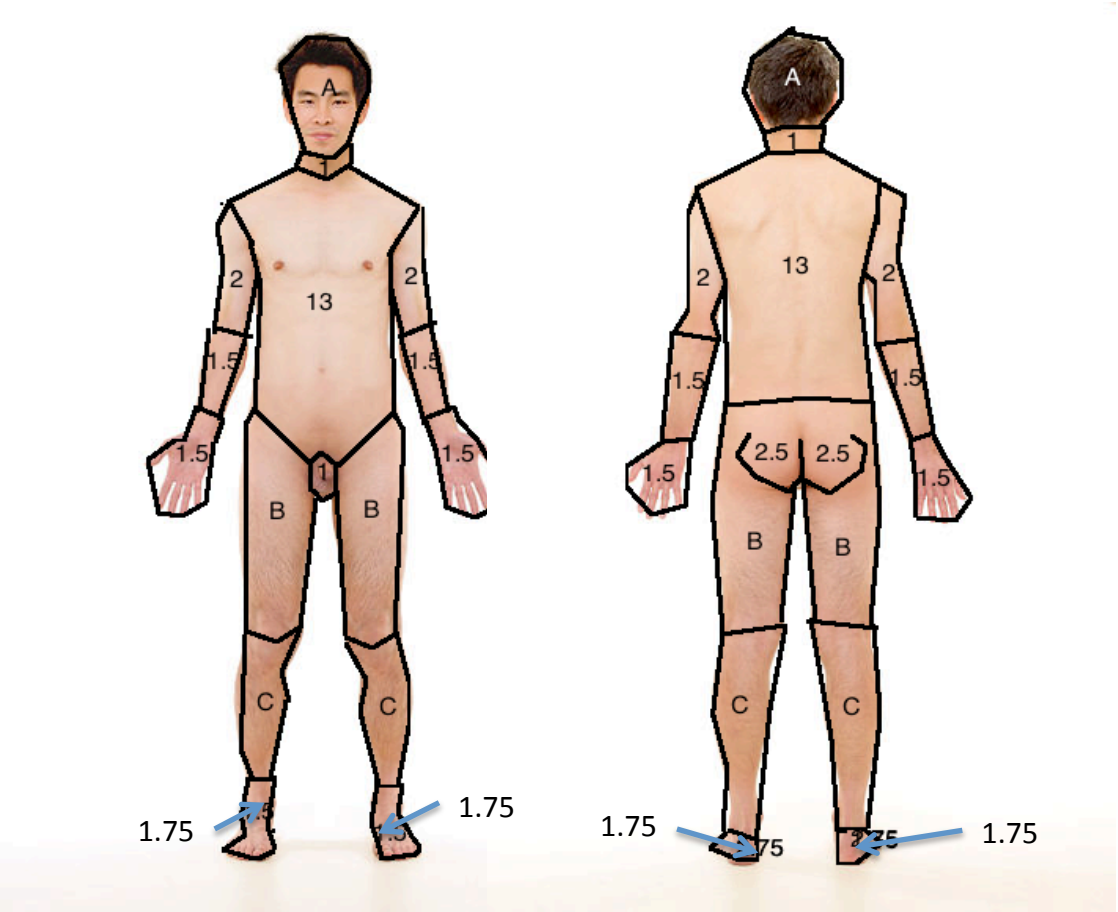
Lund Browder Chart



Age	0yr	1yr	5yr	10yr	15yr	Adult
A	9.5	8.5	6.5	5.5	4.5	3.5
B	2.75	3.25	4	4.5	4.5	4.75
C	2.5	2.5	2.75	3	3.25	3.5

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Superficial Thickness (1^{st} degree) Burns

- Involving only the epidermis
  - Most often likened to a sunburn
  - Characterized by erythematous changes, lack of blistering, and significant pain.
  - Wounds blanch easily.
  - Heals within 2 to 3 days following desquamation of dead cells.
  - Scarring is rare.
- SHOULD NOT BE INCLUDED IN ESTIMATE OF BURN SIZE.

