ADEQUACY OF FLUID RESUSCITATION

OHA Statewide Sepsis Initiative

August 17, 2016
OHA QUALITY PROGRAMS TEAM

Collaborating for a Healthy Ohio

Amy Andres
Senior Vice President of Quality and Data

James Guliano
Vice President of Quality Programs

Rosalie Weakland
Ellen Hughes
Ryan Everett
Carol Jacobson
Rhonda Major-Mack
Paul Hicks
OHA Statewide Sepsis Initiative

I. Michael Taylor, MD, FACS
   Medical Director, Surgical Critical Care, Cleveland Clinic Fairview Hospital
   Medical Director, Critical Care, and Vice Chief of Staff, Cleveland Clinic Avon Hospital
   Board of Directors, Sepsis Alliance

II. Kim Biery, DNP, RN, NEA-BC
    Director Quality Innovation, Miami Valley Hospital and Miami Valley Hospital South

III. Mary Kate Dilts-Skaggs, DNP, RN, NE-BC
     Director of Nursing, Emergency Services, Southern Ohio Medical Center
     Elvis Walters, BSN, RN
     Nurse Manager, Emergency Services, Southern Ohio Medical Center
Objectives

• Briefly review some key concepts on septic shock from the July 20th presentation
• Discuss the evolution of protocolized fluid resuscitation in the management of sepsis
• Emphasize the role of serum lactate level as an indicator of adequacy of resuscitation
• Summarize the National Inpatient Quality Measures
Shock

• “…tissue perfusion is reduced such that blood flow is inadequate to meet cellular metabolic requirements.”

  Edited by Jean-Louis Vincent
Shock

• “…tissue perfusion is reduced such that blood flow is inadequate to meet cellular metabolic requirements.”

• “The rude unhinging of the machinery of life.”
  – Samuel Gross, 1872
Sepsis-induced Hypoperfusion

- Increased thrombosis & decreased fibrinolysis
  - Clot forms in the capillaries
    - Decreased microvascular flow

- Capillary leak
  - Increased interstitial fluid
    - Hypovolemia
    - Decreased cardiac compliance

- Increased nitric oxide production
  - Systemic vasodilation
    - Impaired microvascular flow
  - Direct oxidative injury
  - Impaired mitochondrial function
Sepsis-induced Hypoperfusion

- Increased thrombosis & decreased fibrinolysis
  - Clot forms in the capillaries
    - Decreased microvascular flow

- Capillary leak
  - Increased interstitial fluid
    - Hypovolemia
    - Decreased cardiac compliance

- Increased nitric oxide production
  - Systemic vasodilation
    - Impaired microvascular flow
  - Direct oxidative injury
  - Impaired mitochondrial function
Septic Shock

- Hypovolemic
- Distributive
- Cardiogenic
Septic Shock

- Hypovolemic
- Distributive
- Cardiogenic
Septic Shock

• We’re pretty good at figuring out when to start the fluid resuscitation

• How do we know if our resuscitation is adequate?
Single U.S. center
263 patients enrolled
EGDT vs. “usual therapy”
Mortality: EGDT 30.5% Usual therapy 46.5%
Central venous oxygenation as a goal of therapy
Goals of Resuscitation

• Time sensitive

• Aggressive fluids

• Oxygen delivery/consumption
Endpoints of Resuscitation

Lactate

• “Measuring lactate levels can risk stratify patients with suspected sepsis, to prompt aggressive early treatment, and help monitor the impact of therapy”

Broder G, Weil M. Science 1964;143:1458
Endpoints of Resuscitation

• Initial lactate, as well as response of lactate to resuscitative measures correlates with outcome
  • Crit Care Med 1983;11:449

• Patients whose lactate normalizes by 24 hours survive
  – Normalization by 24-48 hours had 25% mortality
  – Elevated lactate after 48 hours had 86% mortality
  • J Trauma 1993;35:584
3 U.S. hospitals
300 patients with enrolled
Lactate clearance vs. $S_{cv}O_2$ normalization
No difference in mortality
Endpoints of Resuscitation

- Other endpoints that have been considered
  - Base deficit
  - Serum bicarbonate
  - Supranormal oxygen delivery
  - Heart rate variability
  - Orthogonal polarization spectral imaging
  - Transcutaneous oxygenation
  - Transcutaneous, sublingual, esophageal, or gastric capnometry
  - $P_a\text{CO}_2$ to ETCO$_2$ difference
Endpoints of Resuscitation

