Pediatric Sepsis
Definitions and Guidelines

Past, Present, and Future

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Children’s Hospital Association
Sepsis Webcast Series
November 16, 2017
Conflict of Interest Disclosures for
Scott L. Weiss, MD MSCE FAAP FCCM

<table>
<thead>
<tr>
<th>Grant/Research Support</th>
<th>National Institutes of Health</th>
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<td>Society of Critical Care Medicine</td>
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<td>Children’s Hospital of Philadelphia</td>
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<td>Bristol-Meyers Squibb</td>
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<td>Other (identify)</td>
<td>Royalties – Up-To-Date</td>
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Objectives

1. Review the evolution of sepsis definitions and how variability can be useful
2. Discuss the impact and relevance of Sepsis-3 to pediatric sepsis
3. Summarize benefits of existing sepsis guidelines and highlight efforts to optimize care
Hippocrates (400 BC): “Sepo” ~ “I rot”
Semmelweis (1850's): Puerperal fever
Pasteur (1878): Germ theory, sterilization
Lister (1877): “antisepsis”
Asbaugh/Petty (1967): ARDS
Bone (1989): Infection + host response
American College of Chest Physicians/Society of Critical Care Medicine Consensus Conference: Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis

MEMBERS OF THE AMERICAN COLLEGE OF CHEST PHYSICIANS/SOCIETY OF CRITICAL CARE MEDICINE CONSENSUS CONFERENCE COMMITTEE

**SIRS:** “non-specific”  
**Sepsis:** SIRS + infection  
**Severe sepsis:** Sepsis + organ failure  
**Septic shock:** Hypotension, ↓ perfusion
“...no evidence exists to support a change to the definitions.”
SIRS: ≥ 2 abnormalities of temp, HR, RR, WBC

Sepsis: SIRS, plus suspected or proven infection

Severe sepsis: Sepsis, plus organ dysfunction

Septic shock: Sepsis, plus CV dysfunction
  - CV dysfunction ≠ hypotension
  - Abnormal perfusion: ↑lactate, acidosis, oliguria, delayed CR
N=109,663 adult pts in 172 Aust/NZ ICUs
Infection + organ failure

SIRS-Neg
N=13,278

SIRS-Pos
N=96,385

NEJM 2015
N = 40,356 pediatric pts in single US pediatric ED

ICU care required:
SIRS positive: 23
SIRS negative: 76

<table>
<thead>
<tr>
<th>Condition</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>Any SIRS pair</td>
<td>23% (15-33%)</td>
<td>85% (84-85%)</td>
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Value (95% confidence interval)
Nearly half who met criteria for severe sepsis were not corroborated by physician diagnosis.
Sepsis is life-threatening organ dysfunction caused by a dysregulated host response to infection

- Severe sepsis → Sepsis

Septic shock is subset with

- Circulatory (hypotension despite vasoactives) AND
- Cellular/metabolic abnormalities (lactate >2 mmol/L)
Applying Sepsis-3 to Pediatrics

- Integrates pathobiology with clinical criteria

- Concept applicable to pediatrics:
  - Sepsis = Infection + Organ Dysfunction

- Challenges?
  - Defining pediatric organ dysfunction
  - How and when to determine cardiovascular dysfunction
Pediatric Organ Dysfunction

**PELOD-2**

PELOD-2: OR 1.5 death
(95% CI 1.39, 1.63)

Score ≥8: 9.3% mortality

**Sepsis:** 12% mortality
**Septic shock:** 32% mortality

Matics, Sanchez-Pinto *JAMA Peds* 2017

Leclerc *Ped Crit Care Med* 2017

Matics, Sanchez-Pinto *JAMA Peds* 2017
Cardiovascular Dysfunction?

To consider:

- Low lactate not always reassuring
- Most high lactate do well
- Current emphasis (correctly!) on perfusion
- Hypotension late finding

Scott et al JAMA Peds 2017
Defining Sepsis is Inherently Arbitrary

- Not Sepsis
  - Uncomplicated Infection
  - Prevention?

