Sepsis Awareness Month
Advances in Fluid Management

Sept 29, 2022
Our Mission

Advancing Health in Indiana
- Engage and inspire health care providers
- Create safe cultures
- Create reliable systems of care
- Prevent patient harm in Indiana

PREVENT PATIENT HARM
To create high reliability organizations who collaborate and engage in continuous improvement to achieve best in class outcomes

IMPROVE COMMUNITY HEALTH
To partner with communities and stakeholders to develop, plan, and coordinate initiatives that span the prevention and care continuum

INCREASE PATIENT AND FAMILY ENGAGEMENT
To engage patients and families in all aspects of their care and seek their input and inclusion in advisory capacities throughout organizations

LEAD A CULTURE OF SAFETY
To create an environment of mutual trust, respect, and transparency among organizations, patients, and families

IHAconnect.org/Quality-Patient-Safety
# Sepsis: Back and to the Future

## IHA 2022 Sepsis Awareness Month Webinars

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Sept.</td>
<td>3 p.m. ET</td>
<td>Indiana Sepsis State of the State</td>
</tr>
<tr>
<td>8-Sept.</td>
<td>3 p.m. ET</td>
<td>Sepsis Pathophysiology &amp; Bundle Compliance</td>
</tr>
<tr>
<td>15-Sept.</td>
<td>3 p.m. ET</td>
<td>Sepsis Diagnostic Advances</td>
</tr>
<tr>
<td>22-Sept.</td>
<td>3 p.m. ET</td>
<td>Maternal Sepsis</td>
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<tr>
<td>29-Sept.</td>
<td>3 p.m. ET</td>
<td>Sepsis Fluid Management Advances</td>
</tr>
<tr>
<td>6-Oct.</td>
<td>3 p.m. ET</td>
<td>Personal Hygiene and Sepsis Prevention</td>
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</tbody>
</table>

Click on link to register for each webinar.
Sepsis Webinar Details

2022 IHA Clinical Webinar Series - 3 - 4 p.m. ET
Sepsis: Back & to the Future (Click link to register)

Sept. 1: Indiana Sepsis 2022: Current State of the State and New Resources,
   Rebecca Hancock PhD, RN, CNS, Patient Quality & Safety Advisor, IHA
   Chris Newkirk, BSN, RN, CCM, Clinical Quality Advisor, Columbus Regional Health

Sept. 8: Sepsis Back to Basics: Pathophysiology and Bundle Compliance,
   Tom Ahrens, PhD, RN, FAAN

Sept. 15: Sepsis Future: Advances in Sepsis Diagnostics,
   Dr. Sandy Estrada, Pharm.D., Clinical Consultant

Sept. 22: Sepsis Future: Focus on Maternal Sepsis,
   Brittany Waggoner, Patient Safety & Quality Advisor, RN, MSN, CNS, IHA

Sept. 29: Sepsis Future: Fluid Management
   Danielle Herr BSN, CCRN, Therapy Development Specialist
   Vince Holly, MSN, RN, CCNS, ACNS-BC, CCRN, FCNS, Indiana University Health-Bloomington

Oct. 6: Back to the Basics with Personal Hygiene for Infection Prevention
   Rebecca Hancock, Patient Quality & Safety Advisor, IHA
   Annette Handy, Clinical Director, Patient Safety Center, IHA

IHAconnect.org/Quality-Patient-Safety
If we don’t improve, we won’t reduce mortality. If we don’t improve sepsis care sequences....?
Objectives

1. Describe challenges in sepsis fluid resuscitation
2. Describe research in fluid resuscitation responsiveness and assessments (FRESH, Kansas City studies)
3. Apply fluid volume resuscitation management device to sepsis patient scenario
Risk Factors for Sepsis

- Recent UTI, pneumonia or operative event (lines, drains)
- Diabetes
- Immunosuppressive therapy
- Elective surgery
- Chronic renal failure
- Alcohol abuse
- Splenectomy
- Sickle Cell
- Non-modifiable factors: age (very old or young), gender (M>F), race (B>W)

