Mortality Escalates along the Sepsis Continuum: A Clear Trend Exists

Sepsis Mortality Continuum

Perhaps The Best Opportunity for Safe and Effective Intervention is Here!

Sepsis Category: SIRS, Sepsis, Severe Sepsis, Septic Shock

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SERRI: Sepsis Early Recognition And Response Initiative

EARLY RECOGNITION

EARLY INTERVENTION

IMPROVED SURVIVAL

Recognize the Signs of Sepsis

Elevated Heart Rate
Hyperthermia/Hypothermia
Elevated/Low WBC Count
Elevated Respiratory Rate
Acute Change in Mental Status

These vital signs may seem easy to spot – but are often overlooked!
Mild Tachypnea is an *Early* Sign

Sepsis on a Continuum

SIRS Systemic Inflammatory Response Syndrome

- Temperature
  - >100.9° F (38.3° C) (hyperthermia)
  - or <96.8° F (36° C) (hypothermia)
- Heart Rate - >90 bpm (tachycardia)
- Respiratory Rate - > 20 (tachypnea)
- WBC
  - > 12,000 µ/L (leukocytosis)
  - or < 4,000 µ/L (leukopenia)
Sepsis

2 or more SIRS
+
  a suspected or confirmed source of infection
= SEPSIS

Pathophysiology of Sepsis

Intravascular inflammation:
- Is uncontrolled, unregulated, and self-sustaining
- Causes blood to spread mediators usually confined to the interstitial space

Severe Sepsis

Sepsis
+
organ dysfunction,
hypoperfusion
or hypotension
= Severe Sepsis
**Organ Dysfunction Variables**

- Arterial hypoxemia
- Acute lung injury
- Acute oliguria
  - UOP < 0.5 mL/kg/hr for at least 2 hours despite fluid resuscitation
- Coagulation abnormalities
- Thrombocytopenia
- Hyperbilirubinemia
- Ileus/hypoactive bowel sounds

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**Hemodynamic Variables**

- Sepsis-induced hypotension
- Mixed venous oxygen saturation < 70%
- Cardiac index < 3.5 L/min

**Tissue Perfusion Variables**

- Mottled skin or decreased capillary refill
- Elevated lactate > 4 mmol/L
  - (you can have severe sepsis without elevated lactate)

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**Signs of Severe Sepsis (con’t)**

- Tachypnea, tachycardia and changes in mental status are **early signs** of severe sepsis AND often precede both fever and hypotension

- Skin remains warm (in early shock stage) unless **severely volume depleted**, then skin can be **cool and mottled** (in late shock stage)

> Early recognition is the key to successful treatment and outcomes!
Septic Shock

Sepsis

+ ↓ BP after fluid resuscitation (refractory hypotension) & perfusion abnormalities

= Septic Shock

Early Goal Directed Therapy

- Fluid resuscitation
  - NS or LR
  - Blood products if Hgb ≤ 7 (goal is 7-9)
- Labs & Diagnostic Tests
- Pan Culture
  - Blood cultures (X2), urine, sputum, wounds, etc.
    as indicated
- Antibiotics
  - Initiate within 1 hour of recognition of sepsis

Lactic Acid

- ↑ levels common in patients with severe sepsis or septic shock
- ↑ levels may be either/or both metabolic failure or tissue hypoperfusion
- In sepsis, early lactate clearance is associated with preserved organ function and improved survival – prolonged lactate clearance is associated with worsened multi-organ dysfunction
Hemodynamic Support & Antibiotics are *KEY*

Volume resuscitation and immediate antibiotic administration are the most important therapies:

Fluid volume significantly increases cardiac output and systemic oxygen delivery

- Fluids alone may be sufficient to reverse hypotension and restore hemodynamic stability
- Fluid requirements may be as much as 3-5 liters
- Fluid challenge should be titrated to BP, HR and CO

Source Control

**Antimicrobials**
- Source - bacterial, viral, fungal, or parasitic

**Surgery**
- Source control is imperative when possible.

**Other**
- Infected lines, catheters, & implants

Noninfectious Mimics of Sepsis

- Acute myocardial infarction
- Acute pulmonary embolism
- Acute pancreatitis
- Acute GI bleed
- Adverse drug reactions
- Trauma
- Burns
Goals

- HR < 100 bpm
- SBP > 90 mmHg or MAP > 70 mmHg
- RR < 20
- Temperature normalized
- Lactic acid < 1.5 mmol/L
- Urine output ≥ 0.5 ml/hr/kg
- Source control
- Return to baseline mentation

Disclaimer

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References

13. Surviving Sepsis Campaign website: (http://www.survivingsepsis.org/aboutcampaign)
22. SERRI: Sepsis Early Recognition And Response Initiative

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Summary

• ESRD surveillance in the United States
• National incidence of sepsis
• Surveillance & treatment obstacles
• Strategies to improve surveillance & treatment
• Opportunities ahead
The “Dialysis Event”

- Positive blood culture
- IV abx start
- PRS at vascular access
- Fever
- Chills
- Hypotension
- Other

Patient-Months

- Number of:
  - Unique patients
  - Treating on the first two treatment days of the month
  - Grouped by vascular access

