Improving the quality of Pediatric Sepsis Care

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Learning Objectives

1. Describe current guidelines for initial management of pediatric sepsis

2. Describe quality improvement strategies for improving pediatric sepsis care in the ED

3. Discuss the components of a pediatric sepsis screening tool for early identification of sepsis.
March 29 2012

• 9 yo M, cuts arm in gym -> develops myalgias, vomiting, fever

• ED diagnoses with gastroenteritis, receives Zofran and IVF, discharged

• Exam noted mottling of skin
  – Discharge Vitals: HR 143, RR 22, T 102 (no BP reported)
  – CBC drawn at that time showed WBC 14.7 (39%N, 53% bands) but patient discharged before resulted
Our case

• Back to ED the following day in septic shock, admitted to ICU
  – Blood cultures: Group A Streptococcus
  – Date of initial presentation – March 29
  – Date of death - April 1
Could this happen in my ED?

• >40,000 US pediatric severe sepsis cases/year

• ~20,000 pediatric septic shock/year

• Mortality in US 4-10% for severe sepsis and septic shock
  • Previously well children ~4%
  • High risk or chronically ill 7-10%

• Sepsis or related issues causes 7-9% of all pediatric deaths
Presentation

• 1/3-1/2 of patients present via EMS

• 2/3 of patients present to an ED
Review of Definitions

• **Sepsis** is life-threatening organ dysfunction due to a dysregulated host response to infection*

• **Sepsis: SIRS + Infection (suspected or proven)**

• **SIRS** (Need at least 2 of 4, one must be WBC or Temperature)
  - Core Temp >38.5 °C or <36 °C
  - Tachycardia for age (or bradycardia if <1 year)
  - Tachypnea for age
  - WBC elevated or depressed


## Goldstein: Pediatric SIRS

<table>
<thead>
<tr>
<th>Age group</th>
<th>Heart rate (beats/minute)</th>
<th>Respiratory rate (breaths/minute)</th>
<th>Leukocyte count (leukocytes x 10^3/mm^3)</th>
<th>Systolic blood pressure (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tachycardia</td>
<td>Bradycardia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newborn (0 days to 1 week)</td>
<td>&gt;180</td>
<td>&lt;100</td>
<td>&gt;50</td>
<td>&gt;34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;59</td>
</tr>
<tr>
<td>Neonate (1 week to 1 month)</td>
<td>&gt;180</td>
<td>&lt;100</td>
<td>&gt;40</td>
<td>&gt;19.5 or &lt;5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;79</td>
</tr>
<tr>
<td>Infant (1 month to 1 year)</td>
<td>&gt;180</td>
<td>&lt;90</td>
<td>&gt;34</td>
<td>&gt;17.5 or &lt;5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;75</td>
</tr>
<tr>
<td>Toddler and preschool (&gt;1</td>
<td>&gt;140</td>
<td>NA</td>
<td>&gt;22</td>
<td>&gt;15.5 or &lt;6</td>
</tr>
<tr>
<td>to 5 years)</td>
<td></td>
<td></td>
<td></td>
<td>&lt;74</td>
</tr>
<tr>
<td>School age (&gt;5 to 12 years)</td>
<td>&gt;130</td>
<td>NA</td>
<td>&gt;18</td>
<td>&gt;13.5 or &lt;4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;83</td>
</tr>
<tr>
<td>Adolescent (&gt;12 to &lt;18 years)</td>
<td>&gt;110</td>
<td>NA</td>
<td>&gt;14</td>
<td>&gt;11 or &lt;4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;90</td>
</tr>
</tbody>
</table>
Surviving Sepsis Campaign

• “GRADES” recommendations
  – Includes “pediatric considerations”
• Large QI initiative
  – Bundles
  – Data collection

International Group, meets every 2-4 years and develops evidence-based guidelines for the treatment of Sepsis, much like the AHA BLS, ACLS, PALS guidelines


http://www.survivingsepsis.org/About-SSC/Pages/default.aspx
PALS (2006)

1st hour:
- Recognize altered mental status and poor perfusion
- Establish vascular access and begin resuscitation

1st hour: Push repeated 20 mL/kg IVF up to 3
- Administer antibiotics STAT

Fluid responsive (i.e. normalization of BP and/or perfusion)?

yes
- Consider ICU monitoring

no
- Begin vasoactive drug therapy and titrate to correct hypotension / poor perfusion

Carcillo et al. algorithm goal

5 min
5 min
15 min
60 min
60 min
60 min

Children's National
The Basics

• Early recognition

• Timely /adequate fluid resuscitation
  – Timely IV access
  – Reversal of perfusion abnormalities as endpoint

• Early antibiotics

• Timely pressors
How are we doing?

