Improving Sepsis Mortality:
Leveraging Technology

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September 13, 2017
St. Vincent Evansville

436 bed Level II Adult and Pediatric Trauma Center
17,379 admissions per year
4,771 inpatient and 18,903 outpatient surgeries per year
64,131 emergency room visits per year
1,408 severe sepsis and septic shock patients per year
<table>
<thead>
<tr>
<th>Care Priorities</th>
<th>U.S. Incidence</th>
<th># of Deaths</th>
<th>Mortality Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI (1)</td>
<td>900,000</td>
<td>225,000</td>
<td>25%</td>
</tr>
<tr>
<td>Stroke (2)</td>
<td>700,000</td>
<td>163,500</td>
<td>23%</td>
</tr>
<tr>
<td>Trauma (3) (Motor Vehicle)</td>
<td>2.9 million</td>
<td>42,643</td>
<td>1.5%</td>
</tr>
<tr>
<td>Severe Sepsis (4)</td>
<td>751,000</td>
<td>215,000</td>
<td>29%</td>
</tr>
</tbody>
</table>

Sepsis is the leading cause of death in non-coronary care intensive care units.

Mortality rate:

• 30% (Severe Sepsis)
• 50% (Septic Shock)

From 2007 to 2009, over 2,047,038 patients were admitted with a sepsis-related illness

• 52.4% are diagnosed in the ED
• 34.8% on the hospital wards
• 12.8% in the ICU

EARLY GOAL-DIRECTED THERAPY IN THE TREATMENT OF SEVERE SEPSIS AND SEPTIC SHOCK

EMANUEL RIVERS, M.D., M.P.H., BRYANT NGUYEN, M.D., SUZANNE HAVSTAD, M.A., JULIE RESSLER, B.S., ALEXANDRIA MUZZIN, B.S., BERNHARD KNOBLICH, M.D., EDWARD PETERSON, PH.D., AND MICHAEL TOMLANOVICH, M.D., FOR THE EARLY GOAL-DIRECTED THERAPY COLLABORATIVE GROUP*

Conclusions

Early goal-directed therapy provides significant benefits with respect to outcome in patients with severe sepsis and septic shock. (N Engl J Med 2001;345:1368-77.)

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or pulmonary-artery catheterization

enrolled patients up to 72 hours after admission to the intensive care unit. The negative results of studies of the use of hemodynamic variables as end points (“hemodynamic

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*The members of the Early Goal-Directed Therapy Collaborative Group are listed in the Appendix.
In-hospital Mortality

<table>
<thead>
<tr>
<th>Therapy Type</th>
<th>Mortality (%)</th>
<th>Sample Size</th>
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</thead>
<tbody>
<tr>
<td>Standard therapy</td>
<td>46.5%</td>
<td>n=133</td>
</tr>
<tr>
<td>Early goal-directed therapy</td>
<td>30.5%</td>
<td>n=130</td>
</tr>
</tbody>
</table>

*P* = 0.009

In 2007 we launched a Physician Driven Quality initiative for treatment of Severe Sepsis & Septic Shock based on the 2004 Surviving Sepsis Campaign guidelines.

The initiative was successful, but not sustainable...
SSC Serum Lactate within 6 hours of Presentation

- May 08 - June 08: 35%
- July 08 - Dec 08: 45%
- Jan 09 - June 09: 49%
- July 09 - Dec 09: 56%
- Jan 10 - Apr 10: 55%

SSC Blood Cultures collected within 3 hours before Broad Spectrum Abx administered

- May 08 - June 08: 75%
- July 08 - Dec 08: 85%
- Jan 09 - June 09: 86%
- July 09 - Dec 09: 99%
- Jan 10 - Apr 10: 82%

SSC Broad Spectrum Abx administered within 3 hours of ED admission or 1 hour for non-ED admission

- May 08 - June 08: 75%
- July 08 - Dec 08: 77%
- Jan 09 - June 09: 76%
- July 09 - Dec 09: 81%
- Jan 10 - Apr 10: 76%

SSC For hypotension or lactate >4 mmol/L, 20 ml/kg Crystalloid Fluid Bolus delivered followed by Vasopressors if

- May 08 - June 08: 26%
- July 08 - Dec 08: 57%
- Jan 09 - June 09: 62%
- July 09 - Dec 09: 60%
- Jan 10 - Apr 10: 69%
SEPSIS BUNDLE AND MORTALITY RATE
July 2008-February 2009

Resuscitation Bundle
Mortality

Percentage

Jul-08 Aug-08 Sep-08 Oct-08 Nov-08 Dec-08 Jan-09 Feb-09
Surviving Sepsis Campaign
Resuscitation Bundle and Mortality Rate
Jan 2010 - Sep 2013

Percentage

- Resuscitation Bundle
- Linear (Resuscitation Bundle)
- Mortality
- Linear (Mortality)
A grant funded initiative allowed us a full time Sepsis Coordinator position.

