Stop Sepsis: Evidence Based Strategies to Decrease Mortality Across the Continuum

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• Subject matter expert CAUTI, CLABSI, HAPU, Sepsis, Safety culture
• Consultant and speaker bureau for Sage Products LLC
• Consultant and speaker bureau for Eloquest Healthcare
Overview-Objectives

1. Understand the four tier process for effective sepsis program development and implementation across the continuum of care

2. Examine the evidence for the 3 hour and 6 hour core measure sepsis bundles

3. Understand potential barriers and effective resolution strategies for implementation of the evidence
Who do we have in the audience?

A  Bedside Nurse
B  Advanced Practice Nurse
C  Nurse Educator
D  Nurse Manager
Building the Why

- Success
- Stick To It
- Take Action
- Develop A Plan
- Define Your Goal
Faces of Sepsis

https://www.youtube.com/watch?v=12Qbnn6XfH0
Sepsis is an Epidemic

• Affects >1 million Americans per year
• 3rd leading cause of death in the US
• Sepsis occurs in just 10% of U.S. hospital patients, but it contributes to as many as half of all hospital deaths
• US spends $24 billion per year to treat

> 700 people die each day from sepsis in the U.S.

Sepsis Kills 258,000 Americans Each Year

More than

Breast Cancer

Prostate Cancer

& Lung Cancer

COMBINED
# Sepsis Impact on Mortality in Hospitals

In KPNC 2012 subset, patient meeting criteria for EGDT comprised 32.6 percent of sepsis deaths & patients with sepsis, normal BP & lactate < 4 comprised 55.9% of sepsis deaths.

Liu V, et al. JAMA,2014:May 18th, online.
Proportion & Cost of Unplanned 30 day Readmissions after Sepsis (2013 Nationwide Readmission Database)

Mayr FB, et al. JAMA, 2017, Jan 22nd published online

<table>
<thead>
<tr>
<th>Medical Condition</th>
<th>No. of All Index Admissions Readmitted Within 30 Days</th>
<th>Estimated Mean Length of Stay (95% CI), d\textsuperscript{a}</th>
<th>Estimated Mean Cost per Readmission (95% CI), $\textsuperscript{b}</th>
<th>Percentage of Index Admissions Readmitted Within 30 Days (95% CI)</th>
<th>Percentage of Total Estimated Cost of All Readmissions (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admissions associated with 30 d readmission</td>
<td>1 187 697</td>
<td>6.4 (6.4-6.5)</td>
<td>8242 (8225-8258)</td>
<td>NA</td>
<td>100.0</td>
</tr>
<tr>
<td>Sepsis</td>
<td>147 084</td>
<td>7.4 (7.3-7.4)</td>
<td>10 070 (10 021-10 119)</td>
<td>12.2 (11.9-12.4)</td>
<td>14.5 (14.2-14.8)</td>
</tr>
<tr>
<td>Acute myocardial infarction</td>
<td>15 001</td>
<td>5.7 (5.6-5.8)</td>
<td>9424 (9279-9571)</td>
<td>1.2 (1.2-1.3)</td>
<td>1.4 (1.3-1.5)</td>
</tr>
<tr>
<td>Heart failure</td>
<td>79 480</td>
<td>6.4 (6.4-6.5)</td>
<td>9051 (8990-9113)</td>
<td>6.7 (6.5-6.8)</td>
<td>7.5 (7.3-7.7)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>59 378</td>
<td>6.7 (6.6-6.7)</td>
<td>9533 (9466-9600)</td>
<td>5.2 (5.0-5.3)</td>
<td>5.5 (5.4-5.7)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>54 396</td>
<td>6.0 (5.9-6.0)</td>
<td>8417 (8355-8480)</td>
<td>4.6 (4.5-4.8)</td>
<td>4.3 (4.1-4.4)</td>
</tr>
<tr>
<td>Sepsis (Sensitivity Analyses\textsuperscript{d})</td>
<td>89 800</td>
<td>7.6 (7.6-7.7)</td>
<td>10 828 (10 760-10 897)</td>
<td>7.3 (7.1-7.5)</td>
<td>9.1 (8.8-9.4)</td>
</tr>
<tr>
<td>Acute myocardial infarction (Sensitivity Analyses\textsuperscript{d})</td>
<td>21 281</td>
<td>6.0 (5.9-6.1)</td>
<td>9530 (9408-9654)</td>
<td>1.8 (1.7-1.8)</td>
<td>2.0 (1.9-2.1)</td>
</tr>
<tr>
<td>Heart failure (Sensitivity Analyses\textsuperscript{d})</td>
<td>236 636</td>
<td>6.5 (6.5-6.5)</td>
<td>9248 (9211-9285)</td>
<td>20.0 (19.6-20.4)</td>
<td>22.1 (21.6-22.6)</td>
</tr>
<tr>
<td>Pneumonia (Sensitivity Analyses\textsuperscript{d})</td>
<td>130 904</td>
<td>6.9 (6.9-7.0)</td>
<td>9749 (9700-9797)</td>
<td>11.1 (10.9-11.4)</td>
<td>12.5 (12.2-12.8)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease (Sensitivity Analyses\textsuperscript{d})</td>
<td>201 867</td>
<td>6.3 (6.3-6.4)</td>
<td>8677 (8641-8713)</td>
<td>17.4 (17-17.7)</td>
<td>17.2 (16.7-17.7)</td>
</tr>
</tbody>
</table>
Hospitalization rates for sepsis or septicemia were similar for males and females and increased with age.

Figure 2. Rates of hospitalization for septicemia or sepsis, by sex and age, 2008

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Rate per 10,000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td>Male: 22.3, Female: 25.6</td>
</tr>
<tr>
<td>Under age 65</td>
<td>Male: 9.7, Female: 9.3</td>
</tr>
<tr>
<td>65–74</td>
<td>Male: 70.3, Female: 61.3</td>
</tr>
<tr>
<td>75–84</td>
<td>Male: 165.4, Female: 129.4</td>
</tr>
<tr>
<td>85 and over</td>
<td>Male: 266.3, Female: 273.6</td>
</tr>
</tbody>
</table>

NOTES: Rates are significantly higher for males and females in each successive age group.
Common Causes of Hospitalization
Adults aged 85 and over: U.S.

<table>
<thead>
<tr>
<th>First-listed diagnosis</th>
<th>Rate of hospitalization per 1,000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure</td>
<td>48  47  43</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>51  52  34</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>19  24  30</td>
</tr>
<tr>
<td>Septicemia</td>
<td>15  18  28</td>
</tr>
<tr>
<td>Stroke</td>
<td>37  27  28</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>28  23  21</td>
</tr>
</tbody>
</table>

Percent change\(^1\) (2000 to 2010):
- Congestive heart failure: -9.5%
- Pneumonia: -32.8%
- Urinary tract infection: +55.9%
- Septicemia: +84.8%
- Stroke: -25.0%
- Hip fracture: -25.4%

\(^1\)Percent change for each diagnosis is significant from 2000 through 2010 (p < 0.05).

NOTE: First-listed diagnosis is considered to be the main cause or reason for the hospitalization. The diagnoses were chosen because they were the top six first-listed diagnoses in 2010.


Sepsis: CDC Vital Signs

- 80% of sepsis cases begin outside the hospital
- 7 in 10 patients with sepsis had recently used health services
- 4 most common types of infection in sepsis are lung, urinary tract, gut & skin

Health Care Providers: Think Sepsis & Act Fast

https://www.cdc.gov/vitalsigns/sepsis/August 2016
Increased Post-Op Risk

• Post-op Patients 10 X more likely to die of sepsis than PE or MI

• Risk factors for sepsis in surgical pts
  – Age over 60
  – Need for emergency surgery
  – Presence of co-morbidities (Cancer, DM, HTN, or obesity)

• Having a co-morbidity increases the risk of post-op sepsis by 6 times

Sepsis in General Surgery

2005-2007 National Surgical Quality Improvement Program Perspective
## Discharge Disposition After Sepsis

<table>
<thead>
<tr>
<th>Disposition</th>
<th>Septicemia or sepsis</th>
<th>Other diagnoses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine</td>
<td>39%</td>
<td>79%</td>
</tr>
<tr>
<td>Transfer to other short-term care facility</td>
<td>6%</td>
<td>3%</td>
</tr>
<tr>
<td>Transfer to long-term care institution</td>
<td>30%</td>
<td>10%</td>
</tr>
<tr>
<td>Died during the hospitalization</td>
<td>17%</td>
<td>2%</td>
</tr>
<tr>
<td>Other or not stated</td>
<td>8%</td>
<td>6%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

1 Difference is statistically significant at the 0.05 level. SOURCE: CDC/NCHS, National Hospital Discharge Survey, 2008.
Sepsis Practice Collaborative Model
4 Tier Process for Program Implementation

1. Organizational Consensus that Severe Sepsis Must be Managed Early and Aggressively
2. Early Screening with Tools and Triggers
3. Implementation of the Sepsis Bundles
4. Measuring Success

Continuous Quality Improvement (CQI)

Adapted from: Sepsis Solutions International

Infection Prevention

- Hand Washing
- VAE (VAP) Bundle
- CAUTI
- BSI

Documentation Improvement
~ Accurate Coding

1Continuous Quality Improvement
<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>YES</th>
<th>NO</th>
<th>NA</th>
<th>Action Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organizational Commitment/ Team</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician and nursing leadership participate in action planning for sepsis initiatives</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multidisciplinary team in place and monthly meetings (providers, nursing, quality, care management, etc) from various care areas, ED, ICU, Med Surg, Perinatal, pediatrics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Executive sponsor receives regular data reports and provides feedback</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sepsis Team is part of/ reports to Critical care or quality structure in hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managing sepsis is aligned with hospital’s quality, safety or organizational goals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline data collection completed for process and outcome data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dedicated Sepsis resource/ Sepsis Coordinator</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dedicated Sepsis Resource in place (in comments identify title)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTE allocation/ time commitment to sepsis role</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site/ sites supported</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other responsibilities in the role</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Identification/ Screening</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early alert or warning system/process in place in the ED or describe triggers for sepsis screening</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INPATIENT UNITS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERINATAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEDIATRICS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is a screening process completed consistently as designed?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All ED patients are screened/ assessed for sepsis in triage?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All ICU patients are screened/ assessed for sepsis upon admission and every shift – describe process</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All med surg patients are screened/ assessed for sepsis upon admission and every shift – describe process</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All OB patients are screened/ assessed for</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tier I: Organizational Consensus and Support Milestones and Checklist

1. Define Sepsis Program Goal and aligned with organizational goals
2. Identify Executive sponsor
3. Collect Baseline Data—essential step
4. Develop sepsis team (do we have all the right people here?) and schedule monthly (minimum) meeting for at least 6 months
5. Identify nursing and physician champions in ED and ICU and ensure champions attend team meeting
   - Create a sepsis coordinator position to oversee program
6. Begin to define action plan and timeline for program development and implementation
Survival Benefit and Cost Savings From Compliance With a Simplified 3-Hour Sepsis Bundle in a Series of Prospective, Multisite, Observational Cohorts

Daniel E. Leisman, BS1,2; Martin E. Doerfler, MD3; Mary Frances Ward, RN, MS, ANP4,5; Kevin D. Masick, PhD6; Benjamin J. Wie, BA1; Jeanie L. Gribben, BS1; Eric Hamilton, BA6; Zachary Klein, MS6; Andrea R. Bianculli, BS1; Meredith B. Akerman, MS5; John K. D’Angelo, MD1; Jason A. D’Amore, MD1

**Objectives:** To determine mortality and costs associated with adherence to an aggressive, 3-hour sepsis bundle versus non-compliance with greater than or equal to one bundle element for severe sepsis and septic shock patients.

**Design:** Prospective, multisite, observational study following three sequential, independent cohorts, from a single U.S. health system, through their hospitalization.

Leisman et al. *Crit Care Med.* March 2017
Three hour bundle compliance defined as:

1. Blood cultures drawn before antibiotic administration.
2. Source-directed, broad-spectrum, parenteral antibiotics administered within 180 minutes of sepsis identification (≥2 SIRS and lactate ordered) or 60 minutes of time-zero (≥ 2SIRS and available laboratory results or vital signs indicating hypoperfusion or organ dysfunction), whichever occurs earlier.
3. Lactate result available within 90 minutes of order (ordered upon recognition of infection with SIRS).
4. 30 mL/kg IV crystalloid bolus initiated within 30 minutes of time-zero.
# Mortality and Cost Impact with Compliance

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Compliant mortality</th>
<th>Non-compliant mortality</th>
<th>Compliant cost</th>
<th>Non-compliant cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort 1 (n=5,819)</td>
<td>22.6%</td>
<td>26.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cohort 2 (n=1,697)</td>
<td>13.4%</td>
<td>17.8%</td>
<td>$14,845</td>
<td>$20,056</td>
</tr>
<tr>
<td>Cohort 3 (n=7,239)</td>
<td>18.1%</td>
<td>21%</td>
<td>$17,885</td>
<td>$22,108</td>
</tr>
<tr>
<td><strong>Difference between compliant and non-compliant (ARR)</strong></td>
<td><strong>3.9%</strong></td>
<td><strong>p&lt;0.001</strong></td>
<td><strong>$5,211</strong></td>
<td><strong>$4,223</strong></td>
</tr>
</tbody>
</table>
Summary of Results

**DISCUSSION**
In three independent, prospective cohorts of nearly 15,000 SS/SS patients, compliance with a 3-hour sepsis bundle, not reliant on physiologic endpoints but with aggressive timelines, was reproducibly associated with lower in-hospital mortality after adjusting for potential confounders. When assessed in cohorts 2 and 3 (> 7,500 patients), compliance was also associated with substantial cost savings.
Tier I: Organizational Consensus and Support Milestones and Checklist

1. Define Sepsis Program Goal and aligned with organizational goals
2. Identify Executive sponsor
3. Collect Baseline Data—essential step; understand your current process
4. Develop sepsis team (do we have all the right people here?) and schedule monthly (minimum) meeting for at least 6 months
5. Identify nursing and physician champions in ED and ICU and ensure champions attend team meeting
6. Begin to define action plan and timeline for program development and implementation
Role of Executive Sponsor

- Review project plans
- Review results from first team meeting
- Identify anticipated barriers that senior leader can help address
- Enlist support and help AND ASK for a sponsor to be assigned to the project
How engaged is your Executive Sponsor?

