Fluid Resuscitation and Monitoring in Sepsis

Deepa Gotur, MD, FCCP
Anne Rain T. Brown, PharmD, BCPS
Learning Objectives

• Compare and contrast fluid resuscitation strategies in septic shock
• Discuss available fluid resuscitation monitoring tools used to guide therapy
• Review literature surrounding protocol based sepsis management
Disclosures

• I have no conflicts of interest or disclosures as they relate to this presentation
Protocol Based Management is BETTER

CON Perspective
• 2001 results published in NEJM
• Revolutionary 6-hour resuscitation bundle
  • Administration of intravenous fluids, vasopressors, inotropes, and red cell transfusions
• EGDT reduced hospital mortality by 26%
• Prompted world-wide adoption of EGDT

Early Goal Directed Therapy: A Concept

• EGDT provides us with a construct on how to understand resuscitation
  • **Start EARLY**
    • Detection and Risk Stratification
  • **Give ANTIBIOTICS**
    • Within the first hour
  • **Restore PERFUSION PRESSURE**
    • In some patients, a little more or less may be required!

• These concepts are still important today

3 Hour Bundles Emphasize EGDT

TO BE COMPLETED WITHIN 3 HOURS:

1) Measure lactate level
2) Obtain blood cultures prior to administration of antibiotics
3) Administer broad spectrum antibiotics
4) Administer 30 ml/kg crystalloid for hypotension or lactate ≥ 4 mmol/L
Antimicrobials and Survival in Septic Shock

Figure 1. Cumulative effective antimicrobial initiation following onset of septic shock-associated hypotension and associated survival. The x-axis represents time (hrs) following first documentation of septic shock-associated hypotension. Black bars represent the fraction of patients surviving to hospital discharge for effective therapy initiated within the given time interval. The gray bars represent the cumulative fraction of patients having received effective antimicrobials at any given time point.
Examined the impact of timing of fluid resuscitation in 11,182 septic patients at 9 tertiary and community hospitals

Fluid initiation in less than 30 and 31-120 minutes compared to > 120 minutes was associated with significantly lower:

- Hospital mortality
- Mechanical ventilation
- ICU admission
- ICU days
- Hospital length of stay
## Timeliness of Initial Crystalloid Resuscitation

