Burn Resuscitation Formulas

John P. Sabra, MD
Seton Surgical Group
Department of Surgery
Dell Medical School
Austin, TX
Figure 9: Burn Size Group (% TBSA)

Total N = 177,498 (Excluding 27,535 Unknown/Missing)
<table>
<thead>
<tr>
<th>%TBSA</th>
<th>Lived Cases</th>
<th>Died Cases</th>
<th>Mortality Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 - 9.9</td>
<td>133,958</td>
<td>849</td>
<td>0.6</td>
</tr>
<tr>
<td>10 - 19.9</td>
<td>24,850</td>
<td>698</td>
<td>2.7</td>
</tr>
<tr>
<td>20 - 29.9</td>
<td>7,003</td>
<td>660</td>
<td>8.6</td>
</tr>
<tr>
<td>30 - 39.9</td>
<td>2,951</td>
<td>598</td>
<td>16.8</td>
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<tr>
<td>40 - 49.9</td>
<td>1,474</td>
<td>578</td>
<td>28.2</td>
</tr>
<tr>
<td>50 - 59.9</td>
<td>760</td>
<td>461</td>
<td>37.8</td>
</tr>
<tr>
<td>60 - 69.9</td>
<td>469</td>
<td>419</td>
<td>47.2</td>
</tr>
<tr>
<td>70 - 79.9</td>
<td>261</td>
<td>345</td>
<td>56.9</td>
</tr>
<tr>
<td>80 - 89.9</td>
<td>121</td>
<td>433</td>
<td>78.2</td>
</tr>
<tr>
<td>&gt; 90</td>
<td>75</td>
<td>535</td>
<td>87.7</td>
</tr>
</tbody>
</table>

**Subtotal** | 171,922 | 5,576 | 3.1 |
**Missing or 0%** | 26,447 | 1,088 | 4.0 |
**TOTAL** | 198,369 | 6,664 | 3.3 |

Total N=205,033
Major Burns (ABA Criteria)

- >10% TBSA partial thickness burns
- Full thickness burns in any age group
- Face, hands, feet, buttocks or major joints
- Inhalation or traumatic injury
- Significant electrical or chemical burns
- Preexisting diseases affecting therapy
- Patients with psycho/social problems
Physiologic Change

% TBSA burn

BURN INJURY

% Physiologic Change

% TBSA burn
Stasis

Epidermis
Dermis
Subcutaneous Layer

Hyperemia

Coagulation
BURN

↑ VASCULAR PERMEABILITY

↑↑ EDEMA

↓ BLOOD (PLASMA & VISCOSITY ECF) VOLUME

↑ PERIPHERAL RESISTANCE

↓ CARDIAC OUTPUT

↑ HEMATOCRIT
PATHOPHYSIOLOGY OF BURN EDEMA

↓ Plasma-interstitial oncotic pr

Pressure Gradient ↓ Interstitial Protein

Hypoproteinemia

↓

EDEMA
Systemic Effects of Burn Injury

• Magnitude & duration of response proportional to extent of surface burned

• Hypovolemia
  • Decreased perfusion & oxygen delivery

• Corrected with adequate fluid resuscitation
  • Prevent shock & organ failure
Shock & Fluid Resuscitation Goal

- To maintain vital organ function while avoiding the complications of inadequate or excessive therapy
Under Resuscitation

- Shock
- Organ failure
- Death
Over-Resuscitation

- Compartment syndromes
- Cerebral edema
- Pulmonary edema

[Image of a medical setting]
HOW MUCH IS TOO MUCH?

LIKE MANY ARGUMENTS

THE TRUTH IS SOMEWHERE IN THE MIDDLE
The Phenomenon of “Fluid Creep” in Acute Burn Resuscitation

Jeffrey R. Saffle, MD, FACS

Several reports have documented that modern burn patients receive far more resuscitation fluid than predicted by the Parkland formula—a phenomenon termed “fluid creep.” This article reviews the incidence, consequences, and possible etiologies of fluid creep in modern practice and uses this information to propose some therapeutic strategies to reduce or eliminate excessive fluid resuscitation in burn care. A literature review was performed of historical references that form the foundation of modern fluid resuscitation, as well as reports of fluid creep and its consequences. The original Parkland formula required a 24-hour volume of 4 ml/kg/%TBSA lactated Ringer’s solution followed by an infusion of 0.3–0.5 ml/kg/%TBSA plasma. Modern iterations of this formula have omitted the colloid bolus. Numerous exceptions to the formula have been noted, most consistently patients with inhalation injuries. In contrast, recent reports document greatly increased fluid requirements in unselected patients, which seems to consist largely of progressive edema formation in unburned areas, increasing after the first 8 hours post-burn. This has been linked to occurrence of the abdominal compartment syndrome and other serious complications. Strategies to reduce fluid creep include the avoidance of early overresuscitation, use of colloid as a routine component of resuscitation or for “rescue,” and adherence to protocols for fluid resuscitation. Fluid creep is a significant problem in modern burn care. Review of original investigations of burn shock, coupled with modern reports of fluid creep, suggests several mechanisms by which this problem can be controlled. Prospective trials of these therapies are needed to confirm their effectiveness. (J Burn Care Res 2007;28:382–395)
Dr. Haldor Sneve 1905