The multidisciplinary team was carefully constructed and first brought together in January 2014.
Our Goals

Facilitate early recognition of severe sepsis
• Provider education
• Screening tools
• Treat sepsis as an emergency

Emphasize timely evidence-based management
• Assessment of perfusion
• Early antibiotics
• Fluid resuscitation
• Assessment of adequacy of resuscitation
Achieving Our Goals

Screening tools were updated and a process was put in place for all patients (18 or older) coming through the Emergency Department to be screened at the time of triage.

Severe Sepsis order sets were updated to reflect to newest revision of the Surviving Sepsis Campaign Guidelines.

A checklist was created for the staff to utilize to ensure they complete all bundled metrics in the 3 hour and 6 hour time frame.
Achieving Our Goals

Physician education provided to Emergency Department physicians as well as Hospitalist physicians by February 2014

Surviving Sepsis Campaign 2012 Guidelines Summary Posters framed and hung in each nursing department and physician dictation room
Achieving Our Goals

100% of the Critical Care nurses were trained on early identification and treatment of severe sepsis by April 2014

100% of the Emergency Department nurses were trained on early identification and treatment of severe sepsis by May 2014

100% of the Medical/Surgical nurses were trained on early identification and activation of the emergency response team by May 2014
Surviving Sepsis Campaign 3 Hour Bundle
Median Time (hrs) to Quality Indicators

- Serum lactate measured
- Antibiotics administered
- Fluids administered

Linear (Serum lactate measured)
Linear (Antibiotics administered)
Linear (Fluids administered)
Surviving Sepsis Campaign 3 Hour Bundle and Mortality
Oct 2013 - May 2014

- 3 HR Bundle Compliance
- Linear (3 HR Bundle Compliance)
- Mortality Rate
- Linear (Mortality Rate)
What we learned...

Success depends on:

1: Identify Severe Sepsis as an Institutional Priority
2: Implement Early Detection Screening Procedures
3: Implement Aggressive Treatment Policies/Standards
4: Track, Evaluate, and Report Outcomes
Bundled management for Sepsis was announced as a CMS Core Measure beginning October 2015.

With much debate on the definition of sepsis, severe sepsis, and septic shock as well as much debate about methods to abstract data for bundled compliance, official reporting of metrics for Sepsis as a core measure did not begin until July 2016.

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Continued Process Improvement

Early Screening
- ED CNS retrained every RN in the emergency department on sepsis screening tool
- ED CNS reviews sepsis screens performed in the ED for QI
- ED CNS performs 1:1 education and remediation on missed opportunities

Early Management
- Missed opportunity report is reviewed by Sepsis team monthly.
- Physician representatives bring missed opportunities back to colleagues for awareness
- CNSs review and remediate staff on missed opportunities related to nursing
Revisions to the screening tool

Adult Severe Sepsis Screening Tool

1. SUSPICION OF INFECTION:
- Acute abdominal infection
- Blood stream catheter infection
- Bone / joint infection
- Endocarditis
- Implantable device infection
- Meningitis
- Pneumonia, empyema
- Skin / soft tissue infection
- Suspect infection, source unknown
- Urinary tract infection
- Wound infection
- Other

MUST HAVE AT LEAST ONE: __ Yes __ No

If the answer is YES to both questions 1 and 2 above, suspicion of infection is present. Call the physician to obtain orders for a STAT lactate, blood cultures x 2 sets, CBO with platelets and differential, and complete metabolic panel per protocol (if not completed in the past 4 hours).

2. BIR 8:
- Check all that apply & date/time when present:
  - Hyperthermia > 38.5°C (101.3°F)
  - Hypothermia < 36°C (96.8°F)
  - Tachycardia > 90 b/min
  - Tachypnea > 20 resp per min
  - Leukocytosis (WBC > 12,000/µL)
  - Leukopenia (WBC < 4,000/µL)

NEED TO HAVE AT LEAST TWO: __ Yes __ No

3. ORGAN DYSFUNCTION:
- Are there any of the following organ dysfunction criteria present at a site remote from the site of infection that are NOT considered to be chronic conditions? Note: in the case of bilateral pulmonary infiltrates the remote site suspicion is waived.
  - Check all that apply & date/time when present:
    - SBP < 90 mmHg or MAP < 65 mmHg
    - SBP decrease > 40 mmHg from baseline
    - Creatinine > 2 mg/dl or Urine output < 0.5 ml/kg for two hours
    - Bilirubin > 2 mg/dl
    - Platelet count < 100,000/U
    - Lactate > 2 mmol/L (180 mg/dl)
    - Coagulopathy (INR > 1.5 or aPTT > 60 sec)

NEED AT LEAST ONE: __ Yes __ No

If suspicion of infection is present (questions 1 and 2 marked “YES” AND organ dysfunction is present - question 3 marked “yes”), the patient meets the criteria for SEVERE SEPSIS. Consider entering patient into the sepsis protocol.