Partial Thickness (2^{nd} degree) Burns

- **Superficial partial-thickness** burns involve the entire epidermis.
  - Often forms fluid-containing blisters at the dermal-epidermal junction.
  - Wounds are erythematous, wet appearing, painful, and blanch with pressure.
  - Wounds heal within 2 weeks without the need for skin grafting.

Partial Thickness (2^{nd} degree) Burns

- **Deep partial thickness** burns behave clinically like third-degree burns.
  - Blister base will have a mottled pink and white appearance due to partially damaged blood vessels.
  - Do not easily blanch and are less painful than superficial burns due to concomitant nerve injury.
- Risk for developing hypertrophic burn scars and/or contractures.

Full Thickness
(3rd degree) Burns

- Complete involvement of all skin layers
  - Wounds are white, cherry red, brown or black in color, and do not blanch with pressure.
  - Typically insensate from superficial nerve injury.
  - Require definitive surgical management.

Table 1. Assessment of burn wounds

	Superficial epidermal (eg. sunburn) First degree	Superficial dermal (partial) Second degree	Deep dermal thickness (partial) Second degree	Full thickness Third degree
Pathology	Involves epidermis only	Involves epidermis and upper dermis, most adnexal structures intact	Involves epidermis and significant part of dermis, only deeper adnexal structures intact	Epidermis, dermis and cell adnexal structures destroyed
Appearance	Dry and red, blanches to pressure No blistering	Pale pink, smaller blisters Wound base blanches with pressure	Blotchy red or pale deeper dermis where blisters have ruptured	White/waxy/charred No blisters No capillary refill
Sensation	May be painful	Increased sensation Very painful and tender	Decreased sensation	No sensation
Circulation	Normal, increased	Hyperaemic Rapid capillary refill	Sluggish capillary refill	No circulation
Colour	Red, warm	Pink	White/pale pink/ blotchy red	White/charred/black
Blisters	None or (days) later or desquamation	Yes (within hours of injury)	Early – usually large blisters which rupture rapidly and slough	Epidermis and dermis destroyed No blistering
Healing time	Within 7 days	7–14 days	Over 21 days	Does not heal spontaneously
Scarring	No scarring	Colour match defect. Low risk of hypertrophic scarring	High risk (up to 80%) hypertrophic scarring	Wound contraction Heals by secondary intention

PD-INEL

Cleland H. Thermal burns - assessment and acute management in the general practice setting. *Aust Fam Physician*. 2012;41(6):372–375.

For Small Burns <10%

- Blisters <6mm should be left intact
- Larger blisters should be debrided.
- Blisters that prevent proper movement of a joint or that are likely to rupture should be debrided.

- Cleansing and debridement:
  - Mild soap and water.
  - Chlorhexadine/normal saline washes.
- Scrubbing the wound is not recommended.

For Small Burns <10%

- Silver Sulfadiazine (Silvadene) is easy to apply.
  - However delays wound healing: direct toxic effect on keratinocytes.
- Other silver-impregnated dressings (Acticoat, Mepilex) provide the silver antimicrobial effect without trauma and with benefit of decreased dressing changes.
- Burns have significant exudate in the first 24-48°
  - Reassess burns 48° after injury.
  - Then can decrease frequency of dressing changes.