A  Fully Engaged
B  Rises to most challenges of executive leader role
C  Rises to some challenges of executive leader role
D  Partially engaged
E  Not engaged
Tier I: Organizational Consensus and Support Milestones and Checklist

1. Define Sepsis Program Goal and aligned with organizational goals
2. Identify Executive sponsor
3. Collect Baseline Data—essential step; understand your current process
4. Develop sepsis team (do we have all the right people here?) and schedule monthly (minimum) meeting for at least 6 months
5. Identify nursing and physician champions in ED and ICU and ensure champions attend team meeting
6. Begin to define action plan and timeline for program development and implementation
Baseline Data Collection Process

- Pick time period for medical record query
- Sample size: minimum of 20 pts per ICU (may also want to get a 20 patient sample of severe sepsis patients)
- Query strategies: (can use core measure sample)
  - ICD-10 R65.20 and R65.21 or historically can look at ICD 9 codes: 785.52 and 995.92 or DRG 870, 871
  - If not sure that your coded data is accurate:
    - Patients in ICU on 1-2 antibiotics, vasopressor (review charts to see if meet criteria for severe sepsis with lactate > 4 or septic shock before including in outcome data or process data)
    - Or prospectively round in ICUs and pick up all septic shock patients till you get a sample of 20 patients
- Select Data Collection Elements
  - Outcome
  - Process
Do you have process and outcome data to drive your improvement process?

A  Yes
B  No
## How you Collect Data Impacts Use

<table>
<thead>
<tr>
<th>How is Data Used</th>
<th>Prospective</th>
<th>Concurrent</th>
<th>Retrospective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipatory review of patient record (can impact current care)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Data abstracted in real time or within 24 hours</td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Serves as a prompt to execute bundle or the next phase of the bundle</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Recommended for new improvement teams</td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Recommended for advanced improvement teams or those that have demonstrated success with process measures</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

Surviving Sepsis Campaign, Society of Critical Care Medicine, website accessed 1/26/2017
1. List the process steps below each box
2. For each process step include job title of persons performing the step
3. For each queue quantify the delay time (D/T)
4. Then total each to get L/T for the overall process

Highlight the steps with the biggest issues

Supplier Inputs:

Customer Requirements:

Total L/T to admit:

If bundle is not used, describe these resuscitation components

% bundle use:
- Labs:
- Meds:
- IV’s:
- Monitoring:
- Dynamic assessment
- CVP:
- MAP:
- ScvO2:
Tier I: Organizational Consensus and Support
Milestones and Checklist

1. Define Sepsis Program Goal and aligned with organizational goals
2. Identify Executive sponsor
3. Collect Baseline Data—essential step
4. Develop sepsis team (do we have all the right people here?) and schedule monthly (minimum) meeting for at least 6 months
5. Identify nursing and physician champions in ED and ICU and ensure champions attend team meeting
   – Create a sepsis coordinator position to oversee program
6. Begin to define action plan and timeline for program development and implementation
Does Your Organizations Have a Sepsis Committee/Team?

A  Yes
B  No
The Team Is KEY!
Can Be Major Barrier If Not Functioning Well

- **Must** have nurse and physician champions from ED and ICU (need at least one physician at all meetings)
- **Must** be linked in the organization’s quality or operational structure— **Are you linked?**
- **Must** meet at least 1-2 times per month
- Team members **must** be well educated on the evidence and armed with tools and knowledge to change behavior at the bedside— **Does the team need more education?**
- **MUST** have bedside nurses on team—provide reality check and best knowledge of barriers— **Do you?**

Consider developing nurse champions on each patient care unit and shift
Does your hospital have a Sepsis Coordinator?

A  Yes
B  No
Infection Prevention

VAE (VAP) Bundle BSI

Organizational Consensus that Severe Sepsis Must be Managed Early and Aggressively

Early Screening with Tools and Triggers

Implementation of the Sepsis Bundles

Measuring Success CQI

Hand Washing

VAE (VAP) Bundle CAUTI BSI

Infection Prevention

Documentation Improvement ~ Accurate Coding

Rapid Improvement

Adapted from: Sepsis Solutions International

1Continuous Quality Improvement
Tier II: Screening for Severe Sepsis Milestones and Checklist

- Develop screening process for ED, rapid response team, ICU and house wide
- Develop audit process to evaluate compliance and effectiveness
- Ensure screening process has clear “next steps” defined for nursing staff
SSC Guidelines Screening

2016: We recommend that hospitals and hospital systems have a performance improvement program for sepsis, including sepsis screening for acutely ill, high-risk patients (BPS).

2012: We recommend routine screening of potentially infected seriously ill patients for severe sepsis to increase the early identification of sepsis and allow implementation of early sepsis therapy (1C)

Rhodes, A et al. Crit Care Med 2017 published online
Finding the Patients
Redefining what a ‘septic shock’ patient looks like

<table>
<thead>
<tr>
<th>Before</th>
<th>NOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine in bed</td>
<td>Sitting up in bed</td>
</tr>
<tr>
<td>Ventilator</td>
<td>Nasal cannula</td>
</tr>
<tr>
<td>Fluids wide open</td>
<td>IV boluses</td>
</tr>
<tr>
<td>Increasing vasopressors</td>
<td>Weaning vasopressors</td>
</tr>
<tr>
<td>Minimally responsive</td>
<td>Awake</td>
</tr>
</tbody>
</table>

“Don’t look sick enough to be in ICU or to have a central line”

Must correct this misperception
Severe Sepsis: Defining a Disease Continuum

Infection → SIRS → Sepsis → Severe Sepsis

**Adult Criteria**
A clinical response arising from a nonspecific insult, including ≥ 2 of the following:

- **Temperature:** > 38°C or < 36°C
- **Heart Rate:** > 90 beats/min
- **Respiration:** > 20/min
- **WBC count:** > 12,000/mm³, or < 4,000/mm³, or > 10% immature neutrophils

**SIRS** with a presumed or confirmed infectious process

**Sepsis** with ≥ 1 sign of organ dysfunction, hypoperfusion or hypotension.

**Examples:**
- Cardiovascular (refractory hypotension)
- Renal
- Respiratory
- Hepatic
- Hematologic
- CNS
- Unexplained metabolic acidosis

SIRS = Systemic Inflammatory Response Syndrome

Shock
Signs & Symptoms of Sepsis

Chills
Alteration in LOC
Tachypnea
Unexplained metabolic acidosis
↑Heart rate
Altered blood pressure

↓Platelets
↑Bands
↓Skin perfusion
↓Urine output (adult > 0.5 ml/kg/hr)
Skin mottling
Poor capillary refill
Hyperglycemia
Purpura/petechia

Severe Sepsis: Defining a Disease Continuum

<table>
<thead>
<tr>
<th>Infection</th>
<th>SIRS</th>
<th>Sepsis</th>
<th>Severe Sepsis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SIRS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>with a presumed or confirmed infectious process</td>
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</tr>
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**Examples:**
- Cardiovascular (refractory hypotension)
- Renal
- Respiratory
- Hepatic
- Hematologic
- CNS
- Unexplained metabolic acidosis

SIRS = Systemic Inflammatory Response Syndrome

Shock
Identifying Acute Organ Dysfunction as a Marker of Severe Sepsis

**CNS**
- Altered consciousness (unrelated to primary neuro pathology)
- Glasgow Coma Score less than or equal to 12

**Respiratory**
- SaO2 less than 90% or increasing O2 requirements

**Hepatic**
- Serum total bilirubin greater than or equal to 4mg/dl

**Metabolic**
- Serum lactic acid greater than or equal to 2mEq/L

**Cardiovascular**
- SBP less than 90mmHg or 40mmHg less than baseline or MAP < 65mmHg
- Need for Vasopressors

**Renal**
- UO < 0.5 ml/kg per hr (despite fluid)
- Creatinine increase of > 0.5mg/dl from baseline

**Hematologic**
- Platelets less than 100,000; INR greater than 1.5
Why Do You Need to Have a Routine Screening Process?

- **TIME IS TISSUE!!**
  - Similar to trauma, AMI, or stroke, the speed and appropriateness of therapy administered in the initial hours after severe sepsis develops are likely to influence outcomes.¹
- To screen effectively, it must be part of the nurses’ daily routines—i.e., part of admission and shift assessment
- Must define a process for what to do with the results of the screen

If you don’t screen you will miss patients that may have benefited from the interventions

2. Schorr C. et al Journal of Hospital Medicine, 2016;11:S32-S39
What areas are you currently performing routine screening?

- **A** ED only
- **B** ED/ICUs
- **C** ED/ICU/RRT
- **D** House-wide (ED/ICU/RRT/all floors)
- **E** No current routine screening
### Paper or Electronic....That is the Question

<table>
<thead>
<tr>
<th>Method</th>
<th>Pros</th>
<th>Limitations</th>
</tr>
</thead>
</table>
| Paper form                    | • Nurses critically think as they screen the patient  
• Easy and quick to develop  
• No cost | • Screening is intermittent  
• Paper can be misplaced  
• Static—no ability to automate an alert |
| EMR form                      | • Nurses critically thinks as they screen the patient  
• Can automate alerts for positive screens | • Screening is intermittent  
• Length of programming time  
• Cost |
| EMR—real time, continual screening | • 24 hour screening  
• Can automate alerts for positive screens | • Nurse does not screen patient—potential loss of screening knowledge and critical thinking  
• Computer not reliably able to identify patients who have infection  
• Computer not able to discern if SIRS is valid or organ dysfunction is new |
| EMR—real time and scheduled   | • Form fires and pre populates for nurse to screen upon admission and each shift—nurse critically thinks  
• 24 hour screening  
• Manual screen completed when EMR alert fires---nurse discerns/validates appropriateness/correctness of alert | • Screening form needs to be developed in EMR—programming time and costs |
### Patient Units Severe Sepsis Screening Tool

**Severe Sepsis = Infection + SIKS + Organ Dysfunction**

**Directions:** The screening tool is for use in identifying patients with severe sepsis. Screen each patient upon admission, once per shift and PRN with change in condition.

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
</tr>
</thead>
</table>

#### I. SIRS - Systemic Inflammatory Response Syndrome (2 or more of the following):
- Temperature greater than or equal to 100.4°F or less than or equal to 96.8°F
- Heart Rate greater than 90 beats/minute
- Respiratory Rate greater than 20 breaths/minute
- WBC greater than or equal to 12,000/mm³ or less than or equal to 4,000/mm³ or greater than 5,000/mm³
- Blood glucose greater than 140 mmol/L, in non-diabetic patient
- Negative screen for severe sepsis (Please initial)

If check two of the above, move to II.

#### II. Infections (one or more of the following):
- Suspected or documented infection
  - Antibiotic Therapy (not prophylaxis)

If check none of above – Negative screen for severe sepsis (Please initial) – answer infection question NO in I/IV

If check one of above – answer Infection question YES in I/IV, call physician for serum lactate level and move to II.

#### III. Organ Dysfunction (change from baseline) (one or more of the following within 3 days of new infection):
- Respiratory: PaO₂/FiO₂ less than 300 or increasing CI requirements
- Cardiovascular: SBP less than 90 mmHg OR 40 mmHg less than baseline OR MAP less than 65 mmHg
- Renal: urine output less than 0.5 mL/kg/hr, creatinine increase of greater than 0.5 mg/dL from baseline
- CNS: altered consciousness (unrelated to primary neuro pathology)
- Glucose: Glucose <60 mg/dL or <120 mg/dL
- Hematologic: platelets less than 100,000; INR greater than 1.5
- Hepatic: Serum total bilirubin greater than or equal to 4 mg/dL
- Metabolic: Serum lactate greater than or equal to 2 mmol/L

Negative screen for severe sepsis (Please initial)

If check one in section III or a severe sepsis alert fires, patient has screened positive for severe sepsis:
1. Call rapid response team
2. Call physician, physician assistant or nurse practitioner and implement urgent measures protocol
3. Initiate or ensure IV access (2 large bore IVs if no central access)
4. Obtain a venous blood gas (peripheral vein), serum lactate level, CUSP (if it has been greater than 12 hrs since last test), two sets of blood cultures (if greater than 24 hours since last set)
5. If patient is hypotensive via crystalloid fluid bolus – 20 mL/kg over one hour or as fast as possible until hypotension resolved, unless known EF is less than 35% or adverse outcome for heart failure.