(Kumar et al, 2006; Torres et al, 2004; Englert & Ross, 2015)
Sepsis Signs & Symptoms (Clinical)

Systemic Inflammatory Response Syndrome (SIRS) Criteria:
• Suspected new or worsening infection with 2 or more:
  1. Fever > 38.3 °C / 100.4 °F or less than 36 °F / 96.8 °F (NSAIDS / Tylenol can mask)
  2. HR > 90 bpm (beta blockers can mask)
  3. RR > 20 bpm
  4. WBC > 12,000 or < 4,000 or > 10% bands

Other:
  1. Altered mental status, falls
  2. Severe Sepsis/Shock: SBP < 90 mm Hg or SBP decrease > 40 mm Hg in adults
  3. Delirium, anorexia, malaise, urinary incontinence, weakness, functional decline, withdrawal, agitation (Girard et al., 2015; Nasa et al., 2012; Englert & Ross, 2015)

Symptoms atypical in very old and very young
Sepsis Signs & Symptoms

Systemic Inflammatory Response Syndrome (SIRS)

- Suspected or worsened infection with:
  - Low blood pressure <90 SBP
  - Fever (consider recent antipyretics-Tylenol/Advil)
  - Lactate >2; WBC >
  - Hypothermia
  - Heart rate over 90 bpm (consider beta blockers that lower HR)
  - Respiratory rate over 20 bpm
  - Significant edema
  - Hyperglycemia in absence of diabetes
  - Altered mental status?

(Sepsis Alliance, 2016, 2019)
**Numerator**

**Type of Measure:** Process  
**Improvement Noted As:** An increase in the rate  

**Numerator Statement:** Patients who received ALL of the following:  
- Initial lactate level measurement  
- Broad spectrum or other antibiotics administered  
- Blood cultures drawn prior to antibiotics  
AND received within six hours of presentation of severe sepsis. ONLY if the initial lactate is elevated:  
- Repeat lactate level measurement  
AND within three hours of initial hypotension:  
- Resuscitation with 30 mL/kg crystalloid fluids  
OR within three hours of septic shock:  
- Resuscitation with 30 mL/kg crystalloid fluids  
AND within six hours of septic shock presentation, ONLY if hypotension persists after fluid administration:  
- Vasopressors are administered  
AND within six hours of septic shock presentation, if hypotension persists after fluid administration or initial lactate >= 4 mmol/L:  
- Repeat volume status and tissue perfusion assessment is performed

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**Denominator/Exclusions**

**Denominator Statement:** Inpatients age 18 and over with an ICD-10-CM Principal or Other Diagnosis Code of Sepsis, Severe Sepsis, or Septic Shock and not equal to U07.1 (COVID-19).  

**Included Populations:** Discharges age 18 and over with an ICD-10-CM Principal or Other Diagnosis Code of Sepsis, Severe Sepsis, or Septic Shock as defined in Appendix A, Table 4.01.  

**Excluded Populations:**  
- Patients with an ICD-10-CM Principal or Other Diagnosis Code of U07.1 (COVID-19)  
- Directive for Comfort Care or Palliative Care within six hours of presentation of severe sepsis  
- Directive for Comfort Care or Palliative Care within six hours of presentation of septic shock  
- Administrative contraindication to care within six hours of presentation of severe sepsis  
- Administrative contraindication to care within six hours of presentation of septic shock  
- Length of Stay >120 days  
- Transfer in from another acute care facility  
- Patients enrolled in a clinical trial for sepsis, severe sepsis or septic shock treatment or intervention  
- Patients with severe sepsis who are discharged within six hours of presentation  
- Patients with septic shock who are discharged within six hours of Presentation  
- Patients receiving IV antibiotics for more than 24 hours prior to presentation of severe sepsis
Sepsis CMS Specification Changes
starting 7/1/2021

**Fluids Exclusion**
- Provider must specifically and accurately document end stage heart failure NYHA Class 3 or 4, or renal disease as noted in specs,
- Volume patient would have received, and
- Expected volume to infuse in place of 30 ml/kg of ideal body weight

**Antibiotic Modification**
- Broad spectrum or other antibiotic specifications criteria removed, but timeframe for administration remains with focus on timing of administration rather than antibiotic selection

*Quality Net Inpatient Specs v. 5.1, Q3-Q4 2021*
1. Crystalloid fluid volumes ordered that are equivalent to 30 mL/kg or a lesser volume with a reason for the lesser volume specifically documented by the physician/APN/PA are the target ordered volume.