For Small Burns <10%

Table 3. Commonly Used Topical Medications and Wound Membranes

Name	*Type of therapy*	*Characteristics*
Bacitracin	Topical	Narrow antimicrobial coverage; inexpensive; painless; requires frequent dressing changes; can be used on face or near mucous membranes[1]
Mafenide acetate (Sulfamylon)	Topical	Broad-spectrum antimicrobial coverage; penetrates eschar; may delay healing or cause metabolic acidosis; used for deep burns[1,12]
Mupirocin (Bactroban)	Topical	Good gram-positive antimicrobial coverage; expensive; painless; requires frequent dressing changes; can be used on face[1]
SSD (Silvadene)	Topical	Broad-spectrum antimicrobial coverage; painless; requires frequent dressing changes; delays healing; stains tissue; used in deeper partial-thickness burns; relatively contraindicated in pregnant women, newborns, nursing mothers, and patients with glucose-6-phosphate dehydrogenase deficiency or sulfa allergy[1,6,12,24-26]
Aquacel Ag	Absorptive dressing	Silver impregnated; broad-spectrum antimicrobial coverage; decreases dressing changes; reduces pain; decreases use of pain medications; faster wound closure than with standard therapies[12,27]; decreased total cost compared with SSD[33]
Biobrane	Biocomposite dressing	Less pain and shorter time to healing than with SSD; expensive but lower total treatment cost compared with SSD[28-30]; one study showed effectiveness in superficial burns, but high failure rates with mid-dermal depth burns[34]
Hydrocolloids (Duoderm, Urgotul)	Absorptive dressing	Less pain and shorter time to wound closure than with SSD; good for weeping burns; malodorous; opaque[1,31,35]
Impregnated nonadherent gauze (Xeroform, Vaseline gauze)	Nonabsorptive dressing	No antimicrobial activity; messy; provides a nonadherent barrier over the burn for absorptive dressings; used for superficial burns[1]
Silicone (Mepitel)	Nonabsorptive dressing	Expensive; painless; allows seepage of exudates to secondary bandage[1]
Silver-impregnated dressing (Acticoat)	Nonabsorptive dressing	Delivers low concentrations of silver; broad-spectrum antimicrobial coverage; nonadherent; reduces pain; expensive[1,10,12,36]

PD-INEL

Lloyd ECO, et al. Outpatient burns: prevention and care. *Am Fam Physician*. 2012;85(1):25–32

When to Transfer to a Burn Center

- >10% TBSA partial thickness burns
- Any size full-thickness burns
- Burns to special areas of function or cosmesis
- Inhalation injury
- Serious chemical injury
- Electrical injury
- Burns with trauma where burns are the major problem
- Pediatric burns
- Smaller burns in patients with multiple comorbidities

Fluid Resuscitation Protocol

- Aim is to prevent burn shock
  - mixed hypovolemic and distributive shock.
- Challenge is to provide enough fluid without causing overload.

Fluid Resuscitation Protocol

- Large bore IVs away from burn sites.
- TBS >20% may require central line placement.
- Foley placement for close I/O monitoring.
- NG tube for early feeding and prevention of ileus or aspiration.

Fluid Resuscitation Protocol

- Heart rate and urine output are the primary modalities for monitoring adequate resuscitation.
- Arterial line placement becomes important as BP cuff readings may be inaccurate due to tissue edema.

Fluid Resuscitation Protocol

- For TBSA <20%, start maintenance IVF until tolerating adequate PO.
- For TBSA >20% + weight >30kg:
  - Start LR at 2-4mL * kg * TBSA
    - First half given over first 8 hours
    - Second half given over next 16 hours

Fluid Resuscitation Protocol

- Goal for resuscitation is measuring UOP
  - 0.5mL/kg/hr (30-50mL/hr)
- If unable to achieve goal UOP, increase LR infusion by 1/3 of hourly calculated fluid requirement.

Fluid Resuscitation Protocol

- Other fluids evaluated:
  - Colloids
    - No statistically significant improvement in mortality.
    - More expensive than crystalloid.
  - Hypertonic saline
- So far, Lactated Ringers is best.

Adjuncts to Resuscitation

- Tetanus toxoid
- Fluorescein test
- Nutritional support
- Steroids (Oxandralone)
- Prophylactic antibiotics - controversial

Burn Infections

- Prophylactic antibiotics:
  - Improves all-cause mortality but increases antibiotic resistance.

- 2 periods of wound colonization:
  - Initial few hours: gram-positive bacteria including Staphylococcus aureus and epidermidis.
  - By day 5: gut flora such as Pseudomonas aeruginosa, Enterobacter cloacae, and E. coli.

Complications of Resuscitation

- Inadequate resuscitation resulting in necrosis of viable tissue
- “Fluid creep” – approximately 6mL/kg!
- Increasing airway edema
- Infection, sepsis
- Hypothermia
- Compartment syndrome
- DVT
- Heparin-induced thrombocytopenia
- Neutropenia
- Stress ulcers
- Adrenal insufficiency

Assessment and treatment of inhalation injuries

- On physical exam, inspect for:
  - Soot in the oropharynx
  - Carbonaceous sputum
  - Singed nasal or facial hairs
  - Face or neck burns.