### Severe Sepsis Induced Hypoperfusion

- For Lactate Acid 3-6.9
  1. Hypoperfusion AFT POT Initial Fluid Bolus (30 mL/kg)
  2. Lactate acid greater than or equal to 4 mmol/L, with any BP

- Yes
  - Administer CDS SEPSE
  - Initiate transfer to ICU

- NO
  - For Lactate acid 3.3-6.9 or Initial hypoperfusion that persisted to the 30 mL/kg fluid bolus, initiate transfer to MICU
  - Initiate Intermediate Care Severe Sepsis Bundle on back and
  - Complete interventions

### SEPSE, INDUCED HYPOPERFUSION

- For Lactate Acid 3-6.9
  1. Hypoperfusion AFT POT Initial Fluid Bolus (30 mL/kg)
  2. Lactate acid greater than or equal to 4 mmol/L, with any BP

- YES
  - Administer CDS SEPSE
  - Initiate transfer to ICU

- NO
  - For Lactate acid 3.3-6.9 or Initial hypoperfusion that persisted to the 30 mL/kg fluid bolus, initiate transfer to MICU
  - Initiate Intermediate Care Severe Sepsis Bundle on back and
  - Complete interventions

**RN Signature, Initial Date & Time:**
General Care Severe Sepsis Bundle

For patients with 2 or more SIRS + known/suspected infection + initial lactic acid 2-2.9 w/o additional organ dysfunction

- Blood cultures x 2
- Antibiotics w/in 1 hr of screening positive for sepsis. Ensure antibiotic is ordered STAT (call Rx and notify of STAT order)
- Vital signs: every 1 hr x 4, then every 4 hr x 2, then once per shift
- Lactic acid every 4 hr x 24 hr
- I & O every 2 hr (if no void w/in 4 hr, bladder scan- if greater than 200 mL perform intermittent straight cath), call MD if less than 0.5 mL/kg/hr
- Maintain/monitor for:
  - SBP greater than 90 mmHg
  - Urine output greater than 0.5 mL/kg/hr
  - Decrease in lactic acid x 3 results or normalization x2 within 12 hours

**If unable to maintain these parameters or if pt has additional organ dysfunction, call MD for possible transfer to IMC/ICU
- Continue sepsis screen every shift and prn change in patient condition
- Complete 0 to 1 hour interventions, below

Date/Time: ______________ to ______________

If hypotensive, volume resuscitate: initial 30 mL/kg as fast as possible, then additional boluses as needed per order

Time 30 mL/kg fluid bolus infused

Broad spectrum antibiotic after obtaining blood culture

Time antibiotic hung

Initial Labs: serum lactate, additional labs as ordered by physician

Yes No Serum lactic acid drawn
Yes No Blood Cultures x 2

Time 1: ______________ Time 2: ______________

Other cultures:

Establish IV access (2 large bore IVs)

Signature: ______________________________ Date/Time: ______________

Intermediate Care Severe Sepsis Bundle

For patients with 2 or more SIRS + known/suspected infection + initial lactic acid 3-3.9 or had hypotension that responded to fluid bolus

- Blood cultures x 2
- Antibiotics w/in 1 hr of screening positive for sepsis. Ensure antibiotic is ordered STAT (call Rx and notify of STAT order)
- Vital signs: every 30 min x 4, then every 1 hr x 2, then every 2hr x 4; then every 4 hr
- Lactic acid every 4 hr x 24 hr
- I & O every 2 hr (if no void w/in 4 hr, bladder scan- if greater than 200 mL perform intermittent straight cath), call MD if less than 0.5 mL/kg/hr
- Continue to administer fluid boluses per physician order to achieve/maintain the following goals:
  - SBP greater than 90 mmHg
  - Urine output greater than 0.5 mL/kg/hr
  - Decrease in lactic acid x 3 results or normalization x2 within 12 hours

**If unable to achieve these parameters or if pt has increase in lactic acid of 0.5 or more, increase in O2 requirements, mental status change, or additional organ dysfunction, call MD for possible transfer to ICU

- Complete 0 to 1 hour interventions, below

Date/Time: ______________ to ______________

If hypotensive, volume resuscitate: initial 30 mL/kg as fast as possible, then additional boluses as needed per order

Time 30 mL/kg fluid bolus infused

Broad spectrum antibiotic after obtaining blood culture

Time antibiotic hung

Initial Labs: serum lactate, additional labs as ordered by physician

Yes No Serum lactic acid drawn
Yes No Blood Cultures x 2

Time 1: ______________ Time 2: ______________

Other cultures:

Establish IV access (2 large bore IVs)

Signature: ______________________________ Date/Time: ______________
Screening Tool - ED
Screening Tool

COKEVILLE REGIONAL MEDICAL CENTER
ADULT SEPSIS SCREENING TOOL & PROTOCOL FOR CVICU/ICU

☑ Within 48 hours post op CVOR Pt

1. Patient has known or suspected new infection?

then proceed to question 2

2. Check all that apply to your patient
☑ Temperature greater than 38°C (100.4 °F) or Less than 36°C (96.8 °F)
☑ Heart Rate greater than 90 bpm
☑ Respiratory Rate greater than 20 bpm or PaCO2 less than 32 mmHg
☑ WBC count greater than 12,000 mm³ or WBC count less than 4000 mm³ or Greater than 10% bands

3. Are any of the following NEW organ dysfunction criteria present?
(Different from baseline)
☑ Respiratory: increased oxygen requirements
☑ Cardiovascular: SBP less than 90 or MAP less than 65 or on vasopressor
☑ Renal: urine output less than 0.5ml/kg/hr, creatinine greater than 2
☑ Metabolic: lactate greater than 2 mmol/L

• If question 1 is yes and question 2 has less than 2 boxes checked = a negative screen (SIRS criteria may be less if immunocompromised or on beta blockers)

• If question 1 is yes and question 2 has 2 or more boxes checked then obtain/report the following:

☐ Lactic acid STAT (result) Date: ________ Time: ________

☐ Blood cultures x 2 STAT PERIPHERALLY (Only if not done in prior 48 hrs)

Date: ________ Time: ________ Date: ________ Time: ________

☐ Notify physician of results STAT

Discuss with physician if hypotensive, or lactic acid greater than or equal to 4 to start 30mL/kg fluid bolus

Negative screen

Positive screen sepsis (patient has known/suspected infection and 2 or more SIRS criteria)

Positive screen for severe sepsis (Patient has known or suspected infection, 2 or more signs of SIRS and 1 or greater organ affected unrelated to primary pathology) physician notified (RN to fill our Severe Sepsis/Septic Shock Pathway Form 1112-PRN)

Positive screen for septic shock (patient has known or suspected infection, 2 or more signs of SIRS and hypotension after fluid bolus or lactic acid greater than or equal to 4) physician notified, (obtain: order for adult septic shock orders, and transfer to ICU) (RN to fill out Severe Sepsis/Septic Shock Pathway Form 1112-PRN)

Provider: ____________________________ notified, Date: ________ Time: ____________________________

Nurse Signature: ____________________________ Date: ________ Time: ____________________________
Make Screening for Severe Sepsis Process-Dependent

- Weave into fabric of current practice
- Bedside nurse should do the screening—every shift and prn with condition changes
- Define expectation to screen during shift assessment and PRN with changes in patient’s conditions
- Screen for severe sepsis with every rapid response or medical response team call
- Identify strategies for initiation of therapy once patient with positive screen for severe sepsis is identified
Screening: Barriers/Strategies

• Barriers
  – Time for nurses to do it (perception vs. reality)
  – Screening is not specific only for severe sepsis
  – Positive screen is not a diagnosis of severe sepsis

• Strategies
  – Must assign responsibility and enforce accountability
  – Perform audits to measure compliance and identify problems
  – Round on unit and ask nurses how it is going and discuss issues
The Importance of Early Detection

- Efforts to **just treat recognized sepsis** alone is not enough.
- A critical aspect of **mortality reduction** has been pushing practitioners to identify sepsis early.
  - It may well be that **earlier recognition** accounts for much of the signal in mortality reduction and partially explains sharply increasing incidence.
  - Without recognition that the **clock is ticking**, there is simply no incentive to recognize a challenging diagnosis early.

SEPSIS (SEVERE SEPSIS) AND SEPTIC SHOCK ARE MEDICAL EMERGENCIES, AND WE RECOMMEND THAT TREATMENT AND RESUSCITATION BEGIN IMMEDIATELY

2016 Surviving Sepsis Guidelines Best Practice Statement

Definitions (used by CMS and coders)

- Infection
- **Sepsis**: infection plus 2 or more SIRS
- **Severe Sepsis**: infection plus 2 or more SIRS plus new organ dysfunction
- **Septic Shock**: severe sepsis with a lactic acid greater than or equal to 4mmol/L OR continued hypotension (systolic BP<90 or 40mmHg decrease from their baseline) after initial fluid bolus (30ml/kg)
Sepsis 3:
Singer et al, JAMA 2016. PMID: 26903338

- **Sepsis is:** ‘life-threatening organ dysfunction caused by a dysregulated host response to infection’
  - Sepsis-3 does away with:
    - SIRS criteria (sepsis is pro- and anti-inflammatory)
    - Severe sepsis (sepsis = the old severe sepsis)
    - Antiquated concepts: sepsis syndrome; septicemia

- Sepsis-3 codifies the quantification of organ dysfunction through the SOFA score (Sequential Organ Failure Assessment)

- **Septic shock:** vasopressor-dependent hypotension + lactate >2

Sepsis-3 includes clinical criteria to predict life-threatening disease
**qSOFA:**
- Respirator Rate $> 22$
- Altered Mental Status
- Systolic BP $< 100\text{mmHg}$

### Table 1: Sequential (Sepsis-Related) Organ Failure Assessment Score

<table>
<thead>
<tr>
<th>System</th>
<th>Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respiration</strong></td>
<td></td>
<td>400 (53.3)</td>
<td>$&lt;400$ (53.3)</td>
<td>$&lt;300$ (40)</td>
<td>$&lt;200$ (26.7) with respiratory support</td>
<td>$&lt;100$ (13.3) with respiratory support</td>
</tr>
<tr>
<td>PaO$_2$/FiO$_2$, mm Hg (kPa)</td>
<td></td>
<td>$\geq$150</td>
<td>$&lt;150$</td>
<td>$&lt;100$</td>
<td>$&lt;50$</td>
<td>$&lt;20$</td>
</tr>
<tr>
<td><strong>Coagulation</strong></td>
<td></td>
<td>$&lt;1.2$ (20)</td>
<td>$1.2-1.9$ (20-32)</td>
<td>$2.0-5.9$ (33-101)</td>
<td>$6.0-11.9$ (102-204)</td>
<td>$&gt;12.0$ (204)</td>
</tr>
<tr>
<td>Platelets, $\times 10^9$/μL</td>
<td></td>
<td>$&lt;150$</td>
<td>$&lt;100$</td>
<td>$&lt;50$</td>
<td>$&lt;20$</td>
<td></td>
</tr>
<tr>
<td><strong>Liver</strong></td>
<td></td>
<td>$&lt;1.2$ (20)</td>
<td>$1.2-1.9$ (20-32)</td>
<td>$2.0-5.9$ (33-101)</td>
<td>$6.0-11.9$ (102-204)</td>
<td>$&gt;12.0$ (204)</td>
</tr>
<tr>
<td>Bilirubin, mg/dL (μmol/L)</td>
<td></td>
<td>$&lt;1.2$ (20)</td>
<td>$1.2-1.9$ (20-32)</td>
<td>$2.0-5.9$ (33-101)</td>
<td>$6.0-11.9$ (102-204)</td>
<td>$&gt;12.0$ (204)</td>
</tr>
<tr>
<td><strong>Cardiovascular</strong></td>
<td></td>
<td>MAP $\geq$70 mm Hg</td>
<td>MAP $&lt;70$ mm Hg</td>
<td>Dopamine $&lt;5$ or dobutamine (any dose)$^b$</td>
<td>Dopamine 5.1-15 or epinephrine $\leq 0.1$ or norepinephrine $\leq 0.1$</td>
<td>Dopamine $&gt;15$ or epinephrine $&gt;0.1$ or norepinephrine $&gt;0.1$</td>
</tr>
<tr>
<td><strong>Central nervous system</strong></td>
<td></td>
<td>15</td>
<td>13-14</td>
<td>10-12</td>
<td>6-9</td>
<td>$&lt;6$</td>
</tr>
<tr>
<td>Glasgow Coma Scale score$^c$</td>
<td></td>
<td>15</td>
<td>13-14</td>
<td>10-12</td>
<td>6-9</td>
<td>$&lt;6$</td>
</tr>
<tr>
<td><strong>Renal</strong></td>
<td></td>
<td>$&lt;1.2$ (110)</td>
<td>$1.2-1.9$ (110-170)</td>
<td>$2.0-3.4$ (171-299)</td>
<td>$3.5-4.9$ (300-440)</td>
<td>$&gt;5.0$ (440)</td>
</tr>
<tr>
<td>Creatinine, mg/dL (μmol/L)</td>
<td></td>
<td>$&lt;1.2$ (110)</td>
<td>$1.2-1.9$ (110-170)</td>
<td>$2.0-3.4$ (171-299)</td>
<td>$3.5-4.9$ (300-440)</td>
<td>$&gt;5.0$ (440)</td>
</tr>
<tr>
<td>Urine output, mL/d</td>
<td></td>
<td>$&lt;500$</td>
<td>$&lt;200$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Abbreviations: FiO$_2$, fraction of inspired oxygen; MAP, mean arterial pressure; PaO$_2$, partial pressure of oxygen.

$^b$ Catecholamine doses are given as μg/kg/min for at least 1 hour.

$^c$ Glasgow Coma Scale scores range from 3-15; higher score indicates better neurological function.