- Sepsis
  - SIRS
  - Organ Dysfunction
  - Shock
  - Septic Shock
  - Treatment
  - Death
“Is this patient septic?”

- No single definition need satisfy all purposes

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<td>High</td>
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<td>Timeliness</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
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Question #1:

Sepsis-3 can (and should) be applied to children with age-specific caveats?

- YES
- NO (or, at least, not yet)
Sepsis Guidelines


Andrew Rhodes, MB BS, MD(Res) (Co-chair); Laura E. Evans, MD, MSc, FCCM (Co-chair); Waleed Alhazzani, MD, MSc, FRCPC (methodology chair); Mitchell M. Levy, MD, MCCM; Massimo Antonelli, MD; Ricard Ferrer, MD, PhD; Anand Kumar, MD, FCCM;

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

Alan L. Davis, MD, MPH, FAAP, FCCM; Joseph A. Carcillo, MD; Rajesh K. Aneja, MD; Andreas J. Deymann, MD; John C. Lin, MD; Trung C. Nguyen, MD; Regina S. Okhuysen-Cawley, MD, FAAP; Monica S. Relvas, MD, FAAP, MSHA, FCCM;
Formulated following initial 2001 management guidelines, updated every 4 years

Collaboration of SCCM, ESICM, ISF

Injected concept of “bundles” into sepsis

Surviving Sepsis Campaign Bundles

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

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 arterial hypotension despite volume resuscitation (septic shock) or initial lactate ≥4 mmol/L (36 mg/dL):
   - Measure central venous pressure (CVP)*
   - Measure central venous oxygen saturation (ScVO₂)*
7) Remeasure lactate if initial lactate was elevated*

Figure 1. Surviving Sepsis Campaign Care Bundles.
Surviving Sepsis Campaign: Association Between Performance Metrics and Outcomes in a 7.5-Year Study

Mitchell M. Levy, MD, FCCM; Andrew Rhodes, MB BS, MD (Res); Gary S. Phillips, MAS; Sean R. Townsend, MD; Christa A. Schorr, RN, MSN; Richard Beale, MB BS; Tiffany Osborn, MD, MPH; Stanley Lengeshow, PhD; Jean-Daniel Chiche, MD; Antonio Artigas MD, PhD; R. Phillip Dellinger, MD, FCCM
### Point Prevalence Study

**N=1794 adult septic patients from 62 countries**

<table>
<thead>
<tr>
<th>Bundle Compliance</th>
<th>Mortality (aOR)</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full 3-hour bundle</td>
<td>0.64</td>
<td>0.47-0.87</td>
<td>0.004</td>
</tr>
<tr>
<td>Full 6-hour bundle</td>
<td>0.71</td>
<td>0.56-0.90</td>
<td>0.005</td>
</tr>
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</table>

*aOR = adjusted odds ratio*
## Treatment of Pediatric Septic Shock With the Surviving Sepsis Campaign Guidelines and PICU Patient Outcomes*

Jennifer K. Workman, MD¹; Stefanie G. Ames, MD¹; Ron W. Reeder, MS, PhD¹; E. Kent Korgenski, MS, MT (ASCP)³; Susan M. Masotti, BA⁴; Susan L. Bratton, MD, MPH¹; Gitte Y. Larsen, MD, MPH¹

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**N=321 ED/PICU pediatric septic shock**

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Surviving Sepsis Campaign Compliant</th>
<th>Unadjusted ( p ) Values(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No ((n = 204))</td>
<td>Yes ((n = 117))</td>
</tr>
<tr>
<td>Organ dysfunction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New or progressive multiple organ dysfunction syndrome</td>
<td>25 (12.3%)</td>
<td>9 (7.7%)</td>
</tr>
<tr>
<td>Mortality</td>
<td>13 (6.4%)</td>
<td>4 (3.4%)</td>
</tr>
</tbody>
</table>

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*\( p \) Values refer to statistical significance levels for comparing outcomes between Surviving Sepsis Campaign compliant and non-compliant groups.