Screening’s Summary: Infection = BIR 8 + Organ dysfunction = POSITIVE screen suggestive of SEVERE SEPSIS

____ Positive Screen
____ Negative Screen

Notify the physician of positive results immediately to obtain orders.

Physician notified: __________________________ Date/Time notified: ________________

Screeners signature: __________________________ Date/Time: ________________

Screeners signature: __________________________ Date/Time: ________________

*1NPN*
Revisions to the check list

Adult Severe Sepsis Checklist

Time Zero

5-Hour Bundle

- STAT Lactic Acid
  - Time
  - Initials
  - Result

- Blood Cultures Collected Prior to Antibiotics Issued
  - Time
  - Initials

- 2nd set: Time
  - Initials

- Broad Spectrum Antibiotics Administered
  - Time
  - Initials
  - Antibiotic 1
  - Time
  - Initials
  - Antibiotic 2
  - Time
  - Initials
  - Antibiotic 3

- Normal saline 30 mL/kg bolus given for mean arterial pressure less than 65, Systolic Blood Pressure less than 90 millimeters of mercury and or Initial Lactate greater than or equal to 4 millimeters per liter
  - 30 mL/kg equal to
  - Start time
  - Stop time
  - Ant IV Fluid given
  - Initials

- 6-Hour Bundle

- Apply Vasoressors to maintain mean arterial pressure greater than 65 millimeters of mercury and Systolic Blood Pressure greater than 90 millimeters of mercury
  - Time
  - Initials

- Re-measure Lactic Acid if initial greater than 2mmol per L
  - Time
  - Result
  - Initials

- Complete resuscitation status and focused exam/document (6015-118)
  - Perfect serve MD/PA/PNP to sign and place under progress notes in chart
  - Provider may also choose to document that the focused exam was performed
  - In their progress note must be within 6 hours
  - OR
  - Any 2 of the following four:
    - Measure central venous pressure
      - Time
      - Initials
      - Central venous pressure
    - Measure SoCvO2
      - Time
      - SoCvO2
    - Bedside Cardiovascular Ultrasound performed
      - Time
      - Initials
    - Passive leg raise performed
      - Time
      - Initials
    - OR Fluid Challenge performed
      - Time
      - Initials

Nurse Signature
- Initials
- Date / Time

Nurse Signature
- Initials
- Date / Time

* 1NPn *
Continued Process Improvement

Hard wiring the bundle

Sepsis lactate was created when ordered and resulted >2 mmol/L, the system automatically orders another repeat lactate to be performed in 3 hours

Sepsis 3 hour bundle order set created
All 3 hour bundle metrics included in order set, including sepsis lactate and an automatically calculated 30cc/kg fluid bolus that pushes to the EMAR so that it is documented
3 hour bundle: Blood Cultures

% Blood cultures prior to antibiotics
3 hour bundle: Antibiotics

% Antibiotic and/or Appropriate selection

3 hour bundle: Initial Serum Lactate
3 hour bundle: 30cc/kg fluid bolus

% Crystalloid fluids = to 30 ml/kg fluids
6 hour bundle: Repeat lactic acid level

% Repeat lactate for initial lactate > 2
What about the entire bundle?

**SEP-1 Severe Sepsis/Septic Shock Early Management Bundle**

% Received all appropriate care

<table>
<thead>
<tr>
<th>Month</th>
<th>Compliance</th>
</tr>
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<tbody>
<tr>
<td>Oct-15</td>
<td>25%</td>
</tr>
<tr>
<td>Nov-15</td>
<td>38%</td>
</tr>
<tr>
<td>Dec-15</td>
<td>18%</td>
</tr>
<tr>
<td>Jan-16</td>
<td>27%</td>
</tr>
<tr>
<td>Feb-16</td>
<td>25%</td>
</tr>
<tr>
<td>Mar-16</td>
<td>25%</td>
</tr>
<tr>
<td>Apr-16</td>
<td>10%</td>
</tr>
<tr>
<td>May-16</td>
<td>25%</td>
</tr>
<tr>
<td>Jun-16</td>
<td>38%</td>
</tr>
<tr>
<td>Jul-16</td>
<td>17%</td>
</tr>
<tr>
<td>Aug-16</td>
<td>11%</td>
</tr>
<tr>
<td>Sep-16</td>
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<tr>
<td>Oct-16</td>
<td>56%</td>
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<td>Nov-16</td>
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<td>Dec-16</td>
<td>20%</td>
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<td>Jan-17</td>
<td>29%</td>
</tr>
<tr>
<td>Feb-17</td>
<td>29%</td>
</tr>
<tr>
<td>Mar-17</td>
<td>10%</td>
</tr>
<tr>
<td>Apr-17</td>
<td>43%</td>
</tr>
<tr>
<td>May-17</td>
<td>38%</td>
</tr>
<tr>
<td>Jun-17</td>
<td>50%</td>
</tr>
</tbody>
</table>
How to focus our efforts and continue improvement