- **Inhalation injury may be present without cutaneous injury**

Assessment and treatment of inhalation injuries

- Signs of respiratory distress:
  - Wheezing
  - Stridor
  - Tachypnea
  - Hoarseness
  - Altered mental status, agitation, anxiety, or obtundation

Assessment and treatment of inhalation injuries

- Patients presenting with stridor should be intubated on presentation.
- Patients at risk of requiring early intubation include those with hx of being in an enclosed space, with/without facial burns, hx of LOC, carbonaceous sputum, voice change, or complaints of “lump in the throat.”

Assessment and treatment of inhalation injuries

1 b: Assessment of the inhalation trauma
A score of >3/11 suggest an inhalation injury to be present

1. Cause and location of injury, e.g. a fire or a gas explosion in a closed space
2. Hoarseness of the voice,
3. Dyspnea,
4. Fast, wheezy breathing,
5. Anxiety of the patient,
6. Darkened and/or carbon black sputum,
7. Facial burns,
8. Burned hair in the vestibule of the nose,
9. Bronchorrea,
10. Disorientation,
11. Conscience disorder, coma

Marek K, et al. Fibreoptic bronchoscopy in routine clinical practice in confirming the diagnosis and treatment of inhalation burns. *Burns*. 2007;33(5):554–560.

Assessment and treatment of inhalation injuries

- Significant cutaneous burns will likely require intubation.
  - Progressive respiratory failure upon completion of resuscitation.
  - Maintain elevated clinical suspicion for prompt diagnosis.
- Bronchoscopy = “gold standard” for evaluation of airway injury.
  - Does not predict mortality, although more severe findings correlate with higher probability of death.

Assessment and treatment of inhalation injuries

Grade	Class	Description
0	No injury	Absence of carbonaceous deposits, erythema, edema, bronchorrhea, or obstruction.
1	Mild injury	Minor or patchy areas of erythema, carbonaceous deposits in proximal or distal bronchi.
2	Moderate injury	Moderate degree of erythema, carbonaceous deposits, bronchorrhea, or bronchial obstruction.
3	Severe injury	Severe inflammation with friability, copious carbonaceous deposits, bronchorrhea, or obstruction.
4	Massive injury	Evidence of mucosal sloughing, necrosis, endoluminal obliteration

Assessment and treatment of inhalation injuries

- Carboxyhemoglobin taken within 1 hour of injury is strongly indicative of smoke inhalation if >10%.

Traumatic Burns

- Burns + Trauma = synergistic effect on mortality.
- 5-7% of multiply injured patients have concomitant burns.

Traumatic Burns

- Primary issues:
  - Destination of the patient: burn vs. trauma center
    - Ideally a combined Trauma/Burn center
  - Need to perform thorough 1° and 2° surveys - danger of missed injury in the burn patient
  - Orchestration of care:
    - Timing of fracture stabilization
    - Closed head injury: balance of burn fluid resuscitation and ICP management

Survival of Burns

- **Is the injury survivable?**
  - If so:
    - ABCs
    - Prevent organ damage (resuscitate)
    - Prevent wounds from progressing
    - Prevent wounds from infection
  - If not:
    - First Do No Harm

Predicting Survival

- **Baux score:** % Mortality = Age + % BSA burned
  - Point of futility was 100 for 100% mortality
    - This currently over-estimates mortality
    - We're better at treating burns now (burn center care, aggressive resuscitation, early excision, etc…)
- Modified mortality predictors
- Clinical judgment, "eyeball test"
- Patient and family wishes

Predicting Survival

- Age-Risk score – age and sex are important factors in predicting death
- FLAMES Score – age, sex, percent partial- and full-thickness burns, and initial APACHE II scores important determinants
- APACHE III-j score
- Frailty score
- Deliberate self-harm associated with higher mortality

Predicting Survival

Table 1 – Components of APACHE III-j score[a].

