AW Sepsis Update
Orders Standardization

Updated 6/19, 2018
As we continue our journey toward becoming One Ascension Wisconsin, standardization of practices across the state is necessary to ensure the highest level of care is provided to all patients regardless of location.

**Why**

Use of the standard problem-specific order sets are key to compliance with best practice standards. Please let us know if there are barriers with this order set use at your site.
Goals: Sepsis Care Standardization

• **Improve care for patients with sepsis & septic shock through**
  o Implementation of sepsis care protocols consistent with national guidelines
  o Use of Ascension WI standard order sets, leveraging phases of care in
    • ED
    • Inpatient
  o Implementation of Ascension-National source-specific recommendations for antibiotics & labs
    • Ensure appropriate source-specific antibiotic coverage & critical diagnostics
    • Minimize antimicrobial resistance

• **Provide efficient, goal-directed quality care through implementation of nursing clinical & patient pathways**
Sepsis: life-threatening organ dysfunction caused by a dysregulated host response to infection

“Presence of infection/concern for suspected infection with evidence of systemic inflammatory response or life-threatening organ dysfunction which can be characterized by an acute change of ≥ 2 points in the patient’s SOFA score”

SOFA score ≥ 2 associated with > 10% mortality risk

- qSOFA: Hypotension Systolic BP < 100 mmHg
  - Altered Mental Status
  - Tachypnea > 22/min

- qSOFA score: ≥ 2 criteria suggests a greater risk of poor outcome ¹
  (comparing to STEMI 8.1% mortality risk)
Sepsis Definitions

Septic shock: “Sepsis characterized by unresponsive hypotension and lactic acidosis (serum lactate > 2 mmol/L) requiring vasopressor therapy to maintain MAP > 65 mmHg, despite adequate fluid resuscitation”
  - Mortality in this group > 40%

Sepsis & SIRS? ¹

- “Nonspecific SIRS criteria such as pyrexia or neutrophilia will continue to aid in the general diagnosis of infection
- However, SIRS may simply reflect an appropriate host response that is frequently adaptive
- Sepsis involves organ dysfunction, indicating a pathobiology more complex than infection plus an accompanying inflammatory response alone”
  (“severe sepsis” no longer part of the sepsis consensus definitions)
Lay Definitions of Sepsis

Sepsis: “A life-threatening condition that arises when the body’s response to infection injures its own tissues”

How do we screen for sepsis?

• “There are, as yet, no simple and unambiguous clinical criteria or biological, imaging, or laboratory features that uniquely identify a septic patient
• Neither qSOFA nor SOFA is intended to be a stand-alone definition of sepsis
• The task force wishes to stress that SIRS criteria may still remain useful for the identification of infection”
Evidence & Quality Metrics


CMS Sepsis Core Measures (SEP-1)

Opportunities to improve core-measure compliance

- SEP-1 contains 63 interventions for completion within 3 & 6 hr. timeframes
- National average of compliance approximately 40% (meeting all measures for patients)
  - AW sites are at, above & below this national target, and most below the AW target of 60%

See references: New Guideline Just Released 2018
Key to Treating Sepsis Effectively: **Early Identification**
(most patients present via the ED)

- **Screening for sepsis:** Do you suspect infection?
- **Common presenting complaints** (not always clear sepsis presentation)
  - Altered mental status
  - Respiratory complaints: Difficulty breathing, aspiration, pneumonia, cough, etc.
  - Abdominal pain
  - Fever
  - Urinary tract infection or complaints
  - Cellulitis
  - Acute kidney injury or dehydration
- **Suspicion** of infection is key to the start of successful care delivery

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1. B. SCREENING FOR SEPSIS AND PERFORMANCE IMPROVEMENT
2. We recommend that hospitals and hospital systems have a performance improvement program for sepsis, including sepsis screening for acutely ill, high-risk patients (BPS).
3. Notably, sepsis screening has been associated with decreased mortality in several studies.
**Sample Sepsis Screening Tool**

Sepsis-induced organ dysfunction may be occult;

- therefore, its presence should be considered in any patient presenting with infection

- Conversely, unrecognized infection may be the cause of new-onset organ dysfunction.