<table>
<thead>
<tr>
<th><strong>Primary Outcome</strong></th>
<th><strong>Secondary Outcomes</strong></th>
<th><strong>Outcome Less Likely</strong></th>
<th><strong>Outcome More Likely</strong></th>
<th><strong>Effect Size</strong></th>
<th><strong>95% CI</strong></th>
<th><strong>p-value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In-Hospital Death</strong></td>
<td><strong>Mechanical Ventilation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to Fluid Initiation</td>
<td>Time to Fluid Initiation</td>
<td>≤ 30 Minutes</td>
<td>≤ 30 Minutes</td>
<td>0.76</td>
<td>0.64</td>
<td>0.80</td>
</tr>
<tr>
<td>31-120 Minutes</td>
<td>31-120 Minutes</td>
<td>0.75</td>
<td>0.62</td>
<td>0.62</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>Volume in First 6 Hours</td>
<td>Volume in First 6 Hours</td>
<td>None or &lt; 5 mL/kg</td>
<td>None or &lt; 5 mL/kg</td>
<td>1.10</td>
<td>0.88</td>
<td>1.35</td>
</tr>
<tr>
<td>5-19 mL/kg</td>
<td>5-19 mL/kg</td>
<td>1.13</td>
<td>0.97</td>
<td>1.30</td>
<td>0.12</td>
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<tr>
<td>&gt; 35mL/kg</td>
<td>&gt; 35mL/kg</td>
<td>1.18</td>
<td>1.02</td>
<td>1.37</td>
<td>0.022</td>
<td></td>
</tr>
<tr>
<td><strong>ICU Admission</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to Fluid Initiation</td>
<td></td>
<td>≤ 30 Minutes</td>
<td>≤ 30 Minutes</td>
<td>0.66</td>
<td>0.57</td>
<td>0.77</td>
</tr>
<tr>
<td>31-120 Minutes</td>
<td>31-120 Minutes</td>
<td>0.73</td>
<td>0.62</td>
<td>0.67</td>
<td>0.001</td>
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<tr>
<td>Volume in First 6 Hours</td>
<td>Volume in First 6 Hours</td>
<td>None or &lt; 5 mL/kg</td>
<td>None or &lt; 5 mL/kg</td>
<td>1.45</td>
<td>1.26</td>
<td>1.76</td>
</tr>
<tr>
<td>5-19 mL/kg</td>
<td>5-19 mL/kg</td>
<td>1.14</td>
<td>1.06</td>
<td>1.31</td>
<td>0.046</td>
<td></td>
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<tr>
<td>&gt; 35mL/kg</td>
<td>&gt; 35mL/kg</td>
<td>1.10</td>
<td>0.96</td>
<td>1.25</td>
<td>0.17</td>
<td></td>
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<tr>
<td><strong>Hospital Length-of-Stay</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to Fluid Initiation</td>
<td></td>
<td>≤ 30 Minutes</td>
<td>≤ 30 Minutes</td>
<td>0.68</td>
<td>0.59</td>
<td>0.79</td>
</tr>
<tr>
<td>31-120 Minutes</td>
<td>31-120 Minutes</td>
<td>0.66</td>
<td>0.57</td>
<td>0.77</td>
<td>0.001</td>
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<tr>
<td>Volume in First 6 Hours</td>
<td>Volume in First 6 Hours</td>
<td>None or &lt; 5 mL/kg</td>
<td>None or &lt; 5 mL/kg</td>
<td>1.21</td>
<td>1.02</td>
<td>1.44</td>
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<tr>
<td>5-19 mL/kg</td>
<td>5-19 mL/kg</td>
<td>0.99</td>
<td>0.88</td>
<td>1.11</td>
<td>0.68</td>
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<tr>
<td>&gt; 35mL/kg</td>
<td>&gt; 35mL/kg</td>
<td>1.27</td>
<td>1.08</td>
<td>1.57</td>
<td>0.001</td>
<td></td>
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<tr>
<td><strong>Total ICU Days</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to Fluid Initiation</td>
<td></td>
<td>≤ 30 Minutes</td>
<td>≤ 30 Minutes</td>
<td>0.86</td>
<td>0.70</td>
<td>1.03</td>
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<tr>
<td>31-120 Minutes</td>
<td>31-120 Minutes</td>
<td>0.87</td>
<td>0.75</td>
<td>0.91</td>
<td>0.001</td>
<td></td>
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<tr>
<td>Volume in First 6 Hours</td>
<td>Volume in First 6 Hours</td>
<td>None or &lt; 5 mL/kg</td>
<td>None or &lt; 5 mL/kg</td>
<td>1.24</td>
<td>1.13</td>
<td>1.40</td>
</tr>
<tr>
<td>5-19 mL/kg</td>
<td>5-19 mL/kg</td>
<td>1.15</td>
<td>1.02</td>
<td>1.38</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>&gt; 35mL/kg</td>
<td>&gt; 35mL/kg</td>
<td>1.06</td>
<td>0.94</td>
<td>1.22</td>
<td>0.079</td>
<td></td>
</tr>
</tbody>
</table>