2. A physician/APN/PA order for a volume of crystalloid fluids that is within 10% less than 30 mL/kg is acceptable for the target ordered volume. Documentation of a reason for a volume that is within 10% less than 30 mL/kg is not required.

3. There is a physician/APN/PA order for the lesser volume of crystalloid fluids as either a specific volume (e.g. 1500 mL) or a weight-based volume (e.g. 25 mL/kg).

4. The ordering physician/APN/PA documented within a single note in the medical record all of the following:
   – The volume of fluids to be administered as either a specific volume (e.g. 1500 mL) or a weight-based volume (e.g. 25 mL/kg) AND a reason for ordering a volume less than 30 mL/kg of crystalloid fluids.
   – Reasons include and are not limited to:
     • concern for fluid overload
     • heart failure
     • renal failure
     • blood pressure responded to lesser volume
     • a portion of the crystalloid fluid volume was administered as colloids (if a portion consisted of colloids, there must be an order and documentation that colloids were started or noted as given)
Sep-1 vs Sep-3 diagnostic criteria—CMS clearing mud!

*Hospital-Based Sepsis Care: The Evolving Definition of Sepsis and the Roles of the ED Medical Director and Quality Team in Sepsis Care (qualityreportingcenter.com)*, Nov 2021
### 2021 SCCM Sepsis Guidelines

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Quality of Evidence / Strength of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>For patients with sepsis-induced hypoperfusion or septic shock, we suggest</td>
<td>Low/ Weak</td>
</tr>
<tr>
<td>that at least 30 mL/kg of IV crystalloid fluid be given within the first 3</td>
<td></td>
</tr>
<tr>
<td>hours of resuscitation.</td>
<td></td>
</tr>
<tr>
<td>For adults with sepsis or septic shock, we suggest using dynamic measures to</td>
<td>Very Low/Weak</td>
</tr>
<tr>
<td>guide fluid resuscitation over physical examination or static parameters</td>
<td></td>
</tr>
<tr>
<td>alone.</td>
<td></td>
</tr>
<tr>
<td>For adults with septic shock, we suggest using capillary refill time to</td>
<td>Low / Weak</td>
</tr>
<tr>
<td>guide resuscitation as an adjunct to other measures of perfusion.</td>
<td></td>
</tr>
<tr>
<td>For adults with septic shock on vasopressors, we recommend an initial target</td>
<td>Moderate / Strong</td>
</tr>
<tr>
<td>mean arterial pressure (MAP) of 65 mm Hg over higher MAP targets.</td>
<td></td>
</tr>
<tr>
<td>For adults with septic shock, we suggest using capillary refill time to</td>
<td>Low / Weak</td>
</tr>
<tr>
<td>guide resuscitation as an adjunct to other measures of perfusion.</td>
<td></td>
</tr>
</tbody>
</table>
The Frank-Starling law mechanism can be defined as ‘an intrinsic adaptive response which serves to adjust each ventricular output to its inflow by increasing the force of contraction of the myocardium proportionally to any increase in the length of the muscle fibers’, i.e., increase in the volume of blood entering the heart stretches the walls of the ventricle, which causes the heart to contract with more force, like a stretched rubber band, increasing the volume of each stroke of the heart.
Guest Speakers

Danielle Herr, RN, BSN
Therapy Development Specialist at Baxter International Inc

Vince Holly, MSN, RN, CCNS, ACNS-BC, CCRN, FCNS, Clinical Nurse Specialist - Critical Care
Indiana University Health-Bloomington
100+ YEARS OF TECHNOLOGY: WILL MY PATIENT RESPOND TO IV FLUID?