• 3 studies at tertiary care children’s hospitals
  – (Houston, Salt lake City and Boston)

• Poor compliance with adherence to guidelines
  – Barriers to compliance recognized

• Initial QI efforts reported

Boston

- 126 subjects before the intervention
  - (November 2009 to March 2011)
- 116 patients during the QI intervention
  - (October 2011 to May 2013)

- **5-component bundle** (baseline rate of 19%)
  - Recognition in 5 min
  - Vascular access in 5 min
  - Antibiotics in 60 min
  - 60/kg in 60 mins
  - Pressors in 60 mins

Bundle adherence
Cases between deaths
Salt Lake City

• 1380 Patients with septic shock (2007-2014) in ED
  – QI initiative
  • Bundle
    – Timely antibiotics,
    – Intravenous fluids (IVF) for rapid reversal of perfusion abnormalities and/or hypotension
• Triage screening

Bundle compliance
Days between deaths
Early recognition
Screening tool: PCH (paper based)

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity %</td>
<td>97 (95–99)</td>
<td>100 (100–100)(^a)</td>
</tr>
<tr>
<td>(95% CI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specificity %</td>
<td>98 (98–98)(^b)</td>
<td>97 (97–98)(^b)</td>
</tr>
<tr>
<td>(95% CI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPV %</td>
<td>24 (21–27)</td>
<td>15 (13–17)</td>
</tr>
<tr>
<td>(95% CI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPV %</td>
<td>100 (100–100)(^b)</td>
<td>100 (100–100)(^b)</td>
</tr>
<tr>
<td>(95% CI)</td>
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</tbody>
</table>

Mean false positive rate = 80%
Early recognition: CHOP electronic

<table>
<thead>
<tr>
<th>Algorithmic Alert</th>
<th>Physician Judgment</th>
<th>Combination</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Severe sepsis +</td>
<td>Severe sepsis +</td>
</tr>
<tr>
<td>Alert +</td>
<td>81</td>
<td>64</td>
</tr>
<tr>
<td>Alert -</td>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>3,220</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>16,216</td>
<td>19,341</td>
</tr>
</tbody>
</table>

Severe sepsis prevalence = 88 (0.45%)

The ED Pediatric Septic Shock Shock Collaborative

• Sponsored by the American Academy of Pediatrics (AAP)
• > 40 ED’s
• QI study design with rapid cycle changes
  – 1 year of retrospective data 5 years prospective
  – All sites must institute a **screening tool and treatment protocol**
  – No screening or treatment mandates
    • BUT asked to stay as close to suggested screening mechanism as possible
    • Treatment based on best practice guidelines per PALS/Surviving Sepsis
CNMC Data
Post-Implementation 7/2016- Present

Time to Treatment for Potential Sepsis Patients

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Implementation</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to Bolus 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to Antibiotic</td>
<td></td>
<td></td>
<td></td>
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</table>

Goal
**KEY DRIVER DIAGRAM**

**Project Name: Sepsis Treatment in the ED**

**Revision Date: June 3, 2016**

**SMART AIM**

90% of ED suspected sepsis cases will receive first bolus within 30 minutes and antibiotic within 60 minutes in 12 months.

**GLOBAL AIM**

Decrease patient harm in sepsis cases that present to the CNMC ED.