Leisman et al. Crit Care Med 2017;45:1596-1606
Early Antimicrobials and Fluid

- EGDT set the stage for timely antibiotics and giving enough fluid

<table>
<thead>
<tr>
<th></th>
<th>RIVERS</th>
<th>ProCESS</th>
<th>ARISE</th>
<th>PROMISE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EGDT</td>
<td>Standard</td>
<td>EGDT Protocol</td>
<td>Usual Care</td>
</tr>
<tr>
<td>Baseline IV fluids</td>
<td>20-30 mL/kg</td>
<td>30.5 mL/kg</td>
<td>29.2 mL/kg</td>
<td>28 mL/kg</td>
</tr>
<tr>
<td>mL Fluids administered 0 – 6 hours</td>
<td>4981 ± 2984</td>
<td>3499 ± 2438</td>
<td>2805 ± 1957*</td>
<td>3285 ± 1743*</td>
</tr>
<tr>
<td>Time to Antimicrobials</td>
<td>--</td>
<td>--</td>
<td>Time to randomization 187 min</td>
<td>70 minutes (38-114)</td>
</tr>
<tr>
<td>Antimicrobial administration</td>
<td>89% within 6 hours</td>
<td>76% pre-randomization 97% within 6 hours</td>
<td>100% pre-randomization</td>
<td>100% pre-randomization</td>
</tr>
<tr>
<td>APACHE II</td>
<td>21.4</td>
<td>20.4</td>
<td>20.8</td>
<td>20.6</td>
</tr>
<tr>
<td>CVC</td>
<td>100%</td>
<td>100%</td>
<td>93.6%</td>
<td>56.5%</td>
</tr>
<tr>
<td>Mechanical Ventilation 0-72</td>
<td>55.6%</td>
<td>70.6%</td>
<td>36.2%</td>
<td>34.1%</td>
</tr>
</tbody>
</table>
Compliance with Protocols Improves Quality of Care

**TABLE 2. Patient Clinical Characteristics Across Low- and High-Compliance Sites for Resuscitation Bundle**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Low compliance resuscitation</th>
<th>High compliance resuscitation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n = 11,609 ) (39.0%)</td>
<td>( n = 17,681 ) (61.0%)</td>
<td>( n = 29,470 )</td>
</tr>
<tr>
<td>Nosocomial infection</td>
<td>3,389</td>
<td>4,138</td>
<td>7,527</td>
</tr>
<tr>
<td>Septic shock</td>
<td>7,635</td>
<td>10,823</td>
<td>18,458</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Median</th>
<th>IQR</th>
<th>Median</th>
<th>IQR</th>
<th>Median</th>
<th>IQR</th>
<th>( p^* )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis severity score</td>
<td>58</td>
<td>42–74</td>
<td>51</td>
<td>36–67</td>
<td>53</td>
<td>37–69</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Hospital LOS, days</td>
<td>15</td>
<td>7.4–29</td>
<td>12</td>
<td>6.4–23</td>
<td>13</td>
<td>6.8–26</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>ICU LOS, days</td>
<td>6.4</td>
<td>2.9–14</td>
<td>4.6</td>
<td>2.0–9.8</td>
<td>5.1</td>
<td>2.5–11</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>LOS prior to ICU, days</td>
<td>0.28</td>
<td>0.05–2.2</td>
<td>0.17</td>
<td>0.04–1.1</td>
<td>0.2</td>
<td>0.05–1.4</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Compliance with Protocols Improves Mortality

Figure 1. Resuscitation (A) and management (B) Surviving Sepsis Campaign (SSC) bundle compliance and hospital mortality (C). All panels are based on an unadjusted generalized estimating equation population-averaged logistic regression model where circles represent observed values, lines are based on the regression, and shaded areas are the 95% CIs.

Figure 2. Resuscitation compliance by duration of years of Surviving Sepsis Campaign (SSC) participation (< 2 years, A, 2 to < 3 years, B, 3–4 years, C, and hospital mortality (panel D). All panels are based on an unadjusted generalized estimating equation population-averaged logistic regression model where circles represent observed values, lines are based on the regression, and shaded areas are the 95% CIs.

Early Detection and Risk Stratification

Healthcare providers are key to preventing infections and illnesses that can lead to sepsis.

**EDUCATE** patients and their families about the early symptoms of severe infection and sepsis, and when to seek care for an infection, especially those at higher risk.