### Pressure Based
- **Blood Pressure** (1900's)
- **Central Venous Pressure** (1950's)
- **Pulmonary Artery Catheter** (1970's)
- **Echo-cardiogram** (1980's)

### Chamber Size

### Dynamic Assessments
- **Invasive**
  - **Stroke Volume Variation**
  - **Pulse Pressure Variation**
  - **IVC Collapsibility**
- **Non-Invasive**
  - **TODAY**
  - Δ Stroke Volume
  - Direct Fluid Challenge

### Non-Invasive
- **Respiratory Based** (2000's)

TODAY: **2000's**
- **Stroke Volume Variation**
- **Pulse Pressure Variation**
- **IVC Collapsibility**

**1900's**
- **Blood Pressure**

**1950's**
- **Central Venous Pressure**

**1970's**
- **Pulmonary Artery Catheter**

**1980's**
- **Echo-cardiogram**

**2000's**
- **Stroke Volume Variation**
- **Pulse Pressure Variation**
- **IVC Collapsibility**

**TODAY**
- Δ Stroke Volume
- Direct Fluid Challenge
### FLUID RESPONSIVENESS — ONLY ~ 50%

- **Will This Hemodynamically Unstable Patient Respond to a Bolus of Intravenous Fluids?**
  - Peter Bentzer, MD, PhD; Donald E. Griesdale, MD, MPH; John Boyd, MD; Kelly MacLean, MD; Demetrios Sirounis, MD; Najib T. Ayas, MD, MPH

- **META-ANALYSIS**
  - 50 ICU studies
  - 2260 patients
  - 50% Fluid Responsive (95% CI, 42% to 56%)
  - SV change performed best (Sens 88%/Spec 92%)

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#### Table 1. Study Characteristics of the 50 Studies Included in the Meta-Analysis