Age (years)
Chronic conditions
AIDS
Hepatic failure
Lymphoma
Metastatic cancer
Leukaemia/multiple myeloma
Immune suppression
Cirrhosis
Physiological parameters
Pulse
Mean BP
Neurological abnormalities
pH
Temperature
Respiratory rate
PaO_2
A-a gradient
Haematocrit
WBC
Creatinine
Urine output
BUN
Sodium
Albumin
Bilirubin
Glucose

[a] A weighting is given to each variable based on its degree of variation from normal which is then used to calculate the overall score. Highest and lowest values from the first 24 h are recorded.

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Moore EC, et al. A simple tool for mortality prediction in burns patients: APACHE III score and FTSA. *Burns*. 2010;36(7):1086–1091.

Predicting Survival

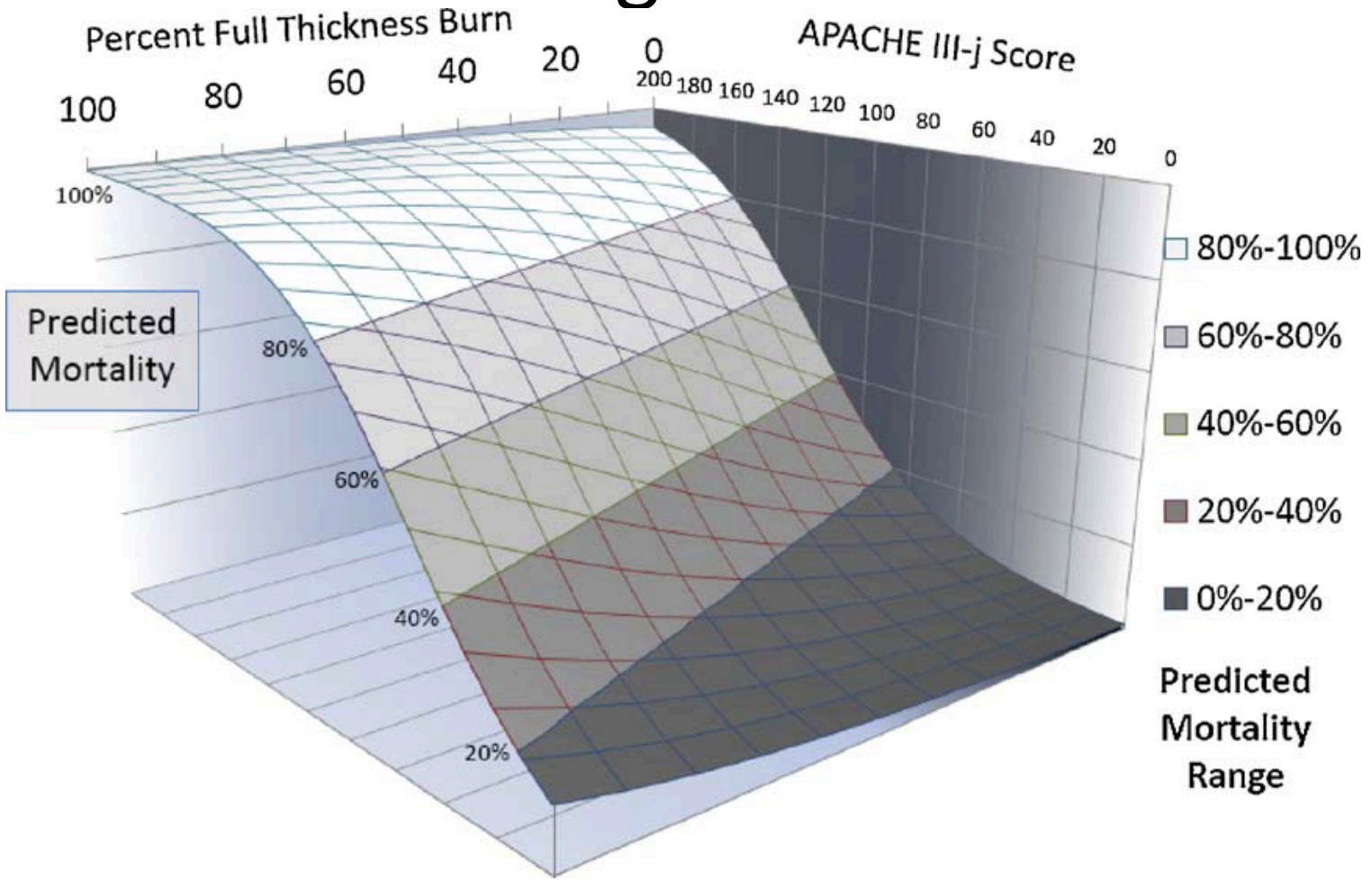

Fig. 2 – Mortality prediction model for burns patients. APACHE III-j score and % FTSA are shown on the x (horizontal right) and y (horizontal left) axes. Predicted mortality (derived from the APACHE III-j score and % FTSA) is shown on the z (vertical) axis.

Moore EC, et al. A simple tool for mortality prediction in burns patients: APACHE III score and FTSA. *Burns*. 2010;36(7):1086–1091.

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Predicting Survival

1	**Very fit**	robust, active, energetic, well motivated and fit; these people commonly exercise regularly and are in the most fit group for their age
2	**Well**	without active disease, but less fit than people in category 1
3	**Well, with treated comorbid disease**	disease symptoms are well controlled compared with those in category 4
4	**Apparently vulnerable**	although not frankly dependant these people commonly complain of being 'slowed up' or have disease symptoms
5	**Mildly frail**	with limited dependence on others for instrumental activities of daily living
6	**Moderately frail**	help is needed with both instrumental and non instrumental activities of daily living
7	**Severely frail**	completely dependent on others for the activities of daily living or terminally ill.

Fig. 1 – The Canadian Study of Health and Aging clinical frailty scale.