- Any unexplained organ dysfunction should thus raise the possibility of underlying infection.¹

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<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Infection:</strong> Is the patient’s history suggestive of a new infection?</td>
<td></td>
</tr>
<tr>
<td>- Pneumonia</td>
<td>✓</td>
</tr>
<tr>
<td>- Urinary tract infection</td>
<td>✓</td>
</tr>
<tr>
<td>- Acute abdominal infection</td>
<td>✓</td>
</tr>
<tr>
<td>- Skins soft tissue infection</td>
<td>✓</td>
</tr>
<tr>
<td>- Bone joint infection</td>
<td>✓</td>
</tr>
<tr>
<td>- Wound infection</td>
<td>✓</td>
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<tr>
<td>- Bloodstream catheter infection</td>
<td>✓</td>
</tr>
<tr>
<td>- Meningitis</td>
<td>No</td>
</tr>
<tr>
<td>- Other</td>
<td>✓</td>
</tr>
</tbody>
</table>

| **2. SIRS Criteria (Systemic Inflammatory Response Syndrome Criteria): Are any two of the following signs & symptoms of infection both present and new to the patient?** |
| ✓ Hyperthermia > 38°C (100.4°F) |
| ✓ Leukopenia | ✓ Leukocyte |
| ✓ Hypothermia < 36°C (96.8°F) |
| ✓ Tachypnea > 20 bpm |
| ✓ Tachycardia > 90 bpm |
| ✓ Paco2 < 35 mm Hg |

| **3. Signs of Organ Dysfunction:** Are any of the following organ dysfunction criteria present? |
| ✓ Systolic BP < 90 mmHg or Mean Arterial Pressure (MAP) < 65 mmHg |
| ✓ Systolic BP decrease > 40 mmHg from baseline |
| ✓ Acute respiratory failure (non-invasive ventilation [NIV]/ with invasive ventilation |
| ✓ Creatinine > 2.0 mg/dL or Urine Output < 0.5 mL/kg/hour for > 4 hours |
| ✓ Bilirubin > 2 mg/dL |
| ✓ Platelet count < 100,000/mm³ |
| ✓ Coagulopathy (INR > 1.5 or PT/PTT > 50 sec) for patients not on warfarin |
| ✓ Lactate > 2 mmol/L |

**SOFIA score & Suspected Infection:** Tachypnea > 22/min, Systolic BP < 100 mmHg, Altered Mental Status (ΔSOFA ≥ 2 reflects increased mortality risk)

4. Screening Completed by: RN MD

5. Physician: Date Time Signature
# Sepsis Resuscitation 3-hr. Targets

## SEPSIS PATHWAY
**ENDPOINTS / TARGETS FOR RESUSCITATION**

**3 & 6 HOUR TARGETS** (version 1 4/9/18)

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### START (Time)

________

(ED/Sepsis triage time or time symptoms evident)

**Search for source, source control, antibiotics, volume resuscitation**

### 3-Hour Goal Time

________

### 6-Hour Goal Time

________

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## Resuscitation Bundle: 3-Hour Bundle Goal

To be accomplished within an hour if possible, but **at least within 3 hours**

<table>
<thead>
<tr>
<th>Time Met</th>
<th>Indicator</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Serum lactate: Measured</strong></td>
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<tr>
<td></td>
<td><strong>Blood cultures: Obtained prior to antibiotic administration.</strong></td>
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<tr>
<td></td>
<td><strong>Antibiotics: Broad-spectrum antibiotics administered within 1 hour if possible (at least within 3 hrs.)</strong></td>
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<tr>
<td></td>
<td><strong>Fluids (for any hypotension or lactate ≥ 4 mmol/L):</strong> Deliver an initial minimum of 30 mL/kg of crystalloid.</td>
</tr>
</tbody>
</table>