“...patient is exposed to death first from shock.”

- Oral and IV salt solutions recommended

**OPEN TREATMENT FOR BURNS**

To the Editor:—Please explain what is meant by the “open treatment for burns”; what are its advantages and how is it carried out? Is my understanding correct that absolutely nothing is put on the burn—that it is merely washed and left open to heal?

   E. S. Dupuy, M.D., Summerlee, W. Va.

Answer.—The uncovered skin is left exposed to the air, blebs are removed, the area gently dried, dusted with stearate of zinc or other bland-dusting powder, and fanned to hasten drying and the formation of crusts. The unburned portion of the surface should be bathed and cleansed often, and the temperature of the room should be high in order to favor the action of the skin. The air must be kept as pure as possible and the utmost cleanliness maintained about the bed linen and everything else that comes in contact with the patient to guard against infection. The patient is quickly relieved of pain by this method of treatment.

The question was answered in this department of The Journal, Aug. 18, 1906, p. 529, and Sept. 22, 1911, p. 1076, but an article by Dr. Haldor Sneve of St. Paul, July 1, 1905, p. 1, took the matter up in detail. There was an editorial comment in the same issue, page 48.
EXPERIMENTAL SHOCK

XII. A STUDY OF THE EFFECTS OF HEMORRHAGE, OF TRAUMA TO MUSCLES, OF TRAUMA TO THE INTESTINES, OF BURNS AND OF HISTAMINE ON THE CARDIAC OUTPUT AND ON BLOOD PRESSURE OF DOGS *

G. S. JOHNSON, M.D.
AND
ALFRED BLALOCK, M.D.
NASHVILLE, TENN.

In a previous study by one of us (Dr. Blalock *) the effects of graded hemorrhages on the cardiac output and blood pressure were determined. In experiments on dogs anesthetized with morphine it was found that the repeated removal of blood is usually associated with a decline in the cardiac output from 30 to 50 per cent below the normal level before a marked diminution in the mean blood pressure occurs. In subsequent experiments it was found that the loss of blood into the injured area after trauma to an extremity was instituted was sufficient to account for the decline in the blood pressure. Mild trauma to an extremity, trauma to the intestines and burns were studied, and the results indicated that the loss of plasma into the injured area was the chief if not the sole cause of the sustained low blood pressure that resulted. Evidence indicating that the decline in blood pressure in these experiments was due to a histamine-like substance was not found. It was believed that additional evidence as to the initiating agent in shock might be obtained from comparative studies on the effects of hemorrhage, of trauma and of histamine on the cardiac output and blood pressure. It was for this purpose that these studies were performed.

METHODS AND RESULTS

Dogs were used in all the experiments. Sodium barbital (0.3 Gm. per kilogram of body weight administered intravenously) was employed

* Submitted for publication, Jan. 27, 1931.
* From the Department of Surgery, Vanderbilt University.
408 DEAD, 350 INJURED IN FIRE AT COCOANUT GROVE

Gay Boston Night Club Turns Into Scene of Horror as Flames Engulf Structure—Starts Stampede to Escape—Hundreds Trapped at Exits—Resort Filled With Nearly 1000 Patrons—Many Holding Parties After B.C. Game

LIST OF DEAD

Dead Are Evenly Divided Among Men and Women—Many Service Men

Dead Start Thursday in 'Melody Bar'—Smoke

- Confirmed relationship between edema and shock in humans
- First to suggest that resuscitation should be both TBSA% AND weight
DR. CP Artz (San Antonio)

Brooke formula
• 1.5 cc + colloid
Burn Shock - 30% Flame Burns
No Treatment

Cardiac Output %
Control

Hours Post-Burn

Cc

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>Burn</th>
<th>1/2</th>
<th>4</th>
<th>18</th>
</tr>
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<tr>
<td>Hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Plasma</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PLASMA VOLUME CHANGES IN 30-50% BURNS