Lactate

- “The prognostic value of lactate levels exceeds that of blood pressure.”
- “Many studies have confirmed the association between initial serum lactate level and mortality independently of clinical signs of organ dysfunction”
- “In this multicenter, open-label randomized controlled study, lactate monitoring during the first 8 hours of ICU admission, aimed at reducing lactate levels by at least 20% per 2 hours, significantly reduced ICU length of stay and also ICU and hospital mortality”
  - Jansen TC, et al. Am J Respir Crit Care Med 2010;182:752
Endpoints of Resuscitation

- Initial resuscitation
  - “We recommend the protocolized, quantitative resuscitation of patients with sepsis-induced tissue hypoperfusion”
  - “We suggest targeting resuscitation to normalize lactate in patients with elevated lactate levels as a marker of tissue hypoperfusion”
- Surviving Sepsis Guidelines
A Randomized Trial of Protocol-Based Care for Early Septic Shock

The ProCESS Investigators

31 U.S. academic centers
1341 patients
EGDT vs. protocol-based therapy (SBP, shock index) vs. “usual care”
No differences in mortality
51 centers in Australia & New Zealand
1600 patients enrolled
EGDT vs. “usual care”
No difference in mortality
56 English NHS hospitals
1260 patients enrolled
EGDT vs. “usual care”
No difference in mortality
## Surviving Sepsis

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EGDT</td>
<td>Usual</td>
<td>EGDT</td>
<td>Protocol</td>
</tr>
<tr>
<td>Crystalloid</td>
<td>5.0</td>
<td>3.5</td>
<td>2.8</td>
<td>3.3</td>
</tr>
<tr>
<td>Pressors %</td>
<td>36.8</td>
<td>51.3</td>
<td>54.9</td>
<td>52.2</td>
</tr>
<tr>
<td>Dobutamine %</td>
<td>15.4</td>
<td>9.2</td>
<td>8.0</td>
<td>1.1</td>
</tr>
<tr>
<td>RBC %</td>
<td>68.4</td>
<td>44.5</td>
<td>14.4</td>
<td>8.3</td>
</tr>
<tr>
<td>Mortality %</td>
<td>30.5</td>
<td>46.5</td>
<td>21.0</td>
<td>18.2</td>
</tr>
</tbody>
</table>
National Inpatient Quality Measures

• Within 3 hours of identification of severe sepsis:
  – Initial lactate level measurement
  – Broad spectrum or other antibiotics administered
  – Blood cultures drawn prior to antibiotics

• Within 6 hours:
  – Repeat lactate measurement if initially elevated
National Inpatient Quality Measures

• Within 3 hours of identification of septic shock:
  – Initial lactate level measurement
  – Broad spectrum or other antibiotics administered
  – Blood cultures drawn prior to antibiotics

• Within 6 hours:
  – Repeat lactate measurement if initially elevated
  – Resuscitation with 30 ml/kg crystalloid fluids
  – Vasopressors if hypotension persists after fluid administration
National Inpatient Quality Measures

Repeat volume status and tissue perfusion assessment consisting of either:

A focused exam including:  OR

- Vital signs, AND
- Cardiopulmonary exam, AND
- Capillary refill evaluation, AND
- Peripheral pulse evaluation, AND
- Skin examination

Any 2 of the following:

- Central venous pressure measurement
- Central venous oxygen measurement
- Bedside Cardiovascular Ultrasound
- Passive Leg Raise or Fluid Challenge
Challenges

• What predominates?
  – Capillary leak (Hypovolemic shock)
  – Vasodilation (Distributive shock)

• How to assess intravascular volume?

• How to assess tissue perfusion?
Challenges

• What predominates?
  – Capillary leak (Hypovolemic shock)
  – Vasodilation (Distributive shock)
    • Capillary refill

• How to assess intravascular volume?
  • Ultrasound, straight leg raise

• How to assess tissue perfusion?
  • Clinical exam, lactate, $S_vO_2$
Surviving Sepsis

• Whatever methods are being utilized, FREQUENT REASSESSMENT is crucial to assess adequacy of resuscitation
Surviving Sepsis

• Sepsis is a time sensitive problem, just like
  – Trauma
  – Acute myocardial infarction
  – Stroke
Sepsis Success Story

Kim Biery, DNP, RN, NEA-BC
Director Quality Innovation
Miami Valley Hospital
Miami Valley Hospital South
Jamestown
Agenda

- Premier Health Partners
- Success Story
- Sepsis Tools
FOUNDED IN 1890, MIAMI VALLEY HOSPITAL IS A FULL-SERVICE, ACUTE CARE HOSPITAL LOCATED IN DAYTON, OHIO.