**Consider RRT/transfer for non-ICU patients not responding to 3-hr. bundle**
Sepsis Resuscitation 6-hr. Targets

Resuscitation Bundle: 6-Hour Bundle Goal
To be accomplished as soon as possible but at least within 6 hours

<table>
<thead>
<tr>
<th>Time Met</th>
<th>Indicator</th>
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<tbody>
<tr>
<td></td>
<td><strong>Re-measure lactate if initial lactate elevated (&gt; 2 mmol/L)</strong></td>
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<tr>
<td></td>
<td><em>(Below interventions done in ED or ICU)</em></td>
</tr>
<tr>
<td></td>
<td><strong>Vasopressors</strong> For hypotension not responding to initial fluid resuscitation (30 ml/kg within 3 hrs.) to maintain mean arterial pressure (MAP) &gt; 65 and SBP &gt; 90 mm Hg.</td>
</tr>
<tr>
<td></td>
<td><em>(Remaining interventions done in ED or ICU)</em></td>
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<tr>
<td></td>
<td>For persistent hypotension after fluids (30 mL/kg) OR lactate &gt; 4 mmol/L; reassess volume status and tissue perfusion by using one of the following strategies</td>
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<tr>
<td></td>
<td><strong>Strategy A:</strong> Repeat focused exam (after initial fluid resuscitation) by licensed independent practitioner (MD/Nurse Practitioner) including vital signs, cardiopulmonary, capillary refill, pulse, and skin findings. Use structured documentation template where available</td>
</tr>
<tr>
<td></td>
<td><strong>OR</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Strategy B:</strong> Reassessment using two of the following</td>
</tr>
<tr>
<td></td>
<td>Measure CVP (goal 8-12 mmHg / fluids)</td>
</tr>
<tr>
<td></td>
<td>Measure ScvO₂ (goal &gt; 70%)</td>
</tr>
<tr>
<td></td>
<td>Bedside cardiovascular ultrasound</td>
</tr>
<tr>
<td></td>
<td>Dynamic assessment of fluid responsiveness with passive leg raise or fluid challenge</td>
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</table>

*Refer to Sepsis Guidelines for complete information [http://survivingsepsis.org/Guidelines/Pages/default.aspx](http://survivingsepsis.org/Guidelines/Pages/default.aspx)*
Antibiotic Recommendations

• **Developed at national level with team lead by**
  - Mohamad Fakih MD (Medical Director Antimicrobial Stewardship)
  - Florijan Daragjati Pharm D BCPS (Manager Pharmacy Services – St. Vincent’s Hospital)

• **Reviewed in Wisconsin by (including reviews of local antibiograms)**
  - Anthony Zeimet DO, Infectious Diseases, Medical Director Co-Chair, Ascension Wisconsin Infection Prevention Council & Northern Region Antimicrobial Stewardship Co-chair
  - Jim Davis RPh Lead Staff Pharmacist, Infectious Diseases/Antimicrobial Stewardship All Saint’s Racine
  - Kyle Piscitello Pharm D Lead Staff Pharmacist, Infectious Diseases/Antimicrobial Stewardship St. Joseph's Hospital
Source-specific antimicrobial guidelines: Source Categories

**Pneumonia**

1. Community-acquired pneumonia

2. Community-acquired pneumonia: MRSA risk factors (*necrotizing pneumonia, recurrent MRSA infections, post-Influenza infection, recipient of IV antibiotics in the previous 90 days*)

3. HAP/HCAP/VAP (*Hospital-acquired pneumonia / Healthcare-associated pneumonia / ventilator-associated pneumonia*)

4. HAP/HCAP/VAP- MRSA risk factors (*necrotizing pneumonia, recurrent MRSA infections, post-Influenza infection, recipient of IV antibiotics in the previous 90 days, 10-20% Staphylococcus at institution are MRSA*)