---

**Pediatr Crit Care 2016**
Bundled Approach to Pediatric Sepsis Resuscitation

An Emergency Department Septic Shock Protocol and Care Guideline for Children Initiated at Triage

Implementation of Goal-Directed Therapy for Children With Suspected Sepsis in the Emergency Department

Improving Adherence to PALS Septic Shock Guidelines

Resuscitation Bundle in Pediatric Shock Decreases Acute Kidney Injury and Improves Outcomes

Comparison of Two Sepsis Recognition Methods in a Pediatric Emergency Department

Ayse Akcan Arikan, MD, PhD, MSCE, Elizabeth R. Alpern, MD, MSCE, Robert W. Grundmeier, MD, Marianne Chilutti, MS, Scott L. Weiss, MD, Julie C. Fitzgerald, MD, PhD, Katie Hayes, Warren Bilker, PhD, and Ebbing Lautenbach, MD, MPH, MSCE
Improving Adherence to PALS Septic Shock Guidelines

**AUTHORS:** Raina Paul, MD, a Elliot Melendez, MD, b,c Anne Stack, MD, b Andrew Capraro, b Michael Monuteaux, ScD, b and Mark I. Neuman, MD, MPH b

**BACKGROUND AND OBJECTIVES:** Few studies have demonstrated im-
Improving Adherence to PALS Septic Shock Guidelines

**Authors:** Raina Paul, MD, Elliot Melendez, MD, Anne Stack, MD, Andrew Capraro, Michael Monuteaux, ScD, and Mark I. Neuman, MD, MPH

**Abstract**

**Background and Objectives:** Few studies have demonstrated improved outcomes in children with sepsis and shock if the PEDIATRIC Advanced Life Support (PALS) guidelines are adhered to. This study aims to assess the number of cases between sepsis deaths and adherence to the PALS guidelines.

**Graph Description:**
- The graph shows the number of cases between sepsis deaths over a period from January to December.
- The x-axis represents the months, and the y-axis represents the number of cases between deaths.
- The graph includes a trend line showing an increase in adherence over time.
- Key data points include:
  - January: 10 cases
  - February: 20 cases
  - March: 30 cases
  - April: 40 cases
  - May: 50 cases
  - June: 60 cases
  - July: 70 cases
  - August: 80 cases
  - September: 90 cases
  - October: 100 cases
  - November: 100 cases
  - December: 100 cases

**Legend:**
- Red line: Upper Control Limit
- Red line: Lower Control Limit
- Black line: Cases Between Deaths
- Blue line: Mean Adherence
Protocolized Treatment Is Associated With Decreased Organ Dysfunction in Pediatric Severe Sepsis

Fran Balamuth, MD, PhD, MSCE\textsuperscript{1,2}; Scott L. Weiss, MD, MSCE\textsuperscript{3,4}; Julie C. Fitzgerald, MD, PhD\textsuperscript{3,4}; Katie Hayes, BS\textsuperscript{2}; Sierra Centkowski, BA\textsuperscript{1}; Marianne Chilutti, MS\textsuperscript{5}; Robert W. Grundmeier, MD\textsuperscript{1,5}; Jane Lavelle, MD\textsuperscript{1,2}; Elizabeth R. Alpern, MD, MSCE\textsuperscript{6,7}

<table>
<thead>
<tr>
<th>Organ Failure Free Day 2</th>
<th>OR (Adjusted)</th>
<th>(p)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency department sepsis protocol</td>
<td>4.23</td>
<td>0.002</td>
<td>1.7–10.4</td>
</tr>
<tr>
<td>Sex</td>
<td>1.23</td>
<td>0.59</td>
<td>0.6–2.6</td>
</tr>
<tr>
<td>Central line</td>
<td>0.95</td>
<td>0.98</td>
<td>0.3–2.8</td>
</tr>
<tr>
<td>Pediatric Index of Mortality-2 score</td>
<td>0.61</td>
<td>&lt;0.005</td>
<td>0.5–0.8</td>
</tr>
<tr>
<td>Any comorbidity</td>
<td>0.92</td>
<td>0.79</td>
<td>0.4–1.9</td>
</tr>
<tr>
<td>Antibiotics &lt; 120 min</td>
<td>0.93</td>
<td>0.9</td>
<td>0.4–2.2</td>
</tr>
<tr>
<td>Bolus &lt; 120 min</td>
<td>3.1</td>
<td>0.04</td>
<td>1.1–8.8</td>
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</tbody>
</table>

OR = odds ratio.