Miami Valley has the region's only Level I Trauma Center and is a Magnet® hospital for nursing excellence.

KEY FACTS
- Licensed Beds: 970
- Physicians: 1,142
- Physician Specialties: 70+
- Employees: 6,711
- Volunteers: 756
- Inpatient Admissions: 39,368
- Outpatient Visits: 289,642
- ER Visits: 128,804

125
1890 YEARS OF EXCELLENCE 2015
Success Story

Severe sepsis presentation=4/12/16@0116 - met with criteria.
   a) infection: 4/11/16@2301 - sepsis
   b) SIRS: 4/11/16@2308 (wbc) and 4/12-16@0033 (pulse)
   c) organ dysfunction: 4/12@0116 (lactate=2.2)

Repeat lactate timely.
Blood culture/ATB timely.
Septic shock met with documentation of septic shock on 4/12@0140.
Crystalloid fluids given @ rate of 30ml/kg.
Sepsis order set - both ED and IP initiated.

NO OFIs
Patient HPI

- 76 year old male
- Nursing home
- Altered mental status and nonresponsive
- Being treated as an outpatient with Levaquin for right middle lobe pneumonia
- Found not responsive
- Nursing home called family
- Advised him to come to the hospital for further evaluation and treatment
- Arrived on 15 L non-rebreather.
Physical Exam - Vital Signs

- Temp: **101 ° F** (38.3 ° C) (04/11/16 2227)
- Temp Source: Axillary (04/11/16 2227)
- Pulse: 92 (04/11/16 2227)
- Rhythm: Normal sinus rhythm (04/12/16 0103)
- Resp: 20 (04/11/16 2227)
- BP: **161/94 mmHg** (04/11/16 2227)
- MAP: Noninvasive: 119 mmHg (04/11/16 2227)
- SpO2: 98 % (04/11/16 2227)
- Oxygen Liters Per Minute: 15 LITERS PER MINUTE (04/11/16 2227)
- Oxygen Source: Mask (04/11/16 2227)
- Height: 177.8 cm (5' 10") (04/11/16 2227)
- Weight: 81.647 kg (180 lb) (04/11/16 2227)
Sepsis Tools

• Sepsis Core Bundle
• Sepsis BPA workflow
• Order Sets
  – System ED Sepsis/Septic Shock
  – System Sepsis/Septic Shock Admission
• Sepsis Scorecard
• Individual abstraction reports
• Reports
• A4Action Plan
SEPSIS CORE MEASURES  
(ALL or NONE BUNDLE)  

Must have all care met for both timeframes:

- **Within 3 hours: (severe sepsis)**
  1. Initial lactate drawn and if > 2mmol (18 mg/dl UVMC), repeat level drawn (repeat must be drawn w/in 6 hours of severe sepsis presentation time)
  2. Blood cultures collected (before antibiotic is started)
  3. Broad spectrum antibiotic
  4. IF the patient meets criteria for SEPTIC SHOCK (Hypotension (SBP < 90 or MAP < 65, Lactate >/= 4.0 mmol/L (36 mg/dl) OR MD/APN/PA documents it) : Administer 30 ml/kg crystalloid fluid.

- **Within 6 hours: (septic shock)**
  1. Vasopressors if hypotension persists after crystalloid fluid administration
  2. Repeat volume status AND tissue perfusion assessment consisting of either:
     - all parts of FOCUSED EXAM performed by Provider: (Vital Signs, Cardiopulmonary Assessment, cap refill, Peripheral Pulse eval, Skin Exam with reference to color and circulatory status)
     OR
     - Any 2 of following: CVP,SVO2, CV ultrasound, passive leg raise, fluid challenge
Sepsis BPA

- ED - Fires to the physician
- IP - Fires to the Registered Nurse
BPA

Patient meets 3 or more of the SIRS (Systemic Inflammatory Response Syndrome) Criteria.