Methods of surveillance

<table>
<thead>
<tr>
<th>Method</th>
<th>Strengths</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centrally identified /</td>
<td>Standardized application of rules</td>
<td>Less facility engagement with surveillance data</td>
</tr>
<tr>
<td>Centrally reported</td>
<td>Highly auditable</td>
<td>Requires advanced technical support</td>
</tr>
<tr>
<td>Centrally identified /</td>
<td>Standardized application of rules</td>
<td>Clerical burden on facilities</td>
</tr>
<tr>
<td>Facility reported</td>
<td>Highly auditable</td>
<td>Opportunity for data entry error</td>
</tr>
<tr>
<td>Facility identified /</td>
<td>Easiest to implement</td>
<td>Requires moderate technical support</td>
</tr>
<tr>
<td>Facility Reported</td>
<td>Most like CDC-defined process</td>
<td>Highly burdensome for facilities</td>
</tr>
<tr>
<td></td>
<td>Large variance in rule application</td>
<td>Difficult to audit</td>
</tr>
</tbody>
</table>

Ideally surveillance would be standardized, accurate, fair, useful and not burdensome to facilities.
Bloodstream Infection Rate

\[
\frac{\Sigma \text{Positive Blood Cultures}}{\Sigma \text{Patient - Months at risk}} \times 100
\]

- BSI rates can be calculated monthly, quarterly, or annually
- BSI rates can be grouped by vascular access type
- Requires that blood cultures were drawn and/or recorded
- IV abx & PRS have no bearing on current BSI rates
- Blood cultures are grouped by the NHSN 21 day rule

### Standardized Infection Rate (SIR)

#### Steps to calculate SIR
1. Obtain the national reference stratified BSI rates
2. Divide the rates by 100 to get the rate per 1 patient month (basic rate)
3. Multiply the basic rate by facility's census stratified by access type to obtain the expected number of infections
4. Obtain the facility's observed infections for the year stratified by access type
5. Sum the expected number of infections
6. Sum the observed number of infections
7. Divide the sum of observed infections by the sum of expected infections to obtain the SIR

#### National Rate

<table>
<thead>
<tr>
<th>Access Type</th>
<th>Rate (per 100 patient-months)</th>
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</thead>
<tbody>
<tr>
<td>CVC</td>
<td>2.16</td>
</tr>
<tr>
<td>AVF</td>
<td>0.26</td>
</tr>
<tr>
<td>AVG</td>
<td>0.36</td>
</tr>
<tr>
<td>Other</td>
<td>0.67</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access Type</th>
<th>Rate (per 100 patient-months)</th>
</tr>
</thead>
<tbody>
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<td>CVC</td>
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<tr>
<td>AVF</td>
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<tr>
<td>AVG</td>
<td>0.0039</td>
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<tr>
<td>Other</td>
<td>0.0067</td>
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</table>

<table>
<thead>
<tr>
<th>Access Type</th>
<th>Expected BSI</th>
<th>Observed BSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVC</td>
<td>5.184</td>
<td>3</td>
</tr>
<tr>
<td>AVF</td>
<td>2.184</td>
<td>2</td>
</tr>
<tr>
<td>AVG</td>
<td>0.468</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0.402</td>
<td>0</td>
</tr>
</tbody>
</table>

SIR = \frac{6}{8.238} = 0.73

### How are we doing?

Bloodstream Infection (BSI) Rate Stratified by Vascular Access Type—NHSN Dialysis Event Data, 2014

<table>
<thead>
<tr>
<th>Vascular Access Type</th>
<th>Rate (per 100 patient-months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artерiovenous (AV) Fistula</td>
<td>0.26</td>
</tr>
<tr>
<td>Dialyzer</td>
<td>0.30</td>
</tr>
<tr>
<td>Other Vascular Access Type</td>
<td>0.67</td>
</tr>
<tr>
<td>Central Venous Catheter</td>
<td>2.16</td>
</tr>
</tbody>
</table>

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(1) Other vascular access type such as catheter or graft hybrid
(2) Includes tunneled and nontunneled catheters
(3) The national access type-specific rates are used to calculate the predicted number of BSIs for each access type in each facility. This is done by multiplying each facility’s access type-specific denominator by the corresponding national rate for that access type. A facility’s SIR (standardized infection ratio) is the total observed BSI count divided by the total predicted number of BSIs across all access type categories (total number of observed BSIs divided by predicted BSI).
Obstacles

- Early and standard identification of sepsis
  - Sign-based identification
  - Cases identified outside the clinic
- Obtaining blood culture results
  - Drawing blood cultures when indicated
  - Obtaining externally resulted results
- Antibiotic stewardship

Strategies to improve identification

- Standardized and clear “sign definitions”
  - Fever, Chills, Hypotension
  - Altered mental status, pain, etc.
  - Consider the vascular access
- Clinical algorithms

Strategies to obtain results

- Blood Culture “Rate”
  \[ \frac{\text{Blood Culture Results}}{\text{IV abx starts with signs of sepsis}} \]
  1. Blood culture results can be negative or positive
  2. Signs of sepsis include fever, chills, hypotension
- Structured follow-up with each hospitalization or missed treatment
- Health Information Exchanges
Opportunities ahead

- Promising new technologies
  - Surveillance
  - Prevention

- Collaboration between stakeholders
  - Dialysis providers, regulators, public health, ESRD networks/QIOs, academia, etc.

AQKC Contact Information and Sepsis Resources

- How to get help
  - Sepsis Resources: http://www.aqkc.org/content/healthcare-associated-infections
  - AQKC website (www.aqkc.org)
  - Network contacts
    - ESRD Network 8: SCM@nw8.esrd.net (Alabama, Mississippi, Tennessee)
    - ESRD Network 14: danchia@nw14.esrd.net (Texas)

- Please take a moment to complete the poll questions at the end of the webinar

DO NOT email patient-specific information (name, DOB, SSN, etc.) to the Network office!