Variables were included in the model if \(p < 0.2\) on univariate analysis.
## Cause of Death

<table>
<thead>
<tr>
<th>Cause</th>
<th>%</th>
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<tbody>
<tr>
<td>Refractory shock</td>
<td>34%</td>
</tr>
<tr>
<td>MODS (after shock recovery)</td>
<td>27%</td>
</tr>
<tr>
<td>Brain injury</td>
<td>19%</td>
</tr>
<tr>
<td>Lung failure (single-organ)</td>
<td>9%</td>
</tr>
<tr>
<td>Comorbidity (not to due sepsis)</td>
<td>6%</td>
</tr>
</tbody>
</table>

Day 1-3:
- Lung failure
- MODS
- Comorbidity
- Brain injury
- Refractory Shock

Day 4-7:
- Lung failure
- MODS
- Comorbidity
- Brain injury
- Refractory Shock

Day >7:
- Lung failure
- MODS
- Comorbidity
- Brain injury
- Refractory Shock

Weiss et al, *Pediatric Crit Care Med* 2017
Pediatric Sepsis-Associated MODS

Year of Publication

Mortality

20%
Limitations of Existing Guidelines

- Current guidelines (correctly!) emphasize circulatory dysfunction and oxygen delivery...
- ...and many (most!) children with sepsis recover with fluid, antibiotics, and vasoactives
- But for 20-40% with *refractory shock or MODS*...

there is a need to determine what works better!
Pathways to Improvement for Sepsis

- Earlier recognition
- Optimize approach to resuscitation
Pathways to Improvement for Sepsis

- Earlier recognition
- Optimize approach to resuscitation

Andrew Rhodes, MB BS, MD(Res) (Co-chair)\(^1\); Laura E. Evans, MD, MSc, FCCM (Co-chair)\(^2\);
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Jonathan E. Sevransky, MD, FCCM\(^8\); Charles L. Sprung, MD, JD, MCCM\(^9\); Mark E. Nunnally, MD, FCCM\(^3\);
Bram Rochwerger, MD, MSc (Epi)\(^3\); Gordon D. Rubenfeld, MD (conflict of interest chair)\(^10\);
Derek C. Angus, MD, MPH, MCCM\(^11\); Djillali Annane, MD\(^12\); Richard J. Beale, MD, MB BS\(^13\);

A. INITIAL RESUSCITATION

1. Sepsis and septic shock are medical emergencies, and we recommend that treatment and resuscitation begin immediately (BPS).

B. SCREENING FOR SEPSIS AND PERFORMANCE IMPROVEMENT

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

- Screen for septic shock using a trigger tool
- Clinician assessment within 15 minutes
- Begin resuscitation within 30 minutes
EHR-Augmented Sepsis Recognition
(The CHOP ED Experience)

Fever or hypothermia and
Tachycardia or hypotension and
Abnormal cap refill or
Altered mental status or
High-risk condition

Balamuth et al Ann Emerg Med 2017
Challenge of Hospital-Acquired Sepsis

The image shows a bar chart comparing hospital mortality rates between community-acquired and hospital-acquired sepsis. The chart illustrates that hospital-acquired sepsis has a significantly higher mortality rate compared to community-acquired sepsis. The chart includes two categories: SPROUT and CHOP, with the bar heights indicating the mortality rates.
Initial CHOP PICU screening tool