$^a$ Adapted from Vincent et al.$^{27}$
Keep doing what you are doing and consider measuring q-SOFA and SOFA scores in addition to current practice to assess high risk of death until CMS changes or large prospective studies are performed.
“qSOFA will Inevitably be Misunderstood to be a “Sepsis Screen.””

• The SOFA score is an illness-severity score which may be used to predict the mortality of any critically ill patient.
• qSOFA was also designed to predict mortality within the context of a cohort of patients with suspected infection.
• Thus, qSOFA and SOFA are predictors of mortality; they are not tests of early sepsis at risk to progress to organ failure.
If you are screening, are you only using known or suspected infection, > 2 q SOFA, and/or SOFA?

A  Yes
B  No
Incompatibility with Current Proven QI Efforts

• The Sep-3 definitions are mortality predictors, not screening definitions for early identification
• CMS definitions and core measures have NOT changed
• ICD-10 has NOT changed
• No pathway to implement at our current institutions —How would a transition happen? Big bang go live?
Infection Prevention

VAE (VAP) Bundle
Organizational Consensus that Severe Sepsis Must be Managed Early and Aggressively
Early Screening with Tools and Triggers
Implementation of the Sepsis Bundles
Measuring Success CQI¹

Sepsis Practice Collaborative Model
4 Tier Process for Program Implementation

Hand Washing

VAE (VAP) Bundle
CAUTI
BSI

Infection Prevention

Documentation Improvement ~ Accurate Coding

¹Continuous Quality Improvement

Adapted from: Sepsis Solutions International
Components of TIER III
Milestones and checklist

• Understand current process for caring for septic shock patients
  • ‘Go and See’ work
  • Baseline data

• Order sets
• Common Barriers/Issues: *identified Gaps from ‘Go and See’ work*

• Educational plan
• Implementation plan
  • Unit champions
  • Prospective rounding
  • Independent checks
<table>
<thead>
<tr>
<th><strong>SURVIVING SEPSIS CAMPAIGN RECOMMENDATION HIGHLIGHTS</strong></th>
<th>2012</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SEPSIS DEFINITION</strong></td>
<td>Systemic manifestation of infection + suspected infection</td>
<td>Life threatening organ dysfunction caused by dysregulated response to infection</td>
</tr>
<tr>
<td></td>
<td>Severe sepsis: sepsis + organ dysfunction</td>
<td>No severe sepsis category</td>
</tr>
<tr>
<td><strong>INITIAL RESUSCITATION</strong></td>
<td>at least 30 cc/kg in first 3 hours</td>
<td>Protocolized care including CVP</td>
</tr>
<tr>
<td></td>
<td>Crystalloid fluid (no recommendations on 0.9% NaCl vs balanced solution)</td>
<td>ScVO2</td>
</tr>
<tr>
<td></td>
<td>Albumin if patients require “substantial” fluids (weak)</td>
<td>Normalize lactate</td>
</tr>
<tr>
<td><strong>VASOPRESSORS</strong></td>
<td>target MAP of 65 mmHg</td>
<td>Use dynamic resuscitation markers (passive leg raise)</td>
</tr>
<tr>
<td></td>
<td>1. Norepinephrine</td>
<td>Target MAP of 65 mmHg</td>
</tr>
<tr>
<td></td>
<td>2. Epinephrine if not at target MAP OR vasopressin to reduce norepinephrine requirement</td>
<td>Reassess hemodynamic status to guide resuscitation</td>
</tr>
<tr>
<td></td>
<td>3. Avoid dopamine in most patients</td>
<td>Normalize lactate</td>
</tr>
<tr>
<td><strong>STEROIDS</strong></td>
<td>Only indicated for patients with septic shock refractory to adequate fluids and vasopressors</td>
<td></td>
</tr>
<tr>
<td><strong>ANTIBIOTICS</strong></td>
<td>One or more antibiotics active against presumed pathogen</td>
<td>Initial broad spectrum antibiotics (ex: vancomycin + piperacillin-tazobactam )</td>
</tr>
<tr>
<td></td>
<td>Combination therapy (double coverage) for neutropenic patients and pseudomonas</td>
<td>Against combined therapy (i.e. do not double cover pseudomonas)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May use procalcitonin to guide de-escalation</td>
</tr>
<tr>
<td><strong>SOURCE CONTROL</strong></td>
<td>Achieve within 12 hours, if feasible</td>
<td>Achieve as soon as medically and logically feasible</td>
</tr>
<tr>
<td><strong>VENTILATOR</strong></td>
<td>6 cc/kg tidal volume</td>
<td>Against high frequency oscillatory ventilation (HFOV)</td>
</tr>
<tr>
<td></td>
<td>prone patients with severe ARDS (P/F &lt;150 in 2017 guideliens)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>no recommendation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>weak recommendation for noninvasive ventilation in select patients with sepsis induced ARDS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unable to make recommendation on noninvasive ventilation</td>
</tr>
</tbody>
</table>

Source Control-Does it Make a Difference

- Prospective observational analysis of an antibiotic intervention in severe sepsis study- Spanish multi center
- 99 medical-surgical ICUs in Spain
- 3663 patients with severe sepsis or septic shock between 2011 and 2013
- Measured outcomes:
  - Source control
  - Hospital mortality

Source Control—Does It Make a Difference

Results:
– 32% underwent source control
– Predominantly abdominal (67.2%), urinary and soft tissue infections
– Time to source control: median 4.6 hrs (1-11.5)
– Source control:
  • Patients had a greater prevalence of shock, MODS, bacteria, lactic acidemia
  • Compliance with resuscitation bundle was worse
  • ICU mortality significantly lower
  • Hospital mortality significantly lower
– Time to source control could not be linked to survival

TO BE COMPLETED WITHIN 3 HOURS OF TIME OF PRESENTATION †:

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

† “time of presentation” is defined as the time of earliest chart annotation consistent with all elements severe sepsis or septic shock ascertained through chart review.
Time Zero

- Will always be when the chart annotation suggests signs and symptoms are all present.
- May be from nursing charting/screens, lab flow sheets, physician documentation, order sets, anything with a time stamp.
- Will = triage time if all signs and symptoms are present at triage.
- *It does not require MD documentation of the clock starting and relying on this alone in the ED would likely result in late clock starts.*

Sepsis coding is increasing but is accurate. More aggressive treatment seen from 2003 to 2013


Slides courtesy of Sean Townsend
5. Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP) $\geq 65\text{ mmHg}$

6. In the event of persistent hypotension after initial fluid administration (MAP $< 65 \text{ mm Hg}$) or if initial lactate was $\geq 4 \text{ mmol/L}$, re-assess volume status and tissue perfusion and document findings according to table 1.

7. Re-measure lactate if initial lactate elevated.
TABLE 1
DOCUMENT REASSESSMENT OF VOLUME STATUS AND TISSUE PERFUSION WITH:

Either

• Repeat focused exam (after initial fluid resuscitation) by licensed independent practitioner including vital signs, cardiopulmonary, capillary refill, pulse and skin findings.

Or two of the following:

• Measure CVP
• Measure ScvO2
• Bedside cardiovascular ultrasound
• Dynamic assessment of fluid responsiveness with passive leg raise or fluid challenge
STUDIES SUPPORTING THE 3 AND 6 HOUR BUNDLES
Early Goal Directed Therapy

Methodology: 263 severe sepsis patients

- Early Goal-Directed Therapy (EGDT)
  - Continuous ScvO2 monitoring & tx with fluids, blood, inotropes &/or vasoactives to maintain:
    - ScvO2 ≥ 70%, SaO2 ≥ 93%, Hct ≥ 30%, CI/VO2
    - CVP ≥ 8-12
    - MAP ≥ 65
    - UO ≥ .5ml/kg/hr

- Standard Therapy
  - CVP ≥ 8-12
  - MAP ≥ 65
  - UO ≥ .5ml/kg/hr

Early Goal-Directed Therapy Results

28-day Mortality

- Standard Therapy: 49.2% (n=133)
- EGDT: 33.3% (n=130)

P = 0.01*

NNT = 7–8

*Key difference was in sudden CV collapse, not MODS

The Changing Paradigm of Septic Shock Management

- ProCESS trial-randomized, 31 centers, 1341 patients
- ARISE trial- randomized, 51 centers (mostly Australia and New Zealand), 1600 patients
- Promise—randomized, UK, 56 centers, 1260 patients
A systematic review and meta-analysis of early goal-directed therapy for septic shock: the ARISE, ProCESS and ProMISe Investigators

### A Primary mortality outcome of each study

<table>
<thead>
<tr>
<th>Study</th>
<th>Events, EGDT</th>
<th>Events, control</th>
<th>OR (95% CI)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers et al. (2001)</td>
<td>38/130</td>
<td>59/133</td>
<td>0.52 (0.31, 0.86)</td>
<td>10.40</td>
</tr>
<tr>
<td>Jones et al. (2010)</td>
<td>34/150</td>
<td>25/150</td>
<td>1.47 (0.82, 2.60)</td>
<td>4.87</td>
</tr>
<tr>
<td>ProCESS Investigators (2014)</td>
<td>92/439</td>
<td>167/902</td>
<td>1.17 (0.88, 1.55)</td>
<td>21.78</td>
</tr>
<tr>
<td>ARISE Investigators (2014)</td>
<td>147/792</td>
<td>150/796</td>
<td>0.98 (0.76, 1.26)</td>
<td>30.71</td>
</tr>
<tr>
<td>ProMISe Investigators (2015)</td>
<td>184/623</td>
<td>181/620</td>
<td>1.02 (0.80, 1.30)</td>
<td>32.23</td>
</tr>
<tr>
<td>Overall (I-squared = 56.7%, p = 0.055)</td>
<td>495/2134</td>
<td>582/2601</td>
<td>1.01 (0.88, 1.16)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

DOI 10.1007/s00134-015-3822-1
A Randomized Trial of Protocol-Based Care for Early Septic Shock

The ProCESS Investigators*

**Intravenous Fluids**

<table>
<thead>
<tr>
<th>Fluid Type</th>
<th>Volume (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGDT</td>
<td>2.8</td>
</tr>
<tr>
<td>Usual Care</td>
<td>2.3</td>
</tr>
</tbody>
</table>

**Intravenous Antibiotics**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGDT</td>
<td>97.5%</td>
</tr>
<tr>
<td>Usual Care</td>
<td>96.9%</td>
</tr>
</tbody>
</table>

DOI: 10.1056/NEJMo1401602

Copyright © 2014 Massachusetts Medical Society.
Results of 3 International Studies 2014-2015

- ARISE and Promise had two groups: EGDT and Usual care
- ProCess had three groups: EGDT, structured resuscitation and usual care
- Before randomization all patients received antibiotics and an average of 2500ml of NS (equal to 30ml/kg), had blood cultures and lactate drawn
- No statistically significant difference in mortality between groups
- Mortality rate 18% for ARISE & ProCess
- Mortality rate 30% for Promise

ProCESS Investigators, 2014; 370:1683-1693
Serum Lactate is Associated with Sepsis Mortality

Objective:
- Test whether the association between initial serum lactate level and mortality in patients presenting to the ED with severe sepsis is independent of organ dysfunction and shock

Design:
- Retrospective, single center cohort study
- Academic teaching hospital

Patients:
- 830 adults admitted with severe sepsis in the ED
- Stratified lactate into 3 groups: low (<2), intermediate (2-3.9) and high (> or equal to 4)

Mikkelsen, Mark et al. CCM 2009 Vol 37 No 5
Results:

Intermediate and high serum lactate significantly associated with mortality regardless of the presence of shock or other organ dysfunction.

A single serum lactate seems to risk-stratify patients independent of organ dysfunction or hemodynamic instability.