**REMINDE** patients that taking care of chronic illnesses helps prevent infections.

**ENCOURAGE** infection prevention measures, such as hand hygiene and vaccination against infections.

Common infections can lead to sepsis:

Among adults with sepsis:
- 35% had a lung infection (e.g., pneumonia)
- 25% had a urinary tract infection (e.g., kidney infection)
- 11% had a type of gut infection
- 11% had a skin infection

Know the signs and symptoms of sepsis:
- Shivering, fever, or very cold
- Extreme pain or discomfort
- Clammy or sweaty skin
- Confusion or disorientation
- Short of breath
- High heart rate

Early Detection and Risk Stratification

- Early recognition and treatment decreases sepsis mortality
- Lack of recognition prevents timely therapy
- Utilize Surviving Sepsis Campaign bundles
- All of the trials to date have all utilized techniques for early detection

Guirgis FW et al. Journal of Critical Care 2017; (40)296-302
Early Identification

<table>
<thead>
<tr>
<th>Systemic Inflammatory Response Syndrome (SIRS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Temperature &gt; 38°C or &lt; 36°C</td>
</tr>
<tr>
<td>• Heart rate &gt; 90 beats/min</td>
</tr>
<tr>
<td>• Respiratory rate &gt; 20 breaths/min or PaCO$_2$ &lt; 32 mmHg</td>
</tr>
<tr>
<td>• White blood cell count &gt; 12000/mm$^3$ or &lt; 4000/mm$^3$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quick SOFA (qSOFA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hypotension (SBP ≤ 100 mmHg)</td>
</tr>
<tr>
<td>• Altered mental status (GCS ≤ 13)</td>
</tr>
<tr>
<td>• Tachypnea (RR ≥ 22 breaths/min)</td>
</tr>
</tbody>
</table>

qSofa ≥ 2

Singer M et al. JAMA. 2016; 315(8):801-10
A New Chapter of EGDT Monitoring

Early Protocolized Interventions coupled with Targeted Goals
**Application of Fluid Resuscitation in Adult Septic Shock**

Sepsis-induced hypotension or lactate ≥ 4 mmol/L  
(Based on SSC bundle and CMS threshold)

- **No high flow oxygen and No ESRD on dialysis or CHF**
  - Rapid infusion of 30 ml/kg crystalloid

- **Pneumonia or ALI with high flow oxygen requirements**
  - Not intubated/mechanically ventilated
  - Consider intubation/mechanical ventilation to facilitate 30 ml/kg crystalloid infusion
  - If no
    - Total of 30 ml/kg with frequent reassessment of oxygenation
  - If yes
    - Intubated/mechanically ventilated
    - Rapid infusion of 30 ml/kg crystalloid

- **ESRD on hemodialysis or CHF**
  - Total of 30 ml/kg crystalloid with frequent reassessment of oxygenation

---

**Considerations post 30ml/kg crystalloid infusion**

1. Continue to balance fluid resuscitation and vasopressor dose with attention to maintain tissue perfusion and minimize interstitial edema
2. Implement some combination of the list below to aid in further resuscitation choices that may include additional fluid or inotrope therapy
   - blood pressure/heart rate response
   - urine output
   - cardiothoracic ultrasound
   - CVP, ScvO2
   - pulse pressure variation
   - lactate clearance/normalization
   - dynamic measurement such as response of flow to fluid bolus or passive leg raising
3. Consider albumin fluid resuscitation, when large volumes of crystalloid are required to maintain intravascular volume.
Implement Combination of Monitoring

**Considerations post 30ml/kg crystalloid infusion**
1. Continue to balance fluid resuscitation and vasopressor dose with attention to maintain tissue perfusion and minimize interstitial edema.
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   - pulse pressure variation
   - lactate clearance/normalization
   - dynamic measurement such as response of flow to fluid bolus or passive leg raising
3. Consider albumin fluid resuscitation, when large volumes of crystalloid are required to maintain intravascular volume.
Intensity of Monitoring

- Minimalist Approach vs. Maximalist Approach

**Need for monitoring**

- Healthy
- "at risk"
- Critically ill

**Severity**

**Complexity**

Static versus dynamic measures?

Vincent JL et al. Critical Care 2011, 15:220
Updated 6 Hour Bundles

Surviving Sepsis Campaign

TO BE COMPLETED WITHIN 3 HOURS:
1) Measure lactate level.
2) Obtain blood cultures prior to administration of antibiotics.
3) Administer broad spectrum antibiotics.
4) Administer 30 ml/kg crystalloid for hypotension or lactate ≥4 mmol/L.