5. HAP/HCAP/VAP- high risk of MDROs

6. HAP/HCAP/VAP- high risk of MDROs AND MRSA (*necrotizing pneumonia, recurrent MRSA infections, post-Influenza infection, recipient of IV antibiotics in the previous 90 days, 10-20% Staphylococcus at institution are MRSA*)
## Source-specific antimicrobial guidelines - Categories

### Urinary Source
- 7. Acute Pyelonephritis-low risk for MDROs (if in Septic Shock, use high risk)*
- 8. Acute Pyelonephritis-high risk for MDROs or in Septic Shock*

### Febrile Neutropenia
- 9. (only one category)

### Meningitis
- 10. Immunocompetent
- 11. Immunocompromised

### Unknown Source
- 12. (only one category)
NEW: Ascension National & Ascension WI
Source-specific antimicrobial guidelines: Categories

**Intra-Abdominal Source**
(including biliary)

13. Mild/Moderate community onset


15. Healthcare-associated with surgical wound infection

**Skin/Soft Tissue***

16. Non-diabetic cellulitis **[MRSA risk factors include]**: cellulitis associated with penetrating trauma, history of MRSA infection/colonization, active injection drug user, residence in a crowded living condition (e.g. homeless, military, incarceration), male with a history of having sex with men, skin infection with poor response to beta lactam antibiotics, patient report of a “spider bite”

17. Diabetic/Severe Sepsis/Septic Shock/Necrotizing Infection
Cellulitis Guidelines*

Ascension National also working on implementation of cellulitis recommendations/order sets (non-sepsis cellulitis)

Information about the new treatment guidelines was sent to

Chief Clinical Officers  Chief Medical Officers
Chief Nursing Officers   Chief Quality Officers
Chief Operating Officers Market Information Officers
Chief Resource Officers  Pharmacy Directors

Watch for a future Ascension order set for cellulitis
When to use the order sets
(Antibiotic recommendations)

- Use the sepsis orders when sepsis is suspected, especially when organ dysfunction is present
  - If pneumonia + sepsis: All pneumonia-specific orders are included with sepsis orders
  - If cellulitis + sepsis: Use the sepsis orders

- Cellulitis without sepsis: use your current antibiotic choices until the Ascension WI order set is released
Revised Order Sets
(Same content: Organization/Workflow varies by E.H.R. System)

EPIC

• IP Sepsis/Septic Shock Admission
• ED Sepsis/Septic Shock

CERNER

• ED Sepsis Treatment
  (related subphases: Work-up, Imaging, Labs, Central line)
• Sepsis Admission
  (related subphases: Work-up, ICU subphases – shock, flotrac)

Notes:
• Orders appear more streamlined in the live E.H.R. environment, i.e. collapsible order sections (Epic) & subphases (Cerner)
• Sample Epic screen print available at the end of the document/reference section
PAPER SEPSIS ORDERS
• Available to sites by 6/20/18

Electronic E.H.R. Build
• Currently in build state
• Coming soon
• Goal implementation by June 30th, 2018
Fluid Resuscitation: “Time is Tissue” (Normosol)
Surviving Sepsis Guideline Recommendations

- Crystalloids are recommended for initial fluid resuscitation\(^3\)
  30 mL/kg to be **COMPLETED** within the first 3 hrs.

- Fluid choices on sepsis orders
  - Normosol (Plasma-Lyte)
  - Lactated Ringers
  - Normal Saline

Pharmacy recommended to reserve use of 0.9% NaCl resuscitation for cases of severe hypochloremia or alkalosis. (see end for additional references)

One before-after study in all ICU patients suggested increased rates of acute kidney injury and RRT in patients managed with a chloride-liberal strategy compared to a chloride-restrictive strategy\(^3\)

Evidence from a network meta-analysis suggesting\(^3\) improved outcome with balanced salt solutions as compared to saline in patients with sepsis\(^3\)
How much fluid is enough for resuscitation

Risks for both under & over resuscitating the patient

- Use a strategy for assessing volume responsiveness

ACEP DART Tool Recommendations

- Prioritize immediate fluid resuscitation.
- Recommended fluid volume in first hour: 30mL/kg.
- A history of heart failure, liver failure, or renal failure is not a contraindication to fluid resuscitation.