<table>
<thead>
<tr>
<th>Authors</th>
<th>Evidence Level</th>
<th>Sample Size</th>
<th>Responders (%)</th>
<th>Ventilation</th>
<th>Tidal Volume (mL/kg)</th>
<th>Reference Standard</th>
<th>Cut-off for Response</th>
<th>Volume and Type of Fluid</th>
<th>Test</th>
<th>Method to Measure Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monnet, 2005</td>
<td>3</td>
<td>38</td>
<td>53</td>
<td>Controlled</td>
<td>8</td>
<td>ED</td>
<td>15%</td>
<td>500 cc NS</td>
<td>ABF</td>
<td>ED</td>
</tr>
<tr>
<td>deOliveira Costa, Bias, 2012</td>
<td>3</td>
<td>32</td>
<td>46</td>
<td>Controlled</td>
<td>6.5</td>
<td>PAC</td>
<td>15%</td>
<td>1000 cc</td>
<td>PPV</td>
<td>Art. Line</td>
</tr>
<tr>
<td>Freitas, 2013</td>
<td>2</td>
<td>30</td>
<td>47</td>
<td>Spontaneous</td>
<td>-</td>
<td>TPT</td>
<td>10%</td>
<td>500 cc Dex</td>
<td>SVV</td>
<td>TPT</td>
</tr>
<tr>
<td>Moretti, 2010</td>
<td>2</td>
<td>29</td>
<td>59</td>
<td>Controlled</td>
<td>8</td>
<td>TPT</td>
<td>15%</td>
<td>7 cc/kg HES</td>
<td>IVC</td>
<td>Ultrasound</td>
</tr>
<tr>
<td>Lakhali, 2010</td>
<td>3</td>
<td>48</td>
<td>40</td>
<td>Mixed</td>
<td>-</td>
<td>TPT</td>
<td>15%</td>
<td>500 cc NS</td>
<td>PLR on CI</td>
<td>TPT</td>
</tr>
<tr>
<td>Kaspersky et al., 2013</td>
<td>3</td>
<td>45</td>
<td>6d</td>
<td>Controlled</td>
<td>8</td>
<td>PCA</td>
<td>15%</td>
<td>500 cc HES</td>
<td>SVV</td>
<td>Art. Line</td>
</tr>
<tr>
<td>Muller, 2010</td>
<td>2</td>
<td>96</td>
<td>54</td>
<td>Controlled</td>
<td>7.1</td>
<td>TPT</td>
<td>15%</td>
<td>500 cc NS</td>
<td>PPV</td>
<td>Art. Line</td>
</tr>
<tr>
<td>Michaud, 2009</td>
<td>2</td>
<td>96</td>
<td>43</td>
<td>Not reported</td>
<td>-</td>
<td>PAC</td>
<td>15%</td>
<td>500 cc HES</td>
<td>CVP</td>
<td>CVC</td>
</tr>
<tr>
<td>Thiel, 2009</td>
<td>2</td>
<td>89</td>
<td>46</td>
<td>Mixed</td>
<td>-</td>
<td>TTE</td>
<td>15%</td>
<td>3.3 mEq/l, L, or NS</td>
<td>PLR on SV</td>
<td>TTE</td>
</tr>
<tr>
<td>Monnet, 2013</td>
<td>2</td>
<td>84</td>
<td>46</td>
<td>Controlled</td>
<td>7.4</td>
<td>TPT</td>
<td>15%</td>
<td>6 cc/kg HES</td>
<td>PPV</td>
<td>Art. Line</td>
</tr>
<tr>
<td>Vaill, 2009</td>
<td>2</td>
<td>66</td>
<td>30</td>
<td>Controlled</td>
<td>8.2</td>
<td>TTE</td>
<td>11%</td>
<td>10 cc/kg HES</td>
<td>PPV</td>
<td>Art. Line</td>
</tr>
<tr>
<td>Vincent-Murray, 2004</td>
<td>2</td>
<td>59</td>
<td>49</td>
<td>Spontaneous</td>
<td>-</td>
<td>TTE</td>
<td>10%</td>
<td>500 cc NS</td>
<td>IVC, PL, COL, or CO</td>
<td>TTE</td>
</tr>
<tr>
<td>Monge Garcia, 2009</td>
<td>2</td>
<td>37</td>
<td>57</td>
<td>Controlled</td>
<td>8.1</td>
<td>ED</td>
<td>15%</td>
<td>500 cc HES</td>
<td>PLR on CO, PP</td>
<td>Art. Line</td>
</tr>
<tr>
<td>Bias, 2008</td>
<td>2</td>
<td>35</td>
<td>49</td>
<td>Controlled</td>
<td>8.4</td>
<td>TTE</td>
<td>15%</td>
<td>20 cc x BMI 4% Albumin</td>
<td>SVV</td>
<td>Art. Line</td>
</tr>
<tr>
<td>Muller, 2008</td>
<td>2</td>
<td>35</td>
<td>51</td>
<td>Controlled</td>
<td>6.8</td>
<td>TPT</td>
<td>15%</td>
<td>250-500 cc HES</td>
<td>CVP</td>
<td>CVC</td>
</tr>
<tr>
<td>Finucan, 2010</td>
<td>2</td>
<td>54</td>
<td>41</td>
<td>Spontaneous</td>
<td>-</td>
<td>TTE</td>
<td>15%</td>
<td>500 cc HES</td>
<td>PLR on SV, PP</td>
<td>Art. Line</td>
</tr>
</tbody>
</table>

Bentzer P et al. Will this hemodynamically unstable patient respond to a bolus of intravenous fluids. JAMA 2016; 316(12): 1298.
Predicting Preload Responsiveness Accurately

Optimization of Preload in Severe Sepsis and Septic Shock
Adil Shujaat and Abubakr A. Bajwa