% NORMAL PLASMA VOLUME

Plasma at 24 hr

R/L only

500 cc Plasma

HOURS POST BURNS

0 12 24 36 48
<table>
<thead>
<tr>
<th>Year</th>
<th>Formula Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1942</td>
<td>Harkins formula</td>
<td>Any patient with at least a 10% burn: administer 1000 cm³ plasma for each 10% total surface area burn over first 24 h.</td>
</tr>
<tr>
<td>1947</td>
<td>Body-Weight Burn Budget</td>
<td>First 24 h: 1–4 LLR + 1200 ml 0.5 NS + 7.5% body weight colloid + 1.5–5 l D₅W. For second 24 h: same formulation except change colloid to 2.5% body weight.</td>
</tr>
<tr>
<td>1952</td>
<td>Evan's formula</td>
<td>First 24 h: NS at 1 ml/kg/% burn + colloids at 1 ml/kg/% burn + plus 2000 ml glucose in water. Second 24 h: one-half the first 24 h crystalloid and colloid req. + the same amount of glucose in water as in the first 24 h.</td>
</tr>
<tr>
<td>1953</td>
<td>Brooke formula</td>
<td>First 24 h: LR at 1.5 ml/kg/% TBSA burn + colloid at 0.5 ml/kg/% TBSA burn. Second 24 h: switch to D5W 2000 ml.</td>
</tr>
<tr>
<td>1974</td>
<td>Formula</td>
<td>First 24 h: LR at 4 ml/kg/% TBSA; give half in first 8 h and the remaining over next 16 h. Second 24 h: colloid at 20–60% of calculated plasma volume to maintain adequate urinary output.</td>
</tr>
<tr>
<td>1979</td>
<td>Modified Brooke</td>
<td>First 24 h: LR at 2 ml/kg/% TBSA burn, one half in the first 8 h and half in the remaining 16 h. Second 24 h: colloid at 0.3–0.5 ml/kg/% TBSA burn + D5W to maintain urine output.</td>
</tr>
<tr>
<td>1984</td>
<td>Monafo formula</td>
<td>First 24 h: saline with 250 mequiv. Na + 150 mequiv. lactate + 100 mequiv. Cl. Rate adjusted per urine output. Second 24 h: one third of isotonic salt administered orally.</td>
</tr>
</tbody>
</table>
Resuscitation

FIGURE 3. An example calculation using the Parkland formula nomogram for pediatric burns.

<table>
<thead>
<tr>
<th>CRYSTALLOID</th>
<th>COLLOID</th>
<th>HYPERTONIC SALINE</th>
<th>DEXTRAN</th>
</tr>
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<tbody>
<tr>
<td>Parkland</td>
<td>Evan’s</td>
<td>Monofo</td>
<td>Denaling</td>
</tr>
<tr>
<td>Modified Brooke</td>
<td>Brooke</td>
<td>Warden</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slater</td>
</tr>
</tbody>
</table>

None is absolute — ultimate resuscitation is conditional.
Any formula is only an estimate of fluid needs
## Initial Burn Chart

### Percent surface area burned (Berkow formula)

<table>
<thead>
<tr>
<th>Area</th>
<th>1 Year</th>
<th>1-4 Years</th>
<th>5-9 Years</th>
<th>10-14 Years</th>
<th>Y 15 Years</th>
<th>Adult</th>
<th>Shallow</th>
<th>Indeterminate of deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>19</td>
<td>17</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ant. Trunk</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post. Trunk</td>
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<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Buttock</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Buttock</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genitalia</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R.U. Arm</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.U. Arm</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. L. Arm</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. L. Arm</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Hand</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td></td>
<td></td>
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<tr>
<td>L. Hand</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td></td>
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</tr>
<tr>
<td>R. Thigh</td>
<td>5.5</td>
<td>6.5</td>
<td>8</td>
<td>8.5</td>
<td>9</td>
<td>9.5</td>
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<td></td>
</tr>
<tr>
<td>L. Thigh</td>
<td>5.5</td>
<td>6.5</td>
<td>8</td>
<td>8.5</td>
<td>9</td>
<td>9.5</td>
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<tr>
<td>R. Leg</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>6.5</td>
<td>6.5</td>
<td>7</td>
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</tr>
<tr>
<td>L. Leg</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>6.5</td>
<td>6.5</td>
<td>7</td>
<td></td>
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<tr>
<td>R. Foot</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Foot</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