*Time of presentation* is defined as the time of triage in the emergency department or, if presenting from another care venue, from the earliest chart annotation consistent with all elements of severe sepsis or septic shock ascertained through chart review.

TO BE COMPLETED WITHIN 6 HOURS:
5) Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP) ≥65 mm Hg.
6) In the event of persistent hypotension after initial fluid administration (MAP < 65 mm Hg) or if initial lactate was ≥4 mmol/L, re-assess volume status and tissue perfusion and document findings according to Table 1.
7) Re-measure lactate if initial lactate elevated.

Surviving Sepsis Campaign

DOCUMENT REASSESSMENT OF VOLUME STATUS AND TISSUE PERFUSION WITH:

**EITHER:**
- Repeat focused exam (after initial fluid resuscitation) including vital signs, cardiorespiratory, capillary refill, pulse, and skin findings.

**OR TWO OF THE FOLLOWING:**
- Measure CVP.
- Measure ScvO².
- Perform bedside cardiovascular ultrasound.
- Perform dynamic assessment of fluid responsiveness with passive leg raise or fluid challenge.

http://survivingsepsis.org/SiteCollectionDocuments/SSC_Bundle.pdf
Benefits to the Central Line

• Optimal monitoring depends on the patient
• Invasive approach is often needed for initial evaluation of critically ill patient
• In addition to monitoring CVP and $S_{CVO_2}$, facilitates rapid administration of fluids
• CVC’s still being utilized in > 50% of cases (despite being randomized to “usual care”), not just for obtaining $ScvO_2$

<table>
<thead>
<tr>
<th></th>
<th>RIVERS</th>
<th>ProCESS</th>
<th>ARISE</th>
<th>PROMISE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EGDT</td>
<td>Standard</td>
<td>EGDT</td>
<td>Protocol</td>
</tr>
<tr>
<td>CVC Placement</td>
<td>100%</td>
<td>100%</td>
<td>93.6%</td>
<td>56.5%</td>
</tr>
</tbody>
</table>
$S_{cvO_2}$ vs $SvO_2$
Early Lactate-Guided Therapy

• Not a direct measure of tissue perfusion

• Objective surrogate for tissue perfusion

• Indicative of tissue hypoxia AND associated with worse outcomes AND standard laboratory test

• Significant reduction in mortality seen with lactate-guided resuscitation (RR 0.61; 95% CI, 0.43-0.87)

Jansen TC et al. Am J Respir Crit Care Med 2010;182:752-761
Protocol Management is Basic Critical Care Triage

Jansen TC et al. Am J Respir Crit Care Med 2010;182:752-761
Monitoring Cardiac Output

**Thermodilution (pulmonary artery catheter)**
- Provides simultaneous measurements of COP, PAP, SvO2
- Invasive

**Transpulmonary or Ultrasound indicator dilution**
- PiCCO, VolumeView, COstatus
- Less-invasive (may require CVC for calibration)

**Arterial pressure trace-derived CO**
- EV1000 (Vigileo), MostCARE
- Non-invasive but may be less accurate

**Echocardiography or Transesophageal Doppler**
- Non-invasive
- Requires training

Vincent et al. Critical Care 2011, 15:229
Fluid Assessment: Ultrasound Utilization

• Echocardiography
  • Allows visualization of cardiac chambers, valves, and pericardium

<table>
<thead>
<tr>
<th>Cardiac Abnormalities in Severe Sepsis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left ventricular dilatation</td>
</tr>
<tr>
<td>Left ventricular contraction impairment</td>
</tr>
<tr>
<td>Global</td>
</tr>
<tr>
<td>Segmental</td>
</tr>
<tr>
<td>Left ventricular diastolic dysfunction</td>
</tr>
<tr>
<td>Right ventricle systolic/diastolic dysfunction</td>
</tr>
<tr>
<td>Ventricular outflow obstruction</td>
</tr>
<tr>
<td>Valvular lesions</td>
</tr>
<tr>
<td>Functional</td>
</tr>
<tr>
<td>Endocarditis</td>
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Requires Training
Advanced Hemodynamic Monitoring Variability