Accept the alert if one or more choices apply (recommended orders will display):
- Acute change in mental status
- Antibiotics prescribed within past 2 weeks
- Indwelling tubes/lines
- Positive blood culture
- Respiratory symptoms (productive cough)
- Suspected infection, unknown source
- UTI or other signs/symptoms of infection
- Wound cellulitis/decubitus

If none of the above choices apply, select acknowledge reason & Accept.

Acknowledge reason:
No infection source identified, Sepsis treatment in progress

Open Order Set: SYSTEM ED SEPSIS / SEPTIC SHOCK
Order Sets

- System **ED** Sepsis/Septic Shock essential orders
- System Sepsis/Septic Shock **Admission**
## Profile Title: Sepsis Core Measure Sub Scorecard -2016 Miami Valley Hospital

### MIDAS Indicator - Profile Core Sepsis Detail

<table>
<thead>
<tr>
<th>Facility: Miami Valley Hospital</th>
</tr>
</thead>
</table>

### Indicator

<table>
<thead>
<tr>
<th>Mortality (OHA Defn)</th>
<th>Achievement threshold (50th Ptile)</th>
<th>Benchmark Mean of Top Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis Mortality</td>
<td>OHA Collaborative State Mean</td>
<td>OHA Target Improvement</td>
</tr>
<tr>
<td>Sepsis Mortality Denominator</td>
<td>20.5</td>
<td>14.9</td>
</tr>
<tr>
<td>Sepsis Mortality %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Core Measures

| Core SEP1 -OFI Group: Early Management Bundle, Severe Sepsis/Septic Shock |
| Core SEP1 - numerator |
| Core SEP1 - denominator |
| Core SEP1 - Early Management 3 hour Bundle, Severe Sepsis/Septic Shock |

| SEP1aa -Initial Lactate OFI |
| SEP1aa -Initial Lactate 3 Hours (Numerator) |
| SEP1aa -Severe Sepsis Present (Denominator) |
| SEP1aa -Initial Lactate within 3 Hours % |

| SEP1ac-BC OFI |
| SEP1ac-BC within 3 Hours (Numerator) |
| SEP1ac-Severe Sepsis Present (Denominator) |
| SEP1ac-BC within 3 Hours % |

| SEP1ab-ATB OFI |
| SEP1ab-ATB within 3 Hours (Numerator) |
| SEP1ab-Severe Sepsis Present (Denominator) |
| SEP1ab-ATB within 3 Hours % |

| SEP1b - severe sepsis - repeat lactate level measurement not in 6hr |
| Core SEP1 - numerator |
| Core SEP1 - denominator |
| SEP1b - severe sepsis - repeat lactate level % |

| SEP1c - Septic shock - resuscitation w/ crystalloid fluids OFI |
| SEP1c -Crystalloid Fluid (Numerator) |
| SEP1c -Septic Shock Present (Denominator) |
| SEP1c Septic shock - resuscitation w/ crystalloid fluids % |

**Benchmarks not avail till 1Q2016**
Reports

• BPA reports for ED physicians and nursing by unit
• Individual abstraction reports
• Weekly fallout reports
• Individual Feedback reports
• Peer Review
## Sepsis System A4 Action Plan

<table>
<thead>
<tr>
<th>Prevention Strategies</th>
<th>Action (Plan)</th>
<th>Action Owner</th>
<th>Due Date</th>
<th>Update (Do)</th>
</tr>
</thead>
</table>

**Date:** 7/29/2016  
**Purpose/Description:** Achieve top decile performance by conducting an analysis of the current state and implementing best practices that will lead to sustained system-wide improvements.

**Ongoing Performance:**

*(Study) Sepsis/Septic Shock Overall Bundle- CMS Sample*
Thank You!!!

from

Premier Health Partners
Sepsis Initiative

Southern Ohio Medical Center
Case Studies
August 17, 2016
Case Study #1

- 88 year male presents to ED with c/o of weakness, lethargy, SpO2 of 84% on RA, Nursing Home stated possible aspiration.

- Arrival to ED – respiratory distress – unable to localize discomfort, BP 81/27 98% on 6L per NC.