Mikkelsen, Mark et al  CCM 2009 Vol 37 No 5
Initiation of Inappropriate Antimicrobial Therapy Results in a Fivefold Reduction of Survival in Human Septic Shock

- Objective: determine the impact of the initiation of inappropriate antimicrobial therapy on survival to hospital discharge of patients with septic shock
- Retrospective review of 5,715 patients from 22 different hospitals in Canada, US and Saudi Arabia
- Data collected from 1996-2005

Kumar A. et al. Chest, 2009; 136; 1237-1248
Initiation of Inappropriate Antimicrobial Therapy Result in a 5-Fold Reduction of Survival in Human Septic Shock

- 5,715 patients in septic shock in three countries
- 55% of cases were from community acquired infection
- Decrease in survival with inappropriate initial antibiotics was fivefold

Kumar A. et al. Chest, 2009; 136; 1237-1248
Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock

*2,154 septic shock patients*

*Effective antimicrobial administration within the 1st hour of documented hypotension was associated with increased survival in patients with septic shock.*

*Each hour of delay over the next 6 hours was associated with an average decrease in survival of 7.6% (range 3.6-9.9%)*
## Mortality by Time to Antibiotics

### Severe Sepsis: SSC Database

<table>
<thead>
<tr>
<th>Time to Abx HOURS</th>
<th>OR</th>
<th>CI</th>
<th>CI</th>
<th>P value</th>
<th>Prob of Death</th>
<th>CI</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.0</td>
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<td>-</td>
<td>-</td>
<td>13.7</td>
<td>13.3</td>
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</tr>
<tr>
<td>1</td>
<td>1.10</td>
<td>1.05</td>
<td>1.15</td>
<td>&lt;0.001</td>
<td>14.9</td>
<td>13.7</td>
<td>16.1</td>
</tr>
<tr>
<td>2</td>
<td>1.21</td>
<td>1.10</td>
<td>1.32</td>
<td>&lt;0.001</td>
<td>16.1</td>
<td>15.1</td>
<td>17.2</td>
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<tr>
<td>3</td>
<td>1.33</td>
<td>1.15</td>
<td>1.52</td>
<td>&lt;0.001</td>
<td>17.4</td>
<td>16.2</td>
<td>18.7</td>
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<tr>
<td>4</td>
<td>1.46</td>
<td>1.22</td>
<td>1.75</td>
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<td>18.8</td>
<td>17.1</td>
<td>20.6</td>
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<tr>
<td>5</td>
<td>1.60</td>
<td>1.20</td>
<td>2.01</td>
<td>&lt;0.001</td>
<td>20.3</td>
<td>18.0</td>
<td>22.8</td>
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<tr>
<td>6</td>
<td>1.76</td>
<td>1.34</td>
<td>2.31</td>
<td>&lt;0.001</td>
<td>21.9</td>
<td>18.8</td>
<td>25.3</td>
</tr>
</tbody>
</table>

5% Increase in Mortality for Every Hour Delayed

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*Surviving Sepsis Campaign: Association Between Performance Metrics and Outcomes in a 7.5-Year Study* Levy, M et al. CCM 2015
## Mortality by Time to Antibiotics Septic Shock: SSC Database

<table>
<thead>
<tr>
<th>Time to Abx HOURS</th>
<th>OR</th>
<th>CI</th>
<th>CI</th>
<th>P Value</th>
<th>Prob of Death</th>
<th>CI</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
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<td>-</td>
<td>-</td>
<td>22.2</td>
<td>20.7</td>
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<tr>
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<td>1.00</td>
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<td>24.5</td>
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<td>1.06</td>
<td>1.00</td>
<td>1.12</td>
<td>&lt;.046</td>
<td>23.2</td>
<td>22.0</td>
<td>24.5</td>
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<td>1.09</td>
<td>1.00</td>
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<td>23.7</td>
<td>22.5</td>
<td>25.1</td>
</tr>
<tr>
<td>4</td>
<td>1.12</td>
<td>1.00</td>
<td>1.26</td>
<td>&lt;.046</td>
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<td>22.7</td>
<td>25.9</td>
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<tr>
<td>5</td>
<td>1.16</td>
<td>1.00</td>
<td>1.33</td>
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<td>24.8</td>
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<td>1.19</td>
<td>1.00</td>
<td>1.41</td>
<td>&lt;.046</td>
<td>25.4</td>
<td>23</td>
<td>27.9</td>
</tr>
</tbody>
</table>

5% Increase in Mortality for Every Hour Delayed

Surviving Sepsis Campaign: Association Between Performance Metrics and Outcomes in a 7.5-Year Study Levy, M etal CCM 2015
What do you feel is the biggest challenge with the 3 hour bundle?

A. Obtaining lactic acid
B. Obtaining blood cultures
C. Obtaining blood cultures prior to antibiotics
D. Giving antibiotics
E. Giving the 30ml/kg fluid bolus
What is your biggest challenge with the 6 hour bundle?

A. Obtaining the repeat lactate
B. Administering the vasopressor for persistent hypotension
C. The physical reassessment
D. The 2/4 options (ScvO2, CVP, PLR, ultrasound)
Common Barriers/Issues

• Timely antibiotics
• Fluid bolus (30ml/kg)
• Repeat focus exam
Antibiotics

- Appropriate initial antibiotics
  - Guide for providers recommending the appropriate antibiotic based on whether hospital or community acquired, source and your hospital's antibiogram
- Turnaround time---from indication to hanging
  - ED vs ICU vs Floor
- Understand your current process and where the gaps are
- Make antibiotics rapidly available
- Factors that showed delay administration
  - Higher APACHE, older, presence of co-morbidities, HLOS before hypotension, dx of pneumonia, admin to academic hospitals & transfer from medical wards

Fluid Boluses

- How fast should they be given?
  - Gravity or pressure bag not by infusion pump
- What about dialysis patients?
- What about patients with CHF or low EF?

Fluid bolus is given rapidly, IV wide open, pressure bag if necessary; goal is 500ml every 15-30 minutes.
Fact

- One liter of normal saline adds 275 ml to the patient’s plasma volume

Slides courtesy of Sean Townsend
Heart Failure—Going to Flood My Patient

- Not Based in Evidence
- Rivers et al Study: % Ventilated Patients

<table>
<thead>
<tr>
<th>Hours after start of Therapy</th>
<th>0-6</th>
<th>7-72</th>
<th>0-72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Therapy</td>
<td>53.8%</td>
<td>16.8%</td>
<td>70.6%</td>
</tr>
<tr>
<td>Early Goal Directed Therapy</td>
<td>53%</td>
<td>2.6%</td>
<td>55.6%</td>
</tr>
<tr>
<td>P Value</td>
<td>&lt;.001</td>
<td>0.02</td>
<td></td>
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</tbody>
</table>

Chronic coexisting conditions-CHF:
Control 30.2%
EGDT 36.7%

Impact of Early Fluid & Amount

- Prospective, observational cohort of all ED severe sepsis or septic shock patients during 13 months
- 90,000 average ER visits
- 1,866 subjects; 53.6% were men, 72.5% were white, mean age was 72 years (SD 16.6 years),
- Mean initial lactate level was 2.8 mmol/L.
- 86% received intravenous antibiotics within 180
- 64% had intravenous fluid initiated within 30 minutes

Impact of Early Fluid and Amount

• Results
  – ↓ Mortality in 30 minutes group (159 [13.3%] versus 123 [18.3%])
  – ↓ median hospital length of stay (6 days versus 7 days)
  – Adjustment for age, lactate, hypotension, acute organ dysfunction, and Emergency Severity Index score, intravenous fluid within 30 minutes was associated with lower mortality
  – ↑ mortality with later fluid administration
    • 13.3% (30 minutes) versus 16.0% (31 to 60 minutes) versus 16.9% (61 to 180 minutes) versus 19.7% (>180 minutes)

Clinical Scenario-with Questions

- 80yr old pt with CHF and ESRD arrives at the ED with severe sepsis and a MAP of 55
- Receives 1.5 liter (15ml/kg) and his MAP increases to 70 & never drops again and receives no more fluid
- His Lactate is 1.0-pt would fail the measure because didn’t get 30/ml/kg response
- Clinicians questions:
  - Is that correct?
  - If it is correct why? I assume you would agree with me that giving such a patient another 1.5/L strong possibility of more harm than benefit
  - If you agree with me that more fluid is not indicated-reviewers would score that as a fall out
  - If 3 is correct-do you still try to convince physicians to give entire 30/ml/kg-if so what evidence to support
Dr. Townsend’s Response

• 4 major trials on shock patients, each of the new trials found the patients received an average of 30/ml/kg

• There is no trial specific to your patient—but trials have averages and patient characteristics

• **If you are falling out all the time—something is wrong** increases if they received the 30 ml/kg

• Rivers trial-CHF with more fluids & EGDT had less mechanical ventilation

• Not an absolutist-He tells peoples do what you think is clinically correct

• The long and short is 30ml/kg is evidence based average. People should deviate from the average if they have strong clinical doubts and accept the failure
Why Do All Severe Sepsis Patients Need Volume?

- Vascular volume is lost into interstitial space due to diffuse capillary leaking from cytokine release.
- Both venous and arteriolar tone is reduced & blood volume occupies a larger intravascular space than normal.
- Many patients also have GI and Skin losses.
- Only 40% of NS stays intravascular; the rest goes into the interstitial space. An initial BP response is not an indication to not give full bolus.

- Large trial before and after bundle implementation for patients with intermediate lactate values >2 < 4.
- ↓ in hospital mortality in the bundle implementation group was observed in the patient with CHF and kidney disease compared with patients without.
- Received more fluid with the bundle approach.

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 Crystallloid*

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

- ESRD on hemodialysis or CHF
  
  Intubated/mechanically ventilated
  
  Rapid infusion of 30 ml/kg crystalloid *

  Total of 30 ml/kg crystalloid* with frequent reassessment of oxygenation

*Administer 30 ml/kg crystalloid within first 3 hours

**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 or
   - 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.

All=acute lung injury; CHF=congestive heart failure; CMS=US Centers for Medicare and Medicaid Services; CVP=central venous pressure; ESRD=end stage renal disease; kg=kilograms; ml=milliliters; oxyhg=oxyhemoglobin; ScvO2=superior vena cava oxygen saturation
Reassessment for Volume Status and Perfusion

- Team decide how to support all options in table 1
  - Focused exam—templated notes? Specific form? Making sure it is done between after fluid bolus and before 6 hours
  - Do you have all the correct equipment and tools and training for:
    - CVP (IJ, Subclav or femoral)
    - ScvO2 (intermittent vs continuous)
    - Bedside cardiovascular ultrasound
    - Dynamic assessment of fluid responsiveness with passive leg raise or fluid challenge (must be able to monitor CI, SV—pulse contour technology, non-invasive or PA catheter,)
Optimize Cardiac Performance

Fluid Bolus to define place on curve:

- Record SV
- Give 250-500 NS bolus over 15 minutes
- Record SV
- If see greater than a 10% increase in SV — pt is on steep portion of curve and will still respond to fluid (fluid responsive)
Algorithm for Stroke Volume Optimization

If stroke volume or corrected flow time is low

Give 200 mL of colloid or 500 mL of crystalloid

Is the heart pumping enough blood?

Yes (stroke volume increased <10%)

Stop giving fluids; monitor stroke volume as indicated

If stroke volume decreased >10%

No (stroke volume increased >10%)

Other therapies as appropriate, for example:

- High afterload state: dilators (± more fluid) if low corrected flow time, low peak velocity, and blood pressure acceptable
- Low contractility state: inotropic agents if low peak velocity and blood pressure
- Low afterload state: vasopressors if high corrected flow time, high stroke volume, and low blood pressure

Figure 7 Example of an algorithm for stroke volume optimization.
Passive Leg Raise

- Meta-analysis of 21 studies of 991 patients whom 995 fluid challenges were performed, found changes in cardiac output induced by a passive leg raise test highly reliable in predicting fluid responsiveness

Sensitivity of .85 & specificity .91

If Using CVP and ScvO2

- Provider confidence/competency in placing central lines
- Defined who will place central line when pt has lactate>4mMol/L or still hypotensive after initial fluid bolus
  - ED or ICU?
  - What happens on off shifts and weekends?
- Adequate equipment in ED/ICU to insert and monitor CVP
- Educate nurses in ED/ICU on hemodynamic monitoring and ScvO2
  - Is there sufficient nursing staff to handle the acuity and intensity of these patients in the ED?
- Why do I need a CVP?
  - Research shows that CVPs don’t accurately reflect volume status.
Focused Examination

- **Vital Signs**
  - Temp, HR, BP, RR

- **Cardiopulmonary**
  - Rhythm, S1/2/3/4, presence of murmur and lung sounds

- **Peripheral Pulses**
  - 1+, 2+ or absent

- **Capillary Refill**
  - Brisk, <2 sec, >2 sec

- **Skin**
  - Mottled vs no mottling, to what level. Warm vs cold, etc

Study compared physical findings of ineffective circulation (cap refill >2, skin mottling and cool extremities) to PA catheter- Physical findings not useful predictor of low cardiac index or low mixed venous

CMS documentation change

• Documentation indicating a physician/APN/PA has reviewed, performed, or attested to reviewing or performing a skin examination is acceptable. If documented this way, reference to skin color, appearance, or condition is not required.

• Documentation indicating a physician/APN/PA has performed, or attested to performing a physical examination, perfusion (re-perfusion) assessment, or sepsis (severe sepsis or septic shock) focused exam is acceptable. If documented this way, reference to skin color, appearance, or condition is not required.
What is your current % all or none compliance with the core measure?

A  75-100%
B  50-74%
C  25-49%
D  0-24%
E  I don’t know my hospital’s compliance data
Tier III: Develop and Implement the Education Plan

- Content: (present to physicians, nurses and RTs)
  - Significance of problem
  - Sepsis continuum
  - Pathophysiology of severe sepsis
  - Prevention and management (share the evidence)
  - Case studies for staff to practice with bedside tools

- Methods:
  - Self learning modules
  - Classroom and/or small groups of staff on unit
  - Web-based: IE: clinicaledonline.com

- Ongoing:
  - build into orientation,
  - monthly for residents,
  - every 6 months for all staff,
  - one-on-one during rounds
TIER III: Develop Implementation Plan

- Identify who will oversee the implementation and the expectations of that person (sepsis nurse or program coordinator)
- Define ICU/ED resources for staff that they can call at any time for questions and assistance
- Create rounding schedule and process
  - Should begin as daily in the ICU and ED
  - Keep master list of all patients who go on the bundles (and those who should have but didn’t if possible)
  - Do real time interventions to ensure patients get the evidence based practices
  - Define follow up process for review and evaluate missed opportunities
Tools to Assist with Consistent Application of the Evidence

- Identify tools to assist bedside staff to implement bundles
  - algorithm, pathway, checklist, pocket cards, green folder etc
- Create protocols
  - For positive screen: lactate, blood cultures and fluids
  - When patients need ICU level care
- Multidisciplinary Rounds
- Handoffs
- Real time review and feedback
**ADULT SEPSIS CRITERIA**

**SIRS**
- T < 96.8°F (36°C) or > 100.3°F (38.3°C)
- HR > 90
- RR > 20
- WBC > 12,000 or < 4,000 or > 10% bands

**Sepsis**
- Known or suspected infection
- PLUS 2 or more SIRS criteria

**Severe Sepsis**
- Organ Failure Criteria:
  - Cardiovascular: SBP < 90 or 40 mm Hg from baseline or MAP < 65
  - Respiratory: SaO2 < 90% or PaCO2 > 40 mmHg
  - Coagulopathy: INR > 1.5
  - Metabolic: Lactic Acid > 2 mmol/L
  - Change in mental status (new)
  - Platelets < 100,000

**Sepsis PLUS New Organ Failure**
- Septic Shock
  - Septic shock (SIRS hypotension: SBP < 90 or MAP less than 65)
  - Despite 30 mL/kg fluid bolus
  - Lactate greater than or equal to 4 mmol/L

**Sepsis Bundles**

**TO BE COMPLETED WITHIN 3 HOURS OF TIME OF PRESENTATION**:  
1. Measure lactate level  
2. Obtain blood cultures prior to antibiotics  
3. Administer broad spectrum antibiotics  
4. Administer 30mL/kg crystalloid for hypotension or lactate >4mmol/L  
   † “time of presentation” is defined from earliest chart notation consistent with severe sepsis/shock

**TO BE COMPLETED WITHIN 6 HOURS**  
5. Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain (MAP) ≥65mmHg  
6. In the event of persistent hypotension after initial fluid administration (MAP < 65 mmHg) or if initial lactate was ≥4mmol/L, reassess volume status and tissue perfusion.  
7. Re-measure lactate if initial lactate > 2  
   DOCUMENT REASSESSMENT OF VOLUME STATUS AND TISSUE PERFUSION BY LIP:  
   - Gender  
   - Repeat focused exam (after initial fluid resuscitation) by LIP including VS, cardiopulmonary cap refill, pulse and skin findings.  
   - Or two of the following:  
     - Measure CVP  
     - Measure Svo2  
     - Bedside cardiovascular ultrasound  
     - Dynamic assessment of fluid responsiveness with passive leg raise or fluid challenge
Badge or Pocket Card

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.