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Technology</th>
<th>AUC with 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLR*</td>
<td>Various methods of CO measurement</td>
<td>0.95 (0.92–0.97)</td>
</tr>
<tr>
<td>PPV</td>
<td>Arterial BP waveform</td>
<td>0.94 (0.93–0.95)</td>
</tr>
<tr>
<td>SVV</td>
<td>Arterial BP waveform analysis by proprietary algorithm</td>
<td>0.84 (0.78–0.88)</td>
</tr>
<tr>
<td>LVEDAI</td>
<td>Echocardiography</td>
<td>0.64 (0.53–0.74)</td>
</tr>
<tr>
<td>GEDV</td>
<td>Thermodilution</td>
<td>0.56 (0.37–0.67)</td>
</tr>
<tr>
<td>CVP</td>
<td>Central venous catheter</td>
<td>0.55 (0.48–0.62)</td>
</tr>
</tbody>
</table>

PLR: passive leg raising, PPV: pulse pressure variation, SVV: stroke volume variation, LVEDAI: left ventricular end-diastolic area index, GEDV: global end-diastolic volume, CVP: central venous pressure, AUC: area under receiver operating characteristics curve.
KU – DYNAMIC MEASURES IN SEPSIS

- **Stroke volume guided resuscitation in severe sepsis and septic shock may improve outcomes**
  - Heath E. Latham, Charles D. Bengtson, Lewis Satterwhite, Mindy Stites, Dipti P. Subramaniam, G. John Chen, Steven Q. Simpson
  - Retrospective, matched, single-center study of nearly 200 patients:
    - SV guided fluid in severe sepsis and septic shock
    - 100 SV vs. 91 Usual Care
    - Retrospective cohort study

- **Reduced Fluid Balance** – 1.77L vs. 5.36L (p = 0.022)
- **Reduced ICU LOS** – 2.89 days (p = 0.03)
- **Less vasopressor** – 32.8 hours (p = 0.001)
- **Less mechanical ventilation** – RR .51 (p = 0.0001)
- **Less dialysis** – 6.25% vs. 19.5% RR .32 (p = 0.01)
- **53% Fluid Responsive**

FRESH STUDY

Published in CHEST journal October 2020

• Multi-Center Randomized Clinical Trial

• 13 hospitals participated

• Enrolled patients from ER to ICU

• Used dynamic assessments to determine need for fluids vs pressors
Fluid Management...Does it Matter?

Clinical Decision is made to treat the patient with either fluid and/or vasoactive medications. This may be due:
- MAP < 65, SBP < 90, or BP is rapidly trending lower
- low urine output
- any other clinical indication to administer/after fluid bolus or pressors
Vasoactive medication may be de-escalated at the clinician’s discretion but re-escalation should trigger this PLR algorithm.

Flowchart:

1. Passive Leg Raise Fluid Assessment
   - No → Observe
   - Yes
     - < 10% SV Change
       - Titrate Pressors (NE) to MAP ≥ 65
     - > 10% SV Change
       - 1. Fluid bolus 0.5L × 1
       - 2. Reassess MAP / SBP
         - Persistent Hypoperfusion
           - May repeat 0.5 L fluid bolus × 1
           - Adequate Perfusion → Observe
           - Persistent Hypoperfusion
             - May initiate / increase pressor dose if additional fluid bolus volume > 2 L
             - Adequate Perfusion → Observe
             - Observe

MAP = mean arterial pressure; NE = norepinephrine; PLR = passive leg raise; SBP = systolic BP; SV = stroke volume.
FRESH SEPSIS TRIAL DEMONSTRATES IMPROVED PATIENT OUTCOMES

- When Using Dynamic Measures to Guide Fluid Decisions\(^1\)
  - 13 hospitals in the United States and the United Kingdom
  - 83 SV vs. 41 Usual Care
  - 523 PLR assessments
  - Investigators were asked to perform a PLR any time they were considering fluid administration
  - Primary clinical outcome was fluid balance at 72-hours or ICU discharge, whichever occurred first


FRESH is the first prospective, multi-center randomized clinical trial demonstrating improved outcomes when a dynamic assessment of fluid responsiveness (PLR) is used to guide treatment in severe sepsis and septic shock patients