Under and over-resuscitation of fluid is an important concern in fluid management

Bellamy Curve

- Hypoperfusion
- Organ dysfunction
- Adverse outcome
- Edema
- Organ dysfunction
- Adverse outcome

OPTIMAL

Hypovolemic

Volume load

Overload

Time is tissue
CMS SEP-1 Core Measure to Assess ²
Volume Responsiveness Septic Shock

**Strategy One:** Documentation of a Repeat Focused Exam of “tissue perfusion” (after initial fluid resuscitation) by licensed independent practitioner (this assessment is missed frequently)

**Alternate Strategy:** Assess *two* of the following
- Measure CVP
- Measure ScvO₂ (saturation of central venous oxygen)
- **Bedside cardiovascular ultrasound**
  - cIVC - percentage collapsibility of the IVC
  - Mechanically ventilated patients dIVC / distensibility index
- **Dynamic assessment of fluid responsiveness with passive leg raise (PLR) or fluid challenge** (can be measured as non-invasive or minimally invasive stroke volume)
  - Stroke volume measured at baseline with HOB elevation
  - PLR: Raise both legs to 45° for 1-2 min
    - Δ SV >10% confirms patient is likely to respond to fluid
    - Δ SV <10% suggests patient is unlikely to respond to fluid
Vasopressors in Septic Shock

Guideline recommendations

• Norepinephrine: First-choice vasopressor
  • Add vasopressin (up to 0.03 U/min) to decrease norepinephrine dosage or
  • Epinephrine to norepinephrine
  • with the intent of raising MAP to target

• Vasopressor dosing should be titrated to an end point reflecting perfusion, and the agent reduced or discontinued in the face of worsening hypotension or arrhythmias

See additional vasopressin information in the reference slides
Revised Order Sets

**EPIC**

- IP Sepsis/Septic Shock Admission
- ED Sepsis/Septic Shock

**Cerner**

- **Sepsis Workup (ED & Admit)**
- **Sepsis Admission**
  - Septic Shock ICU Subphase
  - Flotrac Subphase
  - Sepsis: Central Line Insertion (Admit)
- **ED Sepsis w/organ dysfunction (Tx)**
  - ED Sepsis Optional Labs
  - ED Sepsis Optional Imaging
  - Sepsis: Central Line Insertion (ED)
- **Antibiotic subphases (ED & Admit):** Pneumonia, Unknown Source, Febrile Neutropenia, Urinary, Meningitis, Skin/Soft Tissue, Intraabdominal

**Notes:**

- Orders appear more streamlined in the live E.H.R. environment, i.e. collapsible order sections (Epic) & subphases (Cerner)
- Sample Epic screen print available at the end of the document/reference section
Future Direction / Electronic Alerts

**Epic**

**ED**
- Piloting sepsis workflow opportunities at St. Frances Hospital
- Working on Epic workflow enhancements for ED electronic alerts

**Inpatient**
- Automated Best Practice Sepsis Alerts to the nurse & physician notification continue

**Cerner**

**ED**
- Automated Sepsis Alerts firing to the ED tracking board continues
- Sepsis Screening Tool completion by the provider continues

**Inpatient**
- Automated Sepsis Discern alerts firing to the nurse continues
- Nurse notification to the Physician & completion of the Sepsis Screening tool continues
Performance Improvement

• Our team will continue to monitor performance data, look for workflow efficiencies & aim to provided the best quality care & outcomes for our patients with sepsis.