TABLE 1
DOCUMENT REASSESSMENT OF VOLUME STATUS AND TISSUE PERFUSION WITH:

EITHER:
- Repeat focused exam (after initial fluid resuscitation) including vital signs, cardiopulmonary, 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.

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www.survivingsepsis.org
Inclusion in Interdisciplinary Rounds

### Interdisciplinary Rounds – ABCDE Circular Bundle & Nursing Objectives

1. **Assess Pain:** What is the current score? What is the pain goal and current scale?
2. **Breathing:** Both SAT and SBT  
   - Were they coordinated? Pass or Fail?
3. **Choice of Sedation:** Name of medication, route and dosage
4. **Delirium:** What is the CAM-ICU result?  
   - If +, possible causes & interventions?
5. **Exercise:** Mobility Level?  
   - What level is pt progressing to?  
   - PT/OT consult?
6. **Family:** Patient/Family questions? Goals for the day?  
   - Who will update pt/family? When?  
   *(Continued on back)*
7. **Severe Sepsis** screen result? + or –  
   - On the bundle? What goals have not been met?
8. **Vasoactive Infusions**
9. **Skin:** Pressure Ulcer? POA?  
   - Current description of PU
10. **Foley:** Can it be removed?  
    - Renew Order
11. **Lines / Tubes:**  
    - Other Tubes?  
    - Vascular Access?
12. **Patient Diet / Tube Feeding / Bowel Regimen:** Nutrition concerns?
13. **Restraints:** Type? Time of Order Expiration?
14. Time of scheduled procedures today? Expected labs / tests
15. **Other:** Nursing concerns
# Severe Sepsis / Septic Shock Clinical Pathway

**Please complete the following:**

- **Time severe sepsis criteria met**: Date: ____________ Time: ____________
- **Time septic shock criteria met (Time Zero)**: Date: ____________ Time: ____________

1. Severe sepsis criteria: Known or suspected infection plus 2 or more SIRS plus new organ dysfunction (see screening tool for organ dysfunction criteria).
2. Septic shock criteria: severe sepsis plus SBP less than 90 mm Hg or 40 mm Hg decrease from baseline after initial fluid bolus or requires vasopressors or initial lactic acid is greater than or equal to 4 MEq/L.

<table>
<thead>
<tr>
<th>Decision Grid</th>
<th>Date ______ to _______ 0-6 Hours</th>
<th>Date ______ to _______ 6-24 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient with severe sepsis:</strong> Implement interventions below within 1 hour:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td><strong>Patient with hypotension after initial fluid bolus and/or lactic acid greater than 4 MEq/L</strong></td>
</tr>
<tr>
<td>Establish IV access</td>
<td></td>
<td><strong>Septic Shock Bundle</strong></td>
</tr>
<tr>
<td>Blood Cultures X 2</td>
<td>Time 1:</td>
<td>Apply vasopressor immediately for hypotension after fluid bolus</td>
</tr>
<tr>
<td>Time 2:</td>
<td></td>
<td>Re-measure lactic acid if initial lactic acid is greater than 2 MEq/L within 4 hours of meeting severe sepsis criteria</td>
</tr>
<tr>
<td>If No, and initial lactic acid greater than 2 MEq/L: Repeat lactic acid within 4 hours of meeting severe sepsis criteria</td>
<td><strong>Continue screening</strong></td>
<td>At ___ (next planned draw time)</td>
</tr>
<tr>
<td><strong>If Yes:</strong></td>
<td></td>
<td>In the event of persistent hypotension after initial fluid administration (MAP less than 65 mm Hg) or if initial lactic acid greater than or equal to 4 MEq/L, reassess volume status and tissue perfusion and document findings accordingly to below. Between hours 3-6 (at a minimum)</td>
</tr>
<tr>
<td>Patient meets septic shock criteria</td>
<td><strong>Continue to next column</strong></td>
<td>Repeat focused exam-including vital signs, cardiovascular, capillary refill, pulse and skin findings by physician or APP</td>
</tr>
<tr>
<td>6 hour septic shock bundle</td>
<td><strong>Off two of the following</strong></td>
<td><strong>Stroke volume optimization with passive leg raise or fluid challenge (500 ml over 15 min)</strong></td>
</tr>
<tr>
<td><strong>Yes</strong></td>
<td><strong>Volumetric replacement</strong></td>
<td><strong>Volumetric replacement</strong></td>
</tr>
<tr>
<td><strong>Needs more volume</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**In patients with ARDS (P/F ratio less than 300):**

**Yes** | **No** | Mechanical ventilation  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td><strong>No</strong></td>
<td>Is the tidal volume 6 ml/kg of ideal body weight in the first 24 hours</td>
</tr>
</tbody>
</table>

**Yes** | **No** | Are the static or plateau inspiratory pressures less than 30 cmH2O in the first 24 hours |

<table>
<thead>
<tr>
<th><strong>24-72 Hours</strong></th>
<th><strong>Q</strong></th>
<th>Re-assess need for broad spectrum antibiotics based on culture reports</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q</strong></td>
<td><strong>Yes</strong></td>
<td>Re-evaluate need for invasive lines and tubes</td>
</tr>
<tr>
<td><strong>Q</strong></td>
<td><strong>Yes</strong></td>
<td>Resume screening after 72 hours</td>
</tr>
</tbody>
</table>

**Nurse**

**Nurse**

**Physician**

**Signature, Date & Time**
### Sepsis Checklist

**SEVERE SEPSIS-SEPTIC SHOCK CHECKLIST**

**DATE:**

<table>
<thead>
<tr>
<th>Time Zero Severe Sepsis:</th>
<th>Time Zero Septic Shock:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time ED Sepsis Alert Paged:</td>
<td>Time Rapid Response Team Paged (inpatient):</td>
</tr>
</tbody>
</table>

**Nurse to complete ALL interventions as quickly as possible and within 3 hours or less:**

**Physician order:** Obtain orders for Severe Sepsis Bundle & Sepsis Bundle Antibiotics

- Found in Powerchart under "Sepsis Initial Evaluation".

**IV access:** Obtain 18 gauge or larger if possible
- Attempted but unable to obtain specimen

**Lactate Sent:** Send initial lactate test if not done already
- Attempted but unable to obtain specimen

**Blood Cultures Sent:** Obtain prior to antibiotics send 2 sets from 2 peripheral sites
- Attempted to draw blood cultures prior to antibiotics, unable to obtain specimen

**IV Antibiotic Given STAT:** DO NOT HOLD ANTIBIOTICS if going to OR, give now

- **GOAL:** Give 1st antibiotic within 1 hour of severe sepsis identification (give Vanco 2nd due to infusion time required)
- Date and time of antibiotics that were started within 3 hours: Green available in EDACU Pyxis machine

- Cefepime 2g
- Zosyn 4.5g
- Vanco (if ordered give 2nd)
- Cipro 400mg
- Ceftriaxone 2g
- Others:

**Initial IV Fluid Bolus Completed:**

- Administer 30 mL/kg 0.9% sodium chloride or lactated ringers bolus for a lactate level ≥4 (regardless of BP) or SBP<90mmHg or MAP<65mmHg
- RAPIDLY INFUSE entire bolus amount over 1 hour
- Monitor for improvement in BP, HR, urine output, etc.

**WEIGHT-BASED BOLUS AMOUNT:**

- Actual weight in kg ^ 0.733 x 30 = _____________
- *START TIME DOCUMENTED IN EMR*

**Repeat Lactate Sent:** SEND IMMEDIATELY AFTER IVF BOLUS if initial lactate was > 2.

- If transferred before recheck:
- INFORM ACCEPTING RN UPON HAND-OFF OF NEED TO SEND REPEAT LACTATE
- Attempted to draw blood but was unable to obtain.

**Post-Bolus Vital Signs Recorded:**

- Minimum of 2 full sets VS (including TEMP recorded IMMEDIATELY and 15 min AFTER IVF BOLUS completed e.g. UP-BP-RI-15 in EMR if SBP < 90 or HR < 60 we need VS 30 min)

**The next 3 items to be completed for patients meeting SEPTIC SHOCK criteria:**

- INITIAL lactate 4 or more OR Persistent hypotension despite initial fluid bolus

**Vasopressors Applied:** Required if hypotension despite IVF bolus of 30mL/kg

- Requires physician order: Noradrenaline is 1st choice OR Not required: hypotension not present

**Physician Documented Post IVF Bolus Shock Re-Assessment Exam:**

- I have completed a refocused sepsis exam. Date: __________ Time: __________

**Provider Signature:**

**Provider Printed Name:**

- OR pick 2:
  - Measure CVP
  - Bedside cardiovascular ultrasound
  - Measure ScvO2
  - Passive leg raise or fluid challenge

- **INITIAL**
  - **Initiates:**
  - **Signed by CDS & Date:**

**INITIAL**

- **INITIAL**
  - **Initiates:**
  - **Signed by CDS & Date:**
# Cookeville Regional Medical Center

## Severe Sepsis/Septic Shock Clinical Pathway

### Time Zero: Date: __________ Time: __________
- **Patient:** [Name]  
- **Unit:** [Unit Name]  
- **Diagnosis:** [Diagnosis]  
- **Admission Date:** __________  
- **Time:** __________  
- **Room #:** __________  
- **Discharge Status:** [Alive/Expired]

### Severe Sepsis defined as:
- Known or suspected infection, 2 or more signs of SIRS, organ dysfunction, and hypotension which is defined as systolic BP less than 90mmHg or MAP less than 65 or 40mmHg decrease in BP from baseline after a 30mL/kg fluid bolus or known or suspected infection with 2 or more signs of SIRS, organ dysfunction, and hypoperfusion evidenced by a lactate level greater than or equal to 4.

### Septic Shock defined as:
- Known or suspected infection 2 or more signs of SIRS, organ dysfunction, and hypotension which is defined as systolic BP less than 90mmHg or MAP less than 65 or 40mmHg decrease in BP from baseline after a 30mL/kg fluid bolus or known or suspected infection with 2 or more signs of SIRS, organ dysfunction, and hypoperfusion evidenced by a lactate level greater than or equal to 4.

### Initials/Signature:
- **Initiates:**  
- **Signatures:**

### Goal directed therapy to achieve increased O2 delivery:
- CVP 8-12 mmHg (non-vented)  
- MAP greater than or equal to 65mmHg  
- ScvO2 greater than or equal to 70%  
- Blood Glucose less than 180 mg/dL  
- Urine output greater than 0.5 ml/kg/hour

### Time Zero = ED Arrival Time OR Direct Admit Arrival to Critical Care

### 0-1 Hours to 1-6 Hours:
- **ED Provider:** (if positive screen in ED)
- **Yes:** Serum lactate drawn STAT
- **Yes:** Blood Culture (BC) X 2 Periodically (first done in previous 48 hours)
- **Yes:** Other Cultures:方形 Broken Wound
- **Yes:** Establish IV access

### Date: __________
- **Patient weight in kg:** __________
- **Volume patient received:** (Goal 30mL/kg)
- **CVP 8-12 mmHg (see version):**  
- **MAP:** greater than or equal to 65
- **ScvO2:** greater than or equal to 70% or ScvO2 greater than or equal to 70% if PressO2 not monitored and you have a non-invasive central line drawn an SpO2 from the arterial line. If not, do not draw ones in 3 hours, or until goal of TGF.
- **Yes:** Confirm Infectious Source (actual reports confirming in labs, ct report)

### Date: __________
- **Initiates:**  
- **Signatures:**

### 1-6 Hours to 6-24 Hours:
- **Refer to Severe Sepsis Reclassification Algorithm:**  
- **Yes:** LA 2.3.5 [If yes, recheck LA within 2 hours-goal is to normalize LA  
- **LA T1 Time:** Result:  
- **2 hours later if elevated > 2 Time/LAP:** Result:  
- **Yes:** Initiate lactate greater than or equal to 4mmol/L
- **Yes:** No patient hypotensive after initial fluid bolus

### If above 2 questions both are NO: STOP this form and continue assessing every shift and PRN. If either question YES continue - This is now the Septic Shock portion of this form.