**KEY DRIVERS**

- Early Recognition and Detection
  - Including patient physiological risk factors
  - Escalation of Concerns
- Standardized process/resuscitation/stabilization & treatment
- Frequent patient assessment
- Process Delays - Room availability
- Staff buy in and value participation in achieving goal
- Treatment team reliably implements therapy in timely manner
  - Timely vascular access & IVF administration
- Appropriate timely and effective resuscitation and stabilization
- Team Communication/Situational Awareness

**INTERVENTIONS**

- Staff education: Understand EB sepsis management guidelines and demonstrate performance of critical interventions.
- Identify patients with abnormal vital signs
- Rapidly evaluate high-risk patients
- Reliable tool developed for sepsis alert upon triage/initial assessment
  - Decision Support integrated into Firstnet through Sepsis Trigger tool
- Vital signs monitoring
  - Use Powerplan, protocols/algorithms and reassessment guidelines
- Weekly feedback via email and posted for staff
  - Monthly feedback
- Pre-assigned sepsis team with defined roles
- Collaborate with the IV Team for access assistance
Quality Improvement Strategies

- Increasing compliance with sepsis quality indicators
- Multidisciplinary team collaboration
- Education - introduce guidelines into clinical practice
- Protocol development and implementation
- Data collection
- Feedback – to facilitate continuous improvement
- Ongoing education
Sepsis Training

1. Online educational course (1 hour)- with pre and post test and at 3 months – All Staff
2. Clinical sepsis case study scenarios including hands-on demonstration of push-pull IVF administration, IO placement, vasopressor drip calculation and administration.
3. Sepsis alert training with decision support explanation & nursing documentation requirements
4. Sepsis alert process steps
Sepsis Trigger Algorithm

1. Temperature abnormality within the last 4 hours
   - Yes
     1. Tool positive if ≥ 3 of the shaded pink boxes are checked following patient assessment
       - Yes
         1. Notify MD. Does MD agree with tool?
           - Yes
             1. Launch ED Suspected Sepsis Order Set
                1. Write "Potential Sepsis" in comment box on track board
           - No
             1. Continue routine care
   - No
     - Continue routine care
# Sepsis Trigger Tool Criteria

<table>
<thead>
<tr>
<th>Patient Vital Signs</th>
<th>Check box if:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Check box if ABNORMAL</strong></td>
<td>Enter patient vital signs</td>
</tr>
<tr>
<td>Temp</td>
<td>°C</td>
</tr>
<tr>
<td>Systolic BP</td>
<td>mmHg</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>bpm</td>
</tr>
<tr>
<td>Resp Rate</td>
<td>rpm</td>
</tr>
<tr>
<td>Cap Refill</td>
<td></td>
</tr>
<tr>
<td>Mental Status</td>
<td></td>
</tr>
<tr>
<td>Pulses</td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td></td>
</tr>
<tr>
<td>High Risk Condition</td>
<td></td>
</tr>
</tbody>
</table>

| Number of boxed checked |
Potential Sepsis Alert

Subject: Potential Sepsis
Priority Status: High
Priority Value: 100
Event Date/Time: 03/25/2015 10:23:04
Message class/subclass: APPLICATION/DISCERN

Potential Sepsis has been identified for CERNER, NINETEENSISTER. Immediately inform a provider and document the name of that provider in the Physician Notification Form from adhoc.
Sepsis Alert Trigger Frequency
PDSA Interventions

1. Summer 2014
   - Hands on Education
   - Automated screening algorithm & EHR alert
   - Power plan
   - Online educational tool
   - Simplification of screening algorithm
4. May 2016
   - Weekly Individual Feedback
5. July 2016
   - Pre-assigned Sepsis Team
6. August 2016
   - Re-education and reinvigoration of sepsis initiative
7. October 2016
   - Feedback Form
   - Huddle reminders/Charge Nurse communication
Improvement Timeline
Next Steps

Sepsis trigger characteristics to display on alert notification
Back to our patient

- Fever would have mandated use of tool
  - (T 102 F)
- Exam noted **mottling of skin** (1 point)
- VS HR 143, RR 22 (2 points)

- Would have triggered closer evaluation
The Future?

• ED Sepsis Team
  – Decision making: Launching the pathway?

• Prehospital Alert /treatment
  – Maryland protocol (2016)

• Other areas of the hospital (PICU, Heme Onc)
  – CHA collaborative