- **Shallow**: (pink, painful, moist)
- **Indeterminate or deep**: (dry, less sensation, white, mottled, dark red, brown or black, leathery.)
Add 1/2% to each leg for each year over age 1

Subtract 1% from the head area for each year over age 1

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Resuscitation Fluid Needs

- Related to:
  - extent of burn (rule of nines)
  - body size (pre-injury weight estimate)

- Delivered through large bore peripheral IV
  - Attempt to avoid overlying burned skin
  - Can use venous cut down or central line
Resuscitation Fluid Needs: First 24 Hours

- Parkland Formula:
  - Adults: \(2-4 \text{ ml RL} \times \text{Kg body weight} \times \% \text{ burn}\)
  - Children: \(3-4 \text{ ml RL} \times \text{Kg body weight} \times \% \text{ burn}\)

- First half of volume over first 8 hours, second half over following 16 hours
  - Hypovolemia, decreased CO
  - Increased capillary permeability
  - Crystalloid fluid is keystone, colloid not useful
Resuscitation Fluid Needs: Second 24 Hours

- Capillary permeability gradually returns to normal
- Colloid fluids started to minimize volume
  - Only necessary in patients with large burns (greater than 30% TBSA)
  - 0.5 ml of 5% albumin x Kg body weight x % burn
Monitoring of Resuscitation

- Actual volume infused will vary from calculates according to physiologic monitoring

- Optimal regimen:
  - minimizes volume & salt loading
  - prevents acute renal failure
  - low incidence of pulmonary & cerebral edema
Monitoring of Resuscitation

- Urinary output is a reliable guide to end organ perfusion
  - Adults: 30-50 ml per hour
  - Children (less than 30 Kg): 1 ml/Kg per hour

- Infusion rate should be increased or decreased by 1/3 if u/o falls or exceeds limits by more than 1/3
Monitoring Resuscitation

- Blood pressure:
  - Can be misleading due to progressive edema & vasoconstriction

- Heart Rate:
  - Tachycardia commonly observed

- Hemoglobin & hematocrit:
  - Not a reliable guide
  - Transfusion not to be used for resuscitation
Fluid Resuscitation in the Pediatric Patient

- Require greater amounts of fluid
  - Greater surface area per unit body mass

- More sensitive to fluid overload
  - Lesser intravascular volume per unit surface area burned
MASSIVE SODIUM ADMINISTRATION IS THE COMMON DENOMINATOR IN ALL RESUSCITATION FORMULAE

Example: 70 kg, 40% TBSA burn
total fluid in 48 hrs

Evans formula 12,400cc
Brooke 12,400cc
PMH 13,200cc
<table>
<thead>
<tr>
<th>Area</th>
<th>Water Loss (gm/M²/24 hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Skin</td>
<td>204</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; degree burn</td>
<td>278</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; degree burn</td>
<td>4274</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; degree burn</td>
<td>3436</td>
</tr>
<tr>
<td>Granulating wound</td>
<td>5138</td>
</tr>
<tr>
<td>Donor site</td>
<td>3590</td>
</tr>
</tbody>
</table>
Normal transcutaneous water loss is usually $< 15 \text{ ml/m}^2\text{.hr}$. Severe burn wound fluid losses are approximately $150 \text{ ml/m}^2\text{.hr}$ & can account to 4 to 6 L/day in moderate to severe burns.

Resuscitation Fluid Needs: Second 24 Hours

- Capillary permeability gradually returns to normal
- Colloid fluids started to minimize volume
  - Only necessary in patients with large burns (greater than 30% TBSA)
  - 0.5 ml of 5% albumin x Kg body weight x % burn
<table>
<thead>
<tr>
<th>Formula</th>
<th>Electrolyte</th>
<th>Colloid</th>
<th>D5W</th>
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</thead>
<tbody>
<tr>
<td>Evans</td>
<td>NS 1ml/kg/%</td>
<td>1ml/kg/%</td>
<td>2L</td>
</tr>
<tr>
<td>Brooke</td>
<td>LR 1.5L/kg/%</td>
<td>.5ml/kg/%</td>
<td>2L</td>
</tr>
<tr>
<td>PMH</td>
<td>LR 4ml/kg/%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shrine</td>
<td>5L/m² TBSA RL + 2L RL/m² BSA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Galveston</td>
<td>12.5gm albumin in 1st 8 hrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cincinnati</td>
<td>4ml RL/kg/% burn + 1.5L/m² BSA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 mEq NaHCO₃ for 8 hrs + 12.5 gms albumin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**RESUSCITATION Pearls**