### Yes:** Central Line placed  
- **Type:** PreCath, PICC, Jug, SC TL, Fem, TL
- **Date:** __________
- **Time:** __________

### Provied Name:

### Date: __________
- **Time:** __________
- **Value:** __________

### In patients with acute lung injury or ARDS:
- Is tidal volume setting of ideal body weight in first 24 hours?
  - **Yes:**  
  - **No:**

### All Mechanically Ventilated Patients
- Are the static or plateau inspiratory pressures less than 30 or 20 in first 24 hours?
  - **Yes:**  
  - **No:**

### APRV
- **Yes:**  
- **No:**

### Oscillator Vent
- **Yes:**  
- **No:**

### Time: __________
- **Value:** __________

### Time: __________
- **Value:** __________

### Time: __________
- **Value:** __________

### Time: __________
- **Value:** __________

### TIME ZERO = ED Arrival Time OR Direct Admit Arrival to Critical Care

### Patient Identified on inpatient unit - follow below algorithm

- **Suspected/Known Infection:** (may be less if immunocompromised or on beta blockers)

### + Organ Dysfunction

### SEVERE SEPSIS

### SEPTIC SHOCK

---

*Form 1112-PRN (Rev. 7/16)*

---

**WHITE COPY - CHART**  
**YELLOW COPY - ICU CNS**
Develop a Protocol Based on the SSC Guidelines

• Obtain lactate when have 2 SIRS and suspected infection

• When screen positive for severe sepsis:
  – Nurse protocol to draw labs and give fluid bolus
  – Protocol done by RRT/Medical Response Team or all nurses

• Get medical staff approval
Severe Sepsis Placement Algorithm

Screened Positive for Severe Sepsis

For lactic acid less than 2.9

Initiate General Care Severe Sepsis Bundle on back and complete interventions

SEPSIS INDUCED HYPOPERFUSION?
(Clinical picture of severe sepsis plus one or both of the following criteria)
1. Hypotension AFTER initial fluid bolus (30 ml/kg)
   OR
2. Require vasopressor
   OR
3. Initial lactic acid greater than or equal to 4 mEq/L with any BP

YES

Activate CODE SEPSIS

Initiate transfer to ICU

Meanwhile, continue crystalloid resuscitation of 250-1000ml boluses if hypotensive after the initial bolus – per physician order

NO

For lactic acid 3-3.9 or initial hypotension that responded to the 30 ml/kg fluid bolus, initiate transfer to IMC

NO

Initiate Intermediate Care Severe Sepsis Bundle on back and complete interventions.
CODE SEPSIS: WHAT IS IT?

- Notify through paging the ICUs about septic shock patient
- RRT come to the bedside (for floor code sepsis)
- Urgently assess a patient with severe sepsis
- Assist the primary physician in achieving the goals of care
  - fluid resuscitation
  - expediting antibiotic delivery
  - movement to a higher level of care as indicated

ICU team does a pre admission huddle to define what interventions have been provided and defines top 3 priorities
Infection Prevention

VAE (VAP) Bundle BSI

Organizational Consensus that Severe Sepsis Must be Managed Early and Aggressively

Early Screening with Tools and Triggers

Implementation of the Sepsis Bundles

Measuring Success CQI¹

Rapid Improvement

Sepsis Practice Collaborative Model
4 Tier Process for Program Implementation

Hand Washing

Infection Prevention

VAE (VAP) Bundle CAUTI BSI

Documentation Improvement ~ Accurate Coding

¹Continuous Quality Improvement

Adapted from: Sepsis Solutions International
Tier IV: Measurement Milestones and Checklist

- Define outcome and process data elements that will be collected
- Develop and implement a data collection process
- Revise and update goals and action plan as needed
- Execute implementation plan
- Continuous improvement
CORE MEASURE

- Sepsis management is now a core measure that is reported to CMS started October 1st 2015
- Compliance is All or None—so all measure on the 3 and 6 hour bundles (that the patient qualifies for) need to be met in the appropriate timeframe to be compliant
Data Collection

• Patient Log
  – Define how will find all patients that receive the bundles
  – Real time data collection is optimal—then used as checklist to ensure patient receives all appropriate interventions

• Outcome
  – Mortality (ICU and Hospital)
  – Hospital LOS
  – Cost per case (total and direct)

• Process
  – Core Measures
    • Data elements that measure implementation of 3 hour and 6 hour bundle
Common Challenge: Insufficient Feedback, Data and Accountability

Strategies:

Sepsis Team (core group)
- Monthly multidisciplinary sepsis team meeting with consistent attendance
  - nursing and physician champions
  - lab, pharmacy, and radiology as needed
- Accountable executive understands the role, holds team accountable and assists with problem-solving and removing barriers
- Timely feedback (data) to the team providing care to the sepsis patients
Common Challenge: Insufficient Feedback, Data and Accountability

Strategies:

• Set goals/expectations for sepsis program
• Use examples of hospital patients in case studies for education of staff (good outcomes and bad)
• Review data at:
  • Sepsis team meeting
  • Quality meeting
  • Patient safety meeting
  • Unit based meetings
  • Medial staff/department meetings
  • Board meeting
• Provider specific data on compliance with bundle elements and patient outcomes, compared to the goal
• Individual case feedback based on case reviews
From the choices provided, which is a main obstacle to managing sepsis at your facility?
Real time access to abstracted data

Computerized order sets and alerts

Lack of dedicated sepsis resource

Institution’s commitment to address systematic problems resulting in non-compliance with evidence based sepsis protocols

Routine screening for sepsis on all floors
Severe Sepsis/Septic Shock Bundle Implementation Results
## CRMC’s Story

### Severe Sepsis/Septic Shock Summary

<table>
<thead>
<tr>
<th></th>
<th>Jan'16</th>
<th>Feb'16</th>
<th>Mar'16</th>
<th>April'16</th>
<th>May'16</th>
<th>June'16</th>
<th>July'16</th>
<th>Aug'16</th>
<th>Sept'16</th>
<th>Oct'16</th>
<th>Nov'16</th>
<th>Dec'16</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early Mgt Bundle Compliance Rate:</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td>59%</td>
<td>72%</td>
<td>64%</td>
<td>67%</td>
<td>60%</td>
<td>69%</td>
<td>72%</td>
<td>66%</td>
<td>70%</td>
<td>71%</td>
<td>65%</td>
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<tr>
<td><strong>Severe Sepsis Bundle:</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td># of patients that met criteria</td>
<td>51</td>
<td>58</td>
<td>76</td>
<td>75</td>
<td>49</td>
<td>61</td>
<td>53</td>
<td>65</td>
<td>67</td>
<td>52</td>
<td>80</td>
<td>86</td>
</tr>
<tr>
<td>Initial Lactate w/in 3 hrs</td>
<td>96%</td>
<td>95%</td>
<td>97%</td>
<td>95%</td>
<td>100%</td>
<td>98%</td>
<td>98%</td>
<td>97%</td>
<td>99%</td>
<td>100%</td>
<td>100%</td>
<td>97%</td>
</tr>
<tr>
<td>Bld C/S prior to ATB and w/in 3 hrs</td>
<td>88%</td>
<td>95%</td>
<td>96%</td>
<td>91%</td>
<td>94%</td>
<td>92%</td>
<td>94%</td>
<td>94%</td>
<td>99%</td>
<td>100%</td>
<td>95%</td>
<td>92%</td>
</tr>
<tr>
<td>ATB w/in 3 hrs</td>
<td>96%</td>
<td>90%</td>
<td>93%</td>
<td>97%</td>
<td>92%</td>
<td>95%</td>
<td>96%</td>
<td>92%</td>
<td>94%</td>
<td>94%</td>
<td>94%</td>
<td>91%</td>
</tr>
<tr>
<td>Repeat lactate w/in 6 hrs (if initial &gt;2)</td>
<td>83%</td>
<td>90%</td>
<td>74%</td>
<td>87%</td>
<td>88%</td>
<td>91%</td>
<td>95%</td>
<td>90%</td>
<td>98%</td>
<td>93%</td>
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<tr>
<td><strong>Septic Shock Bundle:</strong></td>
<td></td>
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<td></td>
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<tr>
<td># of patients that met criteria</td>
<td>18</td>
<td>17</td>
<td>24</td>
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<td>11</td>
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<td>19</td>
<td>14</td>
<td>22</td>
<td>25</td>
</tr>
<tr>
<td>Resuscitation W/cystalloid fluid w/in 3 hrs for pt w/initial hypot</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resuscitation w/cystalloid fluid w/in 3hrs for pt w/septic shock</td>
<td>83%</td>
<td>93%</td>
<td>83%</td>
<td>84%</td>
<td>80%</td>
<td>60%</td>
<td>73%</td>
<td>84%</td>
<td>76%</td>
<td>93%</td>
<td>94%</td>
<td>95%</td>
</tr>
<tr>
<td>Vasopressors for persist. Hypotension w/in 6 hrs</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>83%</td>
<td>50%</td>
<td>100%</td>
<td>100%</td>
<td>89%</td>
<td>100%</td>
<td>86%</td>
<td>80%</td>
<td></td>
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<tr>
<td>Repeat volume status/ tissue perfusion assessment w/in 6 hrs</td>
<td>75%</td>
<td>75%</td>
<td>90%</td>
<td>74%</td>
<td>80%</td>
<td>87%</td>
<td>73%</td>
<td>79%</td>
<td>84%</td>
<td>57%</td>
<td>77%</td>
<td>80%</td>
</tr>
<tr>
<td><strong>Other:</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Central line inserted for septic shock patients</td>
<td>39%</td>
<td>41%</td>
<td>67%</td>
<td>63%</td>
<td>53%</td>
<td>73%</td>
<td>64%</td>
<td>42%</td>
<td>53%</td>
<td>50%</td>
<td>55%</td>
<td>32%</td>
</tr>
<tr>
<td>Survival rate for severe sepsis and septic shock patients</td>
<td>88%</td>
<td>88%</td>
<td>83%</td>
<td>88%</td>
<td>82%</td>
<td>80%</td>
<td>94%</td>
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<tr>
<td>Readmission Rate</td>
<td>0%</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
<td>8%</td>
<td>5%</td>
<td>4%</td>
<td>9%</td>
<td>4%</td>
<td>6%</td>
<td>6%</td>
<td>6%</td>
</tr>
</tbody>
</table>
Surviving Sepsis Campaign
Results (28,150 patients)
218 Hospitals

<table>
<thead>
<tr>
<th>Entry Point</th>
<th>Subjects</th>
<th>Mortality (hosp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED</td>
<td>55.8%</td>
<td>26.0</td>
</tr>
<tr>
<td>ICU</td>
<td>32.2%</td>
<td>40.3</td>
</tr>
<tr>
<td>Ward</td>
<td>11.9%</td>
<td>44.2</td>
</tr>
</tbody>
</table>

Mortality over 7 year period
36.7% to 27.5%  ARR: 7%  RRR: 25%  p= 0.005  
ICU & Hos LOS 4% for every 10% ↑ in compliance

Levy, M et al. Intensive Care Medicine;2014;40;1623
## Surviving Sepsis Campaign

<table>
<thead>
<tr>
<th>Bundle Element</th>
<th>Mortality Odds Ratio</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactate &lt;2</td>
<td>0.80</td>
<td>0.73-0.89</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lactate 2 to &lt;3</td>
<td>0.67</td>
<td>0.59-0.76</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lactate ≥ 3</td>
<td>0.69</td>
<td>0.63-0.75</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Blood Cultures</td>
<td>0.82</td>
<td>0.77-0.87</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>0.85</td>
<td>0.81-0.90</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fluid Administration</td>
<td>0.86</td>
<td>0.73-1.01</td>
<td>&lt;0.07</td>
</tr>
<tr>
<td>CVP</td>
<td>0.84</td>
<td>0.78-0.91</td>
<td>&lt;0.001</td>
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<tr>
<td>ScvO2</td>
<td>0.83</td>
<td>0.76-0.90</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Levy, M et al. Intensive Care Medicine; 2014; 40; 1623
# Dose Effect:
High vs. Low Compliance

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Low resuscitation compliance</th>
<th>High resuscitation compliance</th>
<th>Total</th>
<th>p-value¹</th>
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<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Died</td>
<td>Percent</td>
<td>Total</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>11,609</td>
<td>4,475</td>
<td>38.6</td>
<td>17,861</td>
</tr>
<tr>
<td><strong>Location of severe sepsis identification</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ED</td>
<td>5,984</td>
<td>1,850</td>
<td>30.9</td>
<td>10,465</td>
</tr>
<tr>
<td>Ward</td>
<td>3,970</td>
<td>1,800</td>
<td>45.3</td>
<td>5,532</td>
</tr>
<tr>
<td>ICU</td>
<td>1,655</td>
<td>825</td>
<td>49.8</td>
<td>1,864</td>
</tr>
<tr>
<td><strong>Site duration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 years</td>
<td>4,960</td>
<td>1,896</td>
<td>38.2</td>
<td>3,352</td>
</tr>
<tr>
<td>2 to &lt; 3 years</td>
<td>1,611</td>
<td>600</td>
<td>37.2</td>
<td>6,557</td>
</tr>
<tr>
<td>≥ 3 years</td>
<td>5,038</td>
<td>1,979</td>
<td>39.3</td>
<td>7,952</td>
</tr>
</tbody>
</table>