- Decreased Fluid Balance \(-1.37\) L
- Reduced Initiation of Mechanical Ventilation \(-48\%\)
- Reduced Initiation of Renal Replacement Therapy \(-12.4\%\)
- More Likely to be Discharged Home Alive \(+20\%\)
## Dynamic Measures to Guide Fluid in Septic Shock

<table>
<thead>
<tr>
<th>Variable</th>
<th>SV Guided¹</th>
<th>Control¹</th>
<th>Δ / p¹</th>
<th>Cost Assumptions*</th>
<th>Cost Avoidance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Balance (Liters)</td>
<td>1.77L ± 0.60</td>
<td>5.36L ± 1.01</td>
<td>3.59L p=0.002</td>
<td>$\text{US 4004 / ICU day}^2$ $\text{US 906 / floor day}^3$</td>
<td>$8,953$</td>
</tr>
<tr>
<td>ICU LOS (Days)</td>
<td>5.98 ± 0.68</td>
<td>8.87 ± 1.18</td>
<td>2.89 days p=0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressor Use (Hours)</td>
<td>32.08 ± 5.22</td>
<td>64.86 ± 8.39</td>
<td>32.78 hours p=0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Ventilation Risk</td>
<td>29%</td>
<td>57%</td>
<td>RR=0.51 p = 0.001</td>
<td>$\text{US 1522 / day}^4$ 5.1 days³</td>
<td>$1,940$</td>
</tr>
<tr>
<td>Acute Dialysis Therapy Initiated</td>
<td>6.25%</td>
<td>19.5%</td>
<td>13.25% P = 0.01</td>
<td>$27,182 x (12.73 cases avoided/96 total patients)³</td>
<td>$3,605$</td>
</tr>
</tbody>
</table>

### Cost Assumptions

- ICU Length of Stay (LOS): 2.89 days x ($\text{US 4004 / ICU day}^2$ – $\text{US 906 / Floor day}^3$) = $8,953$
- Mechanical Ventilation (MV): $1,522 x 5.1$ days x .25 = $1,940$

Assumes:
1. Incremental cost of MV $1,522 / day.
2. Average duration of MV in septic shock 5.1 days.
3. Assumes an absolute 25% reduction of patients receiving mechanical ventilation.

### Acute Dialysis Therapy

- $27,182$ (avg. dialysis-related hospital costs) x (12.73 cases avoided/96 total patients) = $3,605$

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**Estimated Savings Per Treated Patient**

$\text{US 14,498}$
1. Do I have a perfusion problem?
   Is a perfusion problem developing?
   MAP and/or clinical signs

2. Do I need fluid?
   Fluid responsiveness – will fluid work?

3. Do I need pressors?
   Vascular resistance – TPRI /SVRI

4. Do I need inotropes?
   Low cardiac output after preload & vascular tone optimization
   Consider Echo/cardiac w/u
Case Study #1

Emergency Dept

- 54-year-old male C/O SOB x 3 days
- Productive cough
- PMH: Hyperlipidemia, GERD
- Chest Xray
- Sputum and Blood cultures
- Abx for Community Acquired Pneumonia
- Labs ordered
Case Study #1

• WBC: 17.5 k
• HR: 98 bpm
• RR: 25 bpm
• Temp: 37.5°C
• BP: 82/33 mmHg  MAP 49 mmHg
• Lactate: 5.6 mmol/L
• SpO2: 92% on High Flow NC

• Fluid Bolus???
Case #1

Transfer to ICU

- Received 30ml/kg (2,600 ml) bolus
- BP 87/38mmHg MAP 54 mmHg
- Started Norepinephrine 5 mCg/min
- BP 96/50mmHg MAP 65mmHg
- Reevaluate
  - Lactate
  - Dynamic fluid responsiveness assessment using PLR
Case Study #2

Emergency Dept

• 72-year-old female
• UTI, acute mental status change, poor PO intake
• Chronic Kidney Disease
• CHF
Case #2