PD-INEL

Masud D, Norton S, Smailes S, et al. The use of a frailty scoring system for burns in the elderly. *Burns*. 2012.

Predicting Survival

- In children:
  - No significant co-morbidities.
  - 60% TBSA correlated to 10-fold increase in mortality.
  - Inhalational injuries had an additional 3x increase in mortality.

Predicting Survival

- **Ryan et al.** NEJM 1998
  - Retrospective review 1665 burn patients at two burn centers from 1990 to 1994
  - 3 risk factors identified:
    - Age >60
    - BSA burn >40%
    - Inhalational injury
  - Mortality per # of risk factors:

    0 – 0.3% 1 – 3% 2 – 33% 3 – 90%

Predicting Survival

- **Roberts et al.** J Trauma Acute Care Surg. Jan 2012
  - Retrospective review 11,109 burn patients at a regional burn center (UK) 1982-2008.
  - Divided into age and time cohorts
    - 1982-1991, 1992-2000, 2000-2008
  - 2000-2008 cohort
    - Point of futility (100% mortality): Baux score 160
    - $Baux_{50}$ (50% mortality): Baux score 109.6

Predicting Survival

- **Osler T, et al.** J Trauma. Mar 2010
  - Revised the Baux score to include inhalation injury
  - Tested with data on 39,888 patients from National Burn Registry
  - Inhalation injury = additional 17% mortality
  - **Modified Baux Score =**
    - Age + %TBSA + 17*(Inhalation Injury)

      Inhalation Injury: 1 = Yes 0 = No

Predicting Survival

- Patient EH:
  - Age 69
  - 75% TBSA
  - Inhalation injury = 1 * (17)
    - Traditional Baux Score: 144
    - Modified Baux Score: 161

Withdrawal of Care

- Must consider:
  - Extent/depth of injury
  - Comorbid conditions (biologic vs. chronologic age)
  - Barriers to recovery
  - Anticipated quality of life
  - Trajectory for recovery
- Discuss with patient/surrogate

Withdrawal of Care

- Comfort Care Measures
  - Adequate sedation and analgesia (does not hasten death!)
  - Discontinue any measures that do no provide comfort (including monitors, nutrition, enteral feeds, IVF, ETT)

Summary

- Patient EH
- 69 y.o. F, 75% TBSA burns
- Outcome:
  - initiation of comfort care, death

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