Levy, et al Crit Care Med, 2015, 43:3-12
Intermountain Health: SS and Shock

Miller, Dong, Nelson, et al.: Sepsis Bundle and Mortality
Am J Respir Crit Care Med Vol 188, Iss. 1, pp 77–82, Jul 1, 2013
Intermountain Health: Shock

Miller, Dong, Nelson, et al.: Sepsis Bundle and Mortality
Am J Respir Crit Care Med Vol 188, Iss. 1, pp 77–82, Jul 1, 2013
I HAVE ALL THIS DATA, WHAT’S NEXT ??
Identify Gaps in Application of Evidence

• Set performance targets
  – IE: 90% compliance with obtaining lactates in 3 hours
• Prioritize area to work on first
  – Focus on screening and the 3 hour bundle first then move to the 6 hour bundle
• Understand the ‘why’ there are gaps
  – “go and see”—walk the process, talk with front line staff
  – Cause and effect—Fishbone
• Define action plan—
  – Can use IHI Model for Improvement
  – PDCA—tests of change
Determining the Gaps: Understanding Why

- Success relies on a complex set of tasks being completed in a limited amount of time
- Requires data collection and analysis to determine the bottleneck(s)
- Must analyze the workflow for patients arriving in the ED as well as those who become septic after hospitalization
- QI/PI teams are a great resource when available
- Multiple tools have proven successful
- Some examples of diagnostic tools used for analysis, and the “therapeutic” tools developed out of the analysis
Cause and Effect Diagram

Why is the initial 30ml/kg fluid bolus not being given

Themes:
1. Knowledge and comfort in using protocol
2. Accepting when physician doesn’t want to do protocol without going up chain of command
3. Fear of fluid in elderly, ESRD and CHF
4. Blame hypotension on other conditions
5. Unassertive RN staff

Communication
- Poor between residents and nursing staff
- Responses from physicians
- Physician aware and don’t respond and RN just accept it
- Communication breakdown RN- RN shift report
- Not sure what they received on another unit
- Takes too long for physician to come and see the patient

Policy

Environment/EMR
- Staff busy with more than one patient
- Getting orders in and charting in MAR (should treat like a code and chart late)
- Physical support especially on off shift
- Lack of documentation when fluid actually given

Material
- Appropriate labs not drawn/ordered
- Appears cardiogenic not septic
- ‘has BP has been low before’ accept low BP as normal
- Unsure of baseline BP
- Delay in identifying change in condition
- Infection not suspected—other causes pursued
- Blame hypotension on other conditions or source (i.e. sedation)
- Physician pushback
- Nurse/doctor hesitant because being diuresed
- Patient who ‘hovers’ or have unclear presentation

Process/critical thinking

- New interns
- Staff not aware of sepsis protocol—doesn’t require physician order
- Unassertive RN staff—at advanced beginner stage
- Not properly using screening tool
- Fear of fluid overload of renal or CHF patients (RN’s and doctors)
- Lack of education on appropriate fluid needed
- Physician not familiar with protocol and not consulting with senior
- Give fluid over long period of time or just increase IV rate

People/knowledge

Initial Fluid bolus (30ml/kg) not given in 3 hrs
- Not trusting high lactate and continue to recheck
- Patient not symptomatic with low BP
- RN not sure where pt is on pathway
- SBP >90 but MAP < 65—Rn doesn’t know pt might be in shock
- New RN afraid of starting fluids on someone where no fluids are running
- Doctors order small amt of fluid
- Staff knowledge deficit
- Nurse like exact orders in EMR before starting interventions—causes delays

Need to elicit support of CNL and charge nurse/nurse coordinators
**Sepsis Practice Collaborative Model**

4 Tier Process for Program Implementation

1. **Measuring Success**
   - Continuous Quality Improvement (CQI)

2. **Implementation of the Sepsis Bundles**
   - Early Screening with Tools and Triggers
   - Organizational Consensus that Severe Sepsis Must be Managed Early and Aggressively
   - Hand Washing
   - VAE (VAP) Bundle
   - CAUTI
   - BSI

3. **Infection Prevention**
   - Documentation Improvement ~ Accurate Coding

Adapted from: Sepsis Solutions International
## Sepsis Program Action Plan

<table>
<thead>
<tr>
<th>Item</th>
<th>Responsibility</th>
<th>Due Date</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assemble team</td>
<td></td>
<td></td>
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<tr>
<td>2. Identify executive sponsor</td>
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<tr>
<td>3. Educate team on evidence</td>
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<tr>
<td>4. Project Charter</td>
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<tr>
<td>5. Baseline data</td>
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<tr>
<td>6. Define screening tool and process—audit for ED, ICU, Floor, RRT</td>
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<tr>
<td>7. Define screening audit process</td>
<td></td>
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<tr>
<td>8. Develop triggers/processes to alert staff when time to move from first 3 hrs to shock bundle</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>9. Develop &amp; implement an educational plan for all staff:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Develop an implementation plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Data measurement &amp; feedback</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PRE-HOSPITAL SEPSIS RECOGNITION
Going beyond the hospital walls

*it’s all about the early*

- **Partner with EMS**
  - Have them screen and begin fluids for hypotension, possibly draw lactic acid

- **Partner with PCPs and medical and surgical homes** to educate on severe sepsis
The importance of the EMS role

- A study from Colorado looked at the role of pre-hospital care providers in the treatment of sepsis.
  - Paramedics were trained to recognize sepsis in the field through identification of SIRS criteria and alert the hospital in advance, similar to a STEMI notification.
  - Patients whose caregivers provided those alerts had a median arrival-to-antibiotic time of 24 minutes less than those whose caregivers didn’t.
  - While 24 minutes may seem unimpressive, in the context of previous research demonstrating a 7.6% increase in mortality for every one hour delay to antibiotics, it becomes more significant.

Going beyond the hospital walls

*It’s all about the early*

- Partner with EMS
  - Have them screen and begin fluids for hypotension, possibly draw lactic acid
    - Most EMS don’t routinely take temperatures, so need to change some of their processes
    - Provide education on sepsis and early recognition/management
    - When call to hospital, they can report result of sepsis screen
    - Get protocol/policy approved through EMS leadership
    - Have them measure compliance
EMS sepsis identification and management

Date: June 22, 2016

Sepsis

It is the purpose of this policy to recognize and treat sepsis early to promote optimal care and survival of patients who may be septic. This protocol applies to patients 18 years and above with a clinical suspicion of systemic infection who have 2 or more of the inclusion criteria. These patients are defined as meeting criteria for suspicion of sepsis and should be evaluated and treated per this protocol.

INCLUSION CRITERIA
1. Clinical suspicion of systemic infection, and two or more of the following:
   A. Hyperthermic temp >38°C (100.4°F)
   B. Hypothermic temp <36°C (96.8°F)
   C. Heart rate >90 bpm
   D. Respiratory rate <10 or >20 per min
   E. SBP <90 mm Hg or evidence of hypoperfusion

Pre-Medical Control
PARAMEDIC/SPECIALIST/PARAMEDIC
1. Follow General Pre-Hospital Care protocol.
2. Place patient in supine position.
3. Administer high flow oxygen via non-rebreather, unless contraindicated.

SPECIALIST/PARAMEDIC
4. Start 1 large bore IV catheter.
5. Start 2nd large bore IV catheter, if time permits.

PARAMEDIC
1. Place on cardiac monitor and trasluminator according to appropriate protocol.
2. Place on continuous pulse oximetry.
3. Measure blood glucose.
4. If the patient meets inclusion criteria, administer a NS IV/IO fluid bolus up to 1 liter, wide open. Assess the patient, repeat boluses to a maximum of 2 L NS as long as vital signs stabilizes per act.
5. (Optional) Measure ETCO2 level. If ETCO2 < 25, report level to the receiving facility as soon as possible.

Post Rad
PARAMEDIC
6. Consider Dopamine drip (Infotop) 400 mg in 250 ml of NS if the patient remains hypotensive (<90 mmHg after the 2 L NS bolus). Work to maintain systolic BP above 90 mmHg.
Effective Prehospital Sepsis Screening Tool in Orange County, Fla., Helps Identify Severe Sepsis
Thu, Sep 1, 2016 Journal of Emergency medical services

Figure 1: Orange County EMS System sepsis alert protocol

**Sepsis Alert**
The purpose of a Sepsis Alert is to provide pre-arrival Emergency Department notification in order to facilitate rapid assessment and treatment of a suspected severe sepsis patient.

A Sepsis Alert will be instituted for patients meeting the following 3 criteria:

1. Suspected infection
2. Two or more of the following:
   - Temperature > 38°C (100.4°F) OR < 36°C (96.8°F)
   - Respiratory Rate > 20 breaths/min
   - Heart Rate > 90 beats/min
3. ETCO2 ≤ 25 mmHg OR Lactate > 4 mMol

**Basic Life Support**
- Supplemental 100% Oxygen

**Advanced Life Support**
- Full ALS Assessment and Treatment
- Notify hospital of incoming Sepsis Alert prior to arrival
- IV 0.9% NaCl en route
  - Administer 250 ml boluses until systolic BP > 90 mmHg
  - Total amount of IVF should not exceed 2000 ml
  - Boluses may be given in rapid succession if systolic remains < 90 mmHg
- If systolic BP remains < 90 mmHg after 4th fluid bolus (1000 ml):
  - Dopamine infusion at 5-20 mcg/kg/min titrated to maintain systolic BP > 90 mm Hg
Partner with Skilled Nursing Facilities

- Educate them on sepsis, early identification and initial management
- Help them put in routine screening
Keys to Success

• Team in place with key stakeholders overseeing implementation
• Project coordinator with lead clinical staff on each unit
• Sepsis resource/coordinator rounds frequently on units
• Strong physician leadership on team
• Reminders to staff through use of bedside sepsis tools/checklist
• Empowerment of nursing staff to prevent errors
• Administrative support to help manage barriers
• Review data monthly to identify opportunities for improvement-real time follow up whenever possible
• Provider specific feedback or report cards related to performance
• Support from a collaborative
• EDUCATION, DATA, COACHING, EDUCATION…….
Gap Analysis: 4 Tiers - Example

• **Strong Action**
  - Sepsis coordinator/50% of job
  - Real time data collection & rounding
  - Nurse driven protocol for initiation of care

• **Intermediate Action**
  - Identify broad spectrum antibiotics
  - Placement in Pyxis
  - Order set
  - Education
  - Timely formal feedback to the team

Additional Items: Turn around time for lab (lactate)
Building Resiliency Into Interventions

- Forcing functions and constraints
- Automation and computerization
- Standardization and protocols
- Checklists and independent check systems
- Rules and policies
- Education and information
- Vague warnings – Be more careful!
Principles for Tests of Change

• Don’t wait for a committee approval
• Go to the committee after you have tested and have some data to support the new changes
• Form a hypothesis and collect some data (quantitative and qualitative)
• Revise - it takes many tests to build innovations
The PDSA Cycle for Learning and Improvement¹

**ACT**
- Set objective
- Ask questions and make predictions (why)
- Plan to carry out the cycle and data collection (who, what, where, when)

**STUDY**
- Analyze the data
- Compare data to predictions
- Summarize what was learned

**PLAN**
- Carry out the plan
- Document problems and unexpected observations

**DO**
- Collect and begin data analysis

What changes are to be made?
Next cycle?
### Planning a Test of Change

**Worksheet Example**

<table>
<thead>
<tr>
<th>SMALL TEST OF CHANGE</th>
<th>WHAT do you need to test this idea?</th>
<th>WHO will be involved in the tests?</th>
<th>HOW will you inform participants?</th>
<th>WHERE will the test occur?</th>
<th>WHEN will the test occur?</th>
<th>HOW will you know it is successful?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test routine screening on medical unit</td>
<td>Paper screening form that includes looking for infection, SIRS and organ dysfunction</td>
<td>3 staff nurses on the medical unit</td>
<td>Meet with 3 staff nurses to review the tool and process</td>
<td>9E medical unit</td>
<td>Week of June 5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Screening tool was completed correctly without any confusion and same result is obtained by staff nurse and sepsis team member</td>
</tr>
</tbody>
</table>

When will you compare what happened to your prediction? Week of June 12<sup>th</sup>

When will you decide what to do next? Try it with all the nurses on the day shift and night shift for one week

<table>
<thead>
<tr>
<th>SMALL TEST OF CHANGE</th>
<th>What did you predict will happen?</th>
<th>What happened?</th>
<th>What did you learn?</th>
<th>What are the next steps?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine sepsis screening</td>
<td>Screening form/process will be easy to follow and result in a correct screen</td>
<td>Screening process was easy and the results were correct</td>
<td>Nurses like having clear direction on the form for what to do with a positive screen for severe sepsis</td>
<td>Expand the test of change to the rest of the day shift and the night shift</td>
</tr>
</tbody>
</table>
**Your Turn, Try a Test of Change**

**Planning Worksheet**

<table>
<thead>
<tr>
<th>SMALL TEST OF CHANGE</th>
<th>WHAT do you need to test this idea?</th>
<th>WHO will be involved in the tests?</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When will you compare what happened to your prediction?
When will you decide what to do next?

<table>
<thead>
<tr>
<th>SMALL TEST OF CHANGE</th>
<th>What did you predict will happen?</th>
<th>What happened?</th>
<th>What did you learn?</th>
<th>What are the next steps?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Template for Sharing Your Tests of Change

- Small test of change:
- What did you predict will happen?
- What happened?
- What are your next steps?
Questions?
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