• Performance data will be shared when possible at ED & Critical Care Committees to help us strive for continuous improvement.
Clinical Pathways
Patient Pathways

• A clinical pathway is been created and will be used to ensure that the patient’s recovery is progressing well and that any barriers are identified and addressed.

• A patient care pathway will be given to the patient and their support person to keep them informed and engaged in their recovery.
Multidisciplinary Team Approach

- Under the guidance of an Ascension WI Steering Committee, a multidisciplinary team consisting of a provider, pharmacist, and clinical nurse specialist were brought together to review best practices in the Management of Sepsis.

This team also reviewed all order sets and made recommendations for standardization.
What’s new with sepsis?

• We’re not changing any of our order sets / bundle information

• However: Surviving Sepsis Campaign has just released a bundle & guideline update

• The intent with the ONE-hr. Bundle is that great outcomes can be achieved if we begin immediate resuscitation
  • Much like stroke & heart attack where earlier intervention can make a difference to outcomes

• “Time is Tissue”

“Aspirational Goals”
(Not without national controversy – especially in ED)
Thank You

If you have questions, please contact:

• Patty Haugh: Clinical Nurse Specialist, Columbia St. Mary’s Milwaukee
• Don Lee MD: Hospitalist, Columbia St. Mary’s
• Peter DeGroot: Pharmacist, All Saints
• Anthony Zeimet DO Infectious Diseases, St. Elizabeth with Kyle Piscitello Phm-D, St. Joseph’s Hospital & Jim Davis Phm-D, All Saints
• Zebuline Koran: AW Director of Nursing Practice
• Catherine Kostuch: Case Management, St. Michael’s Hospital
• Paula Gebauer: Clinical Quality Improvement Specialist
• Maciejewski, Shelley: Quality Improvement, St. Joseph’s Hospital
• Richard Shimp MD, CMO Columbia St. Mary’s
• Patricia Gedemer: Director Performance Excellence

Additional references follow this slide
References

1. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) JAMA February 23, 2016 Volume 315, Number 8 (801-810)


The 1-hr. Bundle
Info graphic from Surviving Sepsis Campaign
The baseline Sequential [Sepsis-related] Organ Failure Assessment (SOFA) score should be assumed to be zero unless the patient is known to have preexisting (acute or chronic) organ dysfunction before the onset of infection. qSOFA indicates quick SOFA; MAP, mean arterial pressure.
### Table 2. Terminology and International Classification of Diseases Coding

<table>
<thead>
<tr>
<th>Current Guidelines and Terminology</th>
<th>Sepsis</th>
<th>Septic Shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991 and 2001 consensus terminology&lt;sup&gt;9,10&lt;/sup&gt;</td>
<td>Severe sepsis, Sepsis-induced hypoperfusion</td>
<td>Septic shock&lt;sup&gt;13&lt;/sup&gt;</td>
</tr>
<tr>
<td>2015 Definition</td>
<td>Sepsis is life-threatening organ dysfunction caused by a dysregulated host response to infection</td>
<td>Septic shock is a subset of sepsis in which underlying circulatory and cellular/metabolic abnormalities are profound enough to substantially increase mortality</td>
</tr>
<tr>
<td>2015 Clinical criteria</td>
<td>Suspected or documented infection and an acute increase of ≥2 SOFA points (a proxy for organ dysfunction)</td>
<td>Sepsis&lt;sup&gt;a&lt;/sup&gt; and vasopressor therapy needed to elevate MAP ≥65 mm Hg and lactate &gt;2 mmol/L (18 mg/dL) despite adequate fluid resuscitation&lt;sup&gt;13&lt;/sup&gt;</td>
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</table>

**Recommended primary ICD codes<sup>3</sup>**

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Sepsis</th>
<th>Septic Shock</th>
</tr>
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<tbody>
<tr>
<td>995.92</td>
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<td>785.52</td>
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<table>
<thead>
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<th>ICD-10&lt;sup&gt;a&lt;/sup&gt;</th>
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<th>Septic Shock</th>
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<tbody>
<tr>
<td>R65.20</td>
<td></td>
<td>R65.21</td>
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</table>