**URINE OUTPUT:**
- Adult: 0.05-1 cc/kg/hr
- Pedi: 1 cc/kg/hr

**Colloid:** 25% Albumin - COP of 70 mmHg
- Vol. expansion: 100cc-500cc
- 5% - COP of 20 mmHg
- Vol. expansion: about cc/cc


Base deficit: at 24 hrs pb, a BD ± 2 reflects adequate fluid resuscitation.
ABA 2008 consensus statement:

*Maximum*: Parkland formula 4 cc

*Minimum*: Modified Brooke formula 2 cc
Burn resuscitation: The results of the ISBI/ABA survey

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Shock
Burns

ABSTRACT

Introduction: There are valid concerns that burn shock resuscitation is inadequate; a tendency to over-resuscitate the patient seems to exist which may increase complications such as compartment syndrome. The purpose of this study was to survey members of the ISBI and ABA to determine current practices of burn resuscitation.

Methods: A survey asking for practices of burn shock resuscitation was provided to all participants of a recent ABA meeting. Around the same time, the survey was sent to all members of the ISBI through the internet. The results of the 101 respondents (ABA – 59, ISBI – 42, approximately a 15% response rate) are described.

Results: Surveys were returned from all the continents except Africa. Respondents included directors (48%), staff physicians (19%), nurses (23%) and others. Most programs admitted adults (87%) and children (75%) with a mean of 289 admissions per year. The cut off to initiate resuscitation was 15% TBSA and most preferred peripheral IVs (70%) and central lines (47.5%). The Parkland formula was preferred (69.3%) while others were used: Brooke – 6.9%, Galveston – 8.9%, Warden – 5.9%, and colloid 11.9%. Lactated Ringer’s (LR) was the preferred solution (91.9%), followed by normal saline – 5%, hypertonic saline – 4%, albumin – 20.8%, FFP – 13.9%, and LR/NaHCO3 – 12.9%. Approximately half (49.5%) added colloid before 24 h. Urine output is the major indicator of success (94.9%) while 22.7% use other monitors. Most (88.8%) feel their protocols work well with 69.8% feel that it provides the right amount of fluid (24% – too much, 7% – too little). Despite this feeling, they still feel that they give more fluid than the formula in 55.1%, less than formula in 12.4% and the right amount in 32.6%. Approximately 1/3 use an oral resuscitation formula and 81.8% feel that an oral formula works for burns < 15% TBSA.

Conclusion: Large variations exist in resuscitation protocols but the Parkland formula using LR is still the dominant method. Most feel that their resuscitation protocol works well.

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Burn Resuscitation Index: A Simple Method For Calculating Fluid Resuscitation in the Burn Patient

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The Parkland formula is the standard for calculating the initial intravenous fluid rate for resuscitation after thermal injury. However, it is cumbersome when used by those with modest burn training. We propose an easier method to calculate fluid requirements that can be initiated by first-line providers. Burn size is estimated by using the Burn Size Score (BSS), which is then crossreferenced with the patient’s weight on a preprinted Burn Resuscitation Index (BRI), based on the Parkland formula, to determine initial hourly fluid rate. Seventy-two residents and faculty in the Departments of Surgery and Emergency Medicine were surveyed. Participants were shown a diagram of a burn patient and asked to calculate the initial fluid rate using the Parkland formula from memory. The study was repeated with a different diagram, and the participants were asked to calculate the initial fluid rate using the BRI (a preprinted card with written instruction pertaining to its use). Statistical analysis was performed with the McNemar test. Using the Parkland formula, 33% of surgeons and 17% of emergency medicine physicians were able to calculate the initial fluid rate. Using the BRI, 56% of surgeons and 77% of emergency medicine physicians were able to calculate the fluid rate correctly ($P < .01$ and $P < .001$, respectively). Fifty-four percent of physicians surveyed believed that the BRI was easier to use. The accuracy of determining initial fluid rate was low using the Parkland formula and “rule of nines” from memory. Accuracy increased when the BRI was used. The BRI serves as a visual aid and provides some instruction, allowing the user to calculate fluid resuscitation with greater accuracy than with rote memorization of a formula. The BRI might be a useful tool for providers with minimal burn training. However, further investigation is warranted. (J Burn Care Res 2010;31:616–623)

- 198 ED physicians (US & UK)
- Recall and apply a “standard formula”
- 33% and 4% successful recall
“Rule of Ten” (USAIR San Antonio)

• %TBSA x 10 = initial fluid rate in cc’s

• >80kg add 100cc/10kg
Future

- Continuously monitored feedback

Fig. 3 – Computer interface of resuscitation decision support system from USAISR.