Timeline:
- 2104 – Arrive at ED at (Triage)
- 2133 – CT head, Blood Cultures, ABGs, EKG, Chest X-ray
- 2133 – Lactate Sepsis
- 2247 – Intubated due to respiratory failure
- 2340-0139 – MAP 52- 63 and patient systolic BP hypotensive
- 0022 – Provider diagnosis septic shock
- 0133 – Admitted to ICU
- Discharged to Nursing Home after 22 days.
Time Zero = 0022

3 Hour Bundle

- Lactate –
  - Venous at 2133 (0.8mmol/L)
  - Arterial at 2205 (1.0mmol/L)
- Antibiotics
  - Vancomycin at 2248
  - Levaquin at 0053
  - Maxipime at 0054
- Crystalloids
  - Sodium Chloride 30ml/kg started at 2248

6 Hour Bundle

- Lactate
  - Arterial at 0041 (1.0mmol/L)
- Vasopressors
  - Vital signs stabilized
- Volume Reassessment
  - Vital Signs stabilized
## Review

<table>
<thead>
<tr>
<th>Went Well</th>
<th>Lessons Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 3 hour bundle lactate, antibiotics, and blood cultures completed</td>
<td>• No sepsis screen done at triage</td>
</tr>
<tr>
<td>• Fluid started at 30ml/kg used with pressure bag</td>
<td>• No stop time for crystalloid infusion</td>
</tr>
<tr>
<td></td>
<td>• Failed repeat lactate in 6 hour bundle (ICU)</td>
</tr>
<tr>
<td></td>
<td>• No infectious source identified prior to diagnosis of septic shock</td>
</tr>
<tr>
<td></td>
<td>• 2 lactate drawn prior to time zero (Septic Shock time)</td>
</tr>
</tbody>
</table>
Case Study #2

- 94 year old female presents to ED
- c/o fall, tachycardia, generalized weakness
- Arrival to ED – alert and oriented, respirations easy, tachycardia - rate of 159, hypotensive 99/54 with MAP of 64

Timeline:
- 1836 – Arrive at ED at (Triage)
- 1855 – Blood Cultures
- 1911 – CT of head, thorax, and pelvis
- 2034 – Lactate Sepsis
- 1836-0027 – long periods of Systolic hypotension and MAP <65
- 2246 – Provider diagnosis severe sepsis with septic shock
- 0027 – Admitted to ICU
- Transfer to RMH on 3rd day of admission for PCI.
### Time Zero = 2002

<table>
<thead>
<tr>
<th>3 Hour Bundle</th>
<th>6 Hour Bundle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lactate</strong> –</td>
<td><strong>Lactate</strong> –</td>
</tr>
<tr>
<td>⚫ Venous at 2002 (3.0mmol/L)</td>
<td>⚫ Venous at 2305 (2.4mmol/L)</td>
</tr>
<tr>
<td><strong>Antibiotics</strong></td>
<td><strong>Vasopressors</strong></td>
</tr>
<tr>
<td>⚫ Invanz at 0003</td>
<td>⚫ NeoSynephrine 200mg IVP at 2007 for 2 doses</td>
</tr>
<tr>
<td><strong>Crystalloids (2250ml)</strong></td>
<td>⚫ Norepinephrine at 0025 – to ICU</td>
</tr>
<tr>
<td>⚫ Sodium Chloride (2 IVs)</td>
<td>• Volume Reassessment</td>
</tr>
<tr>
<td>1000ml (1902-2009)</td>
<td>⚫ No hypotension after fluid bolus completed at 2133</td>
</tr>
<tr>
<td>1000ml (1910-2030)</td>
<td></td>
</tr>
<tr>
<td>1000ml (2044-2133)</td>
<td></td>
</tr>
<tr>
<td>150ml/hr (2008 – to ICU)</td>
<td></td>
</tr>
<tr>
<td>Went Well</td>
<td>Lessons Learned</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Severe Sepsis and Septic Shock identified in the ED</td>
<td>No sepsis screen done at triage but completed by provider</td>
</tr>
<tr>
<td>All bundle elements addressed</td>
<td>No sepsis checklist done</td>
</tr>
<tr>
<td>Patient remained Normotensive post fluid resuscitation</td>
<td>Checklist now utilized on Severe Sepsis and Septic Shock patients; handoff communication tool.</td>
</tr>
</tbody>
</table>
QUESTIONS?
OHA collaborates with member hospitals and health systems to ensure a healthy Ohio

James V. Guliano, MSN, RN-BC, FACHE
Vice President, Quality Programs
James.Guliano@ohiohospitals.org