**Framework for implementation for coding and research**

- Identify suspected infection by using concomitant orders for blood cultures and antibiotics (oral or parenteral) in a specified period<sup>b</sup>
- Within specified period around suspected infection<sup>c</sup>:
  1. Identify sepsis by using a clinical criterion for life-threatening organ dysfunction
  2. Assess for shock criteria, using administration of vasopressors, MAP <65 mm Hg, and lactate >2 mmol/L (18 mg/dL)<sup>d</sup>

**Abbreviations:** ICD, *International Classification of Diseases*; MAP, mean arterial pressure; SOFA, Sequential (Sepsis-related) Organ Failure Assessment.<sup>27</sup>

<sup>a</sup> Included training codes.

<sup>b</sup> Suspected infection could be defined as the concomitant administration of oral or parenteral antibiotics and sampling of body fluid cultures (blood, urine, cerebrospinal fluid, peritoneal, etc.). For example, if the culture is obtained, the antibiotic is required to be administered within 72 hours, whereas if the antibiotic is first, the culture is required within 24 hours.<sup>12</sup>

<sup>c</sup> Considers a period as great as 48 hours before and up to 24 hours after onset of infection, although sensitivity analyses have tested windows as short as 3 hours before and 3 hours after onset of infection.<sup>12</sup>

<sup>d</sup> With the specified period around suspected infection, assess for shock criteria, using any vasopressor initiation (eg, dopamine, norepinephrine, epinephrine, vasopressin, phenylephrine), any lactate level >2 mmol/L (18 mg/dL), and mean arterial pressure <65 mm Hg. These criteria require adequate fluid resuscitation as defined by the Surviving Sepsis Campaign guidelines.<sup>4</sup>
Crystalloids: Saline vs. Normosol
“Balanced Crystalloids vs. Saline in Critically Ill Adults”

SMART Investigators and the Pragmatic Critical Care Research Group

Conclusions

- “Among critically ill adults, the use of balanced crystalloids for intravenous fluid administration resulted in a lower rate of the composite outcome of death from any cause, new renal-replacement therapy, or persistent renal dysfunction than the use of saline”

(Funded by the Vanderbilt Institute for Clinical and Translational Research and others; SMART-MED and SMART-SURG
ClinicalTrials.gov numbers NCT02444988 & NCT02547779).

Crystalloids: Saline vs. Normosol/LR

• “A strong signal is emerging from recent large propensity-matched and cohort studies for the adverse effects that 0.9% saline has on the clinical outcome in surgical and critically ill patients when compared with balanced crystalloids. Major complications are the increased incidence of acute kidney injury and the need for renal replacement therapy, and that pathological hyperchloremia may increase postoperative mortality.” ¹

• “Healthy human volunteer studies have shown that retention of fluid in the interstitial space is greater after infusions of 0.9% saline, than after those of balanced crystalloids or 5% dextrose, and that this fluid retention is associated with reduced urine volume.” ¹

• “This comprehensive review of literature has shown that 0.9% saline is neither ‘normal’ nor ‘physiological’ and that its high chloride content leads to many pathophysiological changes, especially with regard to renal function, in both animals and healthy human volunteers. These changes are not seen after infusions with balanced crystalloids” ¹

• “This is the first human study to demonstrate that intravenous infusion of 0.9% saline results in reductions in renal blood flow velocity adrenal cortical tissue perfusion. This has implications for intravenous fluid therapy in perioperative and critically ill patients.” ²

• “In conclusion, we have shown that the hyperchloremic acidosis associated with a 2-L infusion of 0.9% saline has a detrimental effect on renal artery blood flow velocity and renal cortical tissue perfusion. Balanced crystalloids may, therefore, be safer than 0.9% saline in patients with existing renal disease and those at risk of developing renal dysfunction” ²
Crystalloids: Saline vs. Normosol/LR