Emergency Dept

- **WBC:** 13.2 k
- **BP:** 80/54 mmHg MAP 63 mmHg
- **HR:** 103 bpm
- **Temp:** 38.5° C
- **BUN:** 85 mg/dL
- **Cr:** 1.76 mg/dL
- **Lactate:** 4.2 mmol/L
- **Fluid Bolus??**
# Case Study #3

**Inpatient Sepsis Screening**

## SIRS Alert and Sepsis Screen

1. **Is the patient’s history suggestive of a new infection?**
   - If "None" selected, STOP and do not continue screening
     - None
     - Abdomen
     - Antimicrobial therapy
     - Endocarditis
     - Invasive device infection
     - Meningitis
     - Pneumonia
     - Positive culture
     - Soft Tissue Injury, Skin
     - Urinary Tract Infection
     - Other (See Comment)

2. **Check all that apply: SIRS criteria met if 2 or more responses checked below**
   - None
   - Temp <36 DegC or >38 DegC
   - RR > 20 per minute
   - WBC <4,000/UL or >12,000/UL
   - HR > 90 bpm

**If a response other than "None" is selected for #1 and SIRS criteria met for #2 - Order a Lactate Venous PL QN**

When lab is resulted, MODIFY Powerform and continue with #3 and NEXT STEP

### Result: Lactate Venous PL QN

2.5 mmol/L

3. **Does patient meet any criteria for ORGAN DYSFUNCTION?**
   - None
   - SBP <90 mmHg or MAP <65 mmHg
   - New, Acute Mental Status change
   - PaO2/FiO2 ratio <300
   - UOP <0.5 ml/kg/hr
   - Lactate Venous >2 mmol/L
   - Platelets <100,000/UL
   - INR >1.5
   - PTT >50 sec
   - Bilirubin >2 mg/dl
Case Study #4

Inpatient Rapid Response Call

• 18-year-old male
• Admitted to Med/Surg post operative appendectomy
• BP 88/42mmHg   MAP 57mmHg
• PMH: Nothing significant

• Bolus v. tx ICU?
Case Study #4

**Inpatient Rapid Response Call**

**Dynamic Fluid Responsiveness Assessment Script**

**SVI increase of 10% or more**

Dr. _______________, Pt _______________ in room _______________ became hypotensive. I did a fluid responsiveness assessment using the ***** Monitor. The Stroke Volume Index increased by ___%. This increase indicates the patient will respond to a fluid bolus. Would you like 500ml or 1000ml and what fluid would you like me to give?

**SVI increase of less than 10%**

Dr. _______________, Pt _______________ in room _______________ became hypotensive. I did a fluid responsiveness assessment using the ***** Monitor. The Stroke Volume Index increased by only ___%. An increase less than 10% indicates the patient will NOT respond to a fluid bolus. Would you like to start a vasopressor?
## IHA 2022 Sepsis Awareness Month Webinars

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Alan Beaulieu
President
ITR Economics

Political Point/Counterpoint
Cybersecurity
Health Care Economic Forecast
Quality and Patient Safety Team

Karin Kennedy
Vice President, Quality & Patient Safety
317-423-7737
kkennedy@IHAconnect.org

Annette Handy
Clinical Director, Quality & Patient Safety
317-423-7795
ahandy@IHAconnect.org

Becky Hancock
Quality & Patient Safety Advisor
317-423-7799
rhancock@IHAconnect.org

Madeline Wilson
Quality & Patient Safety Advisor
317-974-1407
mwilson@IHAconnect.org

Laurie Gerdt
Quality & Patient Safety Advisor
317-423-7728
lgerdt@IHAconnect.org

Brittany Waggoner
Maternal & Infant Quality Improvement Advisor
317-488-1031
bwaggoner@IHAconnect.org

Casey Hutchens
Patient Safety Project Coordinator
317-974-1457
chutchens@IHAconnect.org

Becky Royer
Consultant
812-249-2341
broyer@IHAconnect.org