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Physicians’ personal opinion and attitude on advanced hemodynamic monitoring in circulatory shock</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly disagree</td>
</tr>
<tr>
<td></td>
<td>(n)</td>
</tr>
<tr>
<td>Further hemodynamic assessment (e.g., assessment of cardiac output) is needed to determine the type of shock if no clear clinical diagnosis of the type of shock can be made</td>
<td>2</td>
</tr>
<tr>
<td>Echocardiography is helpful to determine the type of circulatory shock</td>
<td>2</td>
</tr>
<tr>
<td>Pulmonary artery catheterization is helpful in making a differential diagnosis in complex patients with circulatory shock</td>
<td>24</td>
</tr>
<tr>
<td>Transpulmonary thermodilution is helpful in making a differential diagnosis in complex patients with circulatory shock</td>
<td>8</td>
</tr>
</tbody>
</table>
Conclusions

• Protocols
  • streamline medical care
  • reduce variability in care delivered by different individuals
  • decrease errors in both omission and commission

• Usual Care vs. Protocolized care very much depends on experience and training of health care professionals
  • For less experienced trainees, protocols minimize chance for errors and variability

• Management of severe sepsis and septic shock need to be both EARLY and GOAL DIRECTED
Rebuttal
Early Recognition will always be important

- 30 mL/kg fluid bolus
- Lactate clearance
- Early antibiotics
Hemodynamic Monitoring: Jury still out...

- **VOLUME-CHASERS**: Observation of Variation in Fluids Administered and Characterization of Vasopressor Requirements in Shock
- Multi-center, observational cohort study
- Determine the variability in shock resuscitation and modalities used to determine the amount of fluid and vasopressor administered
Surviving Sepsis Campaign

• Is not dead…

• Individualize and tailor therapy for patients with comorbidities

• Complexity and heterogeneity of septic shock patients dictates individualized approach to hemodynamic management

• Hemodynamic targets must be further elucidated for the different phases of the disease
Updated 6 Hour Bundles

ONE SIZE ≠ FIT ALL

http://survivingsepsis.org/SiteCollectionDocuments/SSC_Bundle.pdf
Individualize Therapy for Comorbidities

- Restricted fluid administration
  - ARDS
  - CHF
- Liberal fluid administration
  - Maintain perfusion pressure
  - Sepsis
  - Positive Fluid Balance
# Four Phases in the Treatment of Shock

<table>
<thead>
<tr>
<th>Phase Focus</th>
<th>Salvage</th>
<th>Optimization</th>
<th>Stabilization</th>
<th>Deresuscitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obtain minimal acceptable blood pressure</td>
<td>Provide adequate oxygen availability</td>
<td>Provide organ support</td>
<td>Wean from vasoactive agents</td>
</tr>
<tr>
<td></td>
<td>Perform lifesaving measures</td>
<td>Optimize cardiac output, SvO2, lactate</td>
<td>Minimize complications</td>
<td>Achieve a negative fluid balance</td>
</tr>
</tbody>
</table>
Learning Assessment Questions

• Initial appropriate fluid resuscitation in septic shock includes which of the following?

  a) Administer at least 15 mL/kg of crystalloid fluid within the first 3 hours
  b) Administer at least 30 mL/kg of colloid fluid within the first 3 hours
  c) Administer at least 30 mL/kg of crystalloid fluid within the first 3 hours
  d) Administer at least 20 mL/kg of crystalloid fluid with reassessment using passive leg raise
Learning Assessment Questions

• Which of the following elements are NOT included in the Surviving Sepsis Guidelines for initial resuscitation?

a) Utilize static variables over dynamic ones to predict fluid responsiveness
b) Guide resuscitation with lactate clearance
c) Target mean arterial pressure (MAP) of 65 mm Hg in patients requiring vasopressors
d) Use frequent reassessment of hemodynamic status for additional fluids
Thank You!

Anne Rain Brown, PharmD, BCPS
UT MD Anderson Cancer Center
artanner@mdanderson.org