- “Among critically ill adults with sepsis, resuscitation with balanced fluids was associated with a lower risk of in-hospital mortality.” ³
- “In-hospital mortality was lower following initial resuscitation with balanced versus non-balanced crystalloids among nonoperative patients admitted with early vasopressor-dependent sepsis. Mortality was progressively lower among patients receiving greater proportions of balanced crystalloids. These findings support an urgent need for definitive clinical trials, as crystalloid therapy is nearly universal and any outcomes differences between common alternatives could have a large public health impact.” ³
- “The implementation of a chloride-restrictive strategy in a tertiary ICU was associated with a significant decrease in the incidence of AKI and use of RRT.” ⁴
- “We conducted a before-and-after study comparing a chloride-restrictive intra-venous fluids strategy with a chloride liberal intravenous fluids strategy in a multidisciplinary tertiary ICU. We found that restricting intravenous chloride intake was associated with a significant decrease in the incidence of AKI and the use of RRT. These observations support the desirability of further clinical studies in this field.” ⁴

References for Crystalloids:

- Association Between the Choice of IV Crystalloid and In-Hospital Mortality Among Critically Ill Adults With Sepsis. KARTHIK RAGHUNATHAN, MD, MPH1,2; ANDREW SHAW, MB, FRCA, FFICM, FCCM1; BRIAN NATHANSON, PhD3; TIL STÜRMER, MD, PhD4; ALAN BROOKHART, PhD4; MIHAELA S. STEFAN, MDS; SOKO SETOGUCHI, MD, DrPH6; CHRIS BEADLES, MD, PhD2; PETER K. LINDENAUER, MD, MSC Critical Care Medicine July 2014 • Volume 42 • Number 7

- Association Between a Chloride-Liberal vs Chloride-Restrictive Intravenous Fluid Administration Strategy and Kidney Injury in Critically Ill Adults. Nor’azim Mohd Yunos, MD, Rinaldo Bellomo, MD, FCICM, Colin Hegarty, BSc, David Story, MD, Lisa Ho, MClinPharm, Michael Bailey, PhD. JAMA, October 17, 2012—Vol 308, No. 15
Vasopressin – Adjunctive Therapy

Vasopressin used as an adjunct Vasopressor in Septic Shock not first line

- Effects usually seen in 30-45 min as an increase in MAP and decreased need for Norepinephrine
- Dose is 0.03 units/min
- Studies have shown specific patient populations (i.e., obese and those who have a genetic predisposition to be vasopressin deficient) may require dose of 0.04-0.06 units/min
- When to add?? There is no consensus at what dose of Norepinephrine should it be initiated.

- VAST trial 2008 Vasopressin started at Norepinephrine dose of 5 mcg/min; Results: There was no significant difference between the vasopressin and norepinephrine groups in the 28-day mortality rate (35.4% and 39.3%, respectively; P=0.26) or in 90-day mortality (43.9% and 49.6%, respectively; P=0.11).

- Vanderbilt Study 2016 compared starting Vasopressin at Norepinephrine doses of 10 mcg/min compared to 50 mcg/min; Results: Time to achieve goal mean arterial pressure (MAP) was shorter in the postintervention group (2.0 vs 1.3 hours; P = 0.03) in univariate analysis but not after adjusting for prespecified confounders.
Antibiotic orders are more streamlined when viewed within Epic or Cerner subphases.
Special Thank You to Our Order Builders
(for this very complex order set)

EPIC
• Diane Roszek
• Kylee Albright
• Tuyet Vance
• Gary Swart MD (consulting ED provider workflow)
• The several pharmacists who proofed the medication section

Cerner
• Julie Kreckow
• Drs. Wilkerson, Riepenhoff, Brown, Stech & Lee (Consulting provider workflow)
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