June 2017

| **116 cases** | **21 in sample** |

7 excluded due to:
- 2 transfer from other acute care
- 4 no severe sepsis/septic shock criteria by documentation
- 1 comfort measures within 3 hours

**BUNDLE COMPLIANCE:**

| **50% (7/14)** | **ALL bundle care** |
| **93% (13/14)** | **Initial lactate** |
| **100% (14/14)** | **Blood cultures** |
| **93% (13/14)** | **Antibiotics** |
| **75% (9/12)** | **Fluids≥30ml/kg** |
| **75% (6/8)** | **Repeat Lactate** |
| **67% (2/3)** | **Vasopressor** |
| **100% (3/3)** | **Focused Exam** |
## Tracking order set utilization

<table>
<thead>
<tr>
<th>Sepsis Order Set Use</th>
<th>May-16</th>
<th>Jun-16</th>
<th>Jul-16</th>
<th>Aug-16</th>
<th>Sep-16</th>
<th>Oct-16</th>
<th>Nov-16</th>
<th>Dec-16</th>
<th>Jan-17</th>
<th>Feb-17</th>
<th>Mar-17</th>
<th>Apr-17</th>
<th>May-17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Measure Sepsis Focused Population Outcome Cases</td>
<td>117</td>
<td>112</td>
<td>119</td>
<td>115</td>
<td>131</td>
<td>116</td>
<td>100</td>
<td>132</td>
<td>116</td>
<td>106</td>
<td>112</td>
<td>100</td>
<td>112</td>
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<tr>
<td>Rapid Sepsis Screen</td>
<td>8</td>
<td>6</td>
<td>2</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Not in use</td>
<td></td>
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<tr>
<td>Sepsis Bundle 3 Hr Orders</td>
<td>19</td>
<td>32</td>
<td>30</td>
<td>32</td>
<td>53</td>
<td>38</td>
<td>44</td>
<td>39</td>
<td>42</td>
<td>79</td>
<td></td>
<td></td>
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<tr>
<td>Used in Sepsis Core Measure Population Sample</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0/10</td>
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<tr>
<td>Sepsis Bundle 6 Hr Orders</td>
<td>7</td>
<td>23</td>
<td>15</td>
<td>11</td>
<td>14</td>
<td>17</td>
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<td>7</td>
<td>21</td>
<td>21</td>
<td>17</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>
Are we saving lives?

MORTALITY RATE SEPSIS CORE MEASURE FOCUSED POPULATION* - ICD-10 Codes

- Actual
- Expected
- Linear (Actual)

CY2016  Actual 11.41%  Expected 10.87%
CY2017  Actual 11.87%  Expected 11.31%

CareScience Methodology, Standard
We ARE saving lives!!

Take July 2017 for example:

116 severe sepsis/septic shock admissions

Using the mortality data found with Early Goal Directed Therapy of 30% risk of mortality - that would equal 35 patient deaths

We experienced a 6.02% mortality for the month of July - this meant 7 patient deaths

This means, just from the month of July, there are 109 people alive because of our focused efforts to reduce sepsis mortality and 28 of them beat the odds because of the same
Relationship between bundle compliance and mortality

Severe Sepsis/Septic Shock Core Measure*  October 2015 – May 2017

- SEP-1 Bundle Rate
- Linear (SEP-1 Bundle Rate)
- Mortality Observed
- Linear (Mortality Observed)

*ICD-10 Severe Sepsis/Septic Shock Core Measure Focused Population - Premier Quality Advisor
A BIG THANKS to our team!

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Emergency Department: Becky Basham, RN
Hospitalist: Ramanand Heeralall, MD
ICU Nursing Director: Brian Marvel, RN
ICU Stepdown RN: Debra Gogel, RN/Jenanne Locker, RN
Med & Surg Floors: Kim Salee, RN
Pharmacy: Scott Groves, Pharm.D.
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Quality Analyst: Angela Miller, RN
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Documentation Specialist: Tammy Reidford, RN
Infection Prevention: Kim Bellessa, RN
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Utilization Review: Stacie Wenk, MD
VP Cardiac Services: Jan Ernest, MSN