- Consensus criteria
- SIRS-based
- Laborious
- Inaccurate

1. SIRS
   - Present at any time in last 24 hours as per the Nursing Flowsheet:
     - TEMP
     - HEART RATE
     - RESP RATE
     - WBC COUNT
   - Are 2 or more boxes checked?
     - NO → Circle "NONE" in #4 and you are done!
     - YES → Is one box TEMP or WBC?
       - NO → Circle "NONE" in #4 and you are done!
       - YES → If also YES, then...
         - CIRCLE THIS BOX
         - Go to Section #2

2. Suspected infection
   - Is ANY BOX in #2 checked?
     - NO → CIRCLE THIS BOX
     - YES → Go to Section #3

3. Organ dysfunction
   - Check here if no organ dysfunction (= no boxes checked in a – f above)
   - Daytime NURSE: Say on rounds “Sepsis screen = _______. Discuss on rounds, then...
     - Circle the final team decision: None SIRS Sepsis Severe Sepsis Septic Shock
     - Add “final team decision” to EPIC bulletin board. Check here □ when this is done.
Final, Revised Pediatric Severe Sepsis Screening Tool

SIRS combined with Acute Organ Dysfunction* = Severe Sepsis or Septic Shock

**Modified SIRS**

SIRS requires **two** abnormal measures, one of which must be HR or RR, and the other must be one of the following: temperature, WBC, or % Neutrophil Banding.

<table>
<thead>
<tr>
<th>SIRS Components</th>
<th>AND</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate or Respiratory Rate</td>
<td>One Major Organ Dysfunction</td>
<td>At least two Minor Organ Dysfunctions</td>
</tr>
<tr>
<td>Temperature, WBC, or % Neutrophil Banding</td>
<td></td>
<td></td>
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**To meet Acute Organ Dysfunction (OD) criteria, patient must have either one major or two minor organ dysfunctions.**

---

### Respiratory

- Does the patient need mechanical ventilation?
  - (Respiratory organ dysfunction is ignored for the 1st hour after arrival, for two hours following administration of asthma or seizure meds.)

### Cardiopulmonary

- Is the patient’s blood pressure below 30? Percentage of normal value for age? (see below for reference values)
- Does the patient have a low platelet count (< 80,000/mm³)?
- Does the patient have two consecutive pulse oximetry measurements with arterial saturation < 90% and < 64%? (and has not received Asthma or Seizure meds within 2 hours)
- Does the patient have a low platelet count (< 80,000/mm³) OR Decline in platelet count > 50% from highest value recorded in past 3 days, AND is NOT receiving ECMO
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---

*From Chameides et al. (29)
†† From Taketomo et al. (20)
Definitions vs Diagnosis

Sepsis Definitions (2005)
- SIRS plus
- Low BP despite 40 ml/kg fluid
- Need for vasoactive
- Two of the following:
  - Base deficit < -5
  - Lactate > 4 mmol/L
  - UOP < 0.5 ml/kg/hr
  - CR > 5 seconds
  - Core-peripheral temp gap

Prognostic – Worse Outcomes

Shock Guidelines (2014)
- Fever/hypothermia plus
- Hypotension
- Altered mental status
- Bounding pulses, flash CR
- CR > 2 seconds
- UOP < 1 ml/kg/hr
- Cool or mottled extremities

Operational – Early Recognition, Tx

Goldstein et al Ped Crit Care Med 2005
ACCM Ped Crit Care Med 2017
“Is this patient septic?”

- No single definition need satisfy all purposes

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Definitions vs Diagnosis

**Sepsis Definitions (2005)**
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**Prognostic – Worse Outcomes**

**Shock Guidelines (2014)**
- Fever/hypothermia \textit{plus}
- Hypotension
- Altered mental status
- Bounding pulses, flash CR
- CR $> 2$ seconds
- UOP $< 1$ ml/kg/hr
- Cool or mottled extremities

**Operational – Early Recognition, Tx**

Goldstein et al \textit{Ped Crit Care Med} 2005
ACCM \textit{Ped Crit Care Med} 2017
Question #2:
My hospital uses a systematic tool to screen for pediatric sepsis?

- YES
- NO
Pathways to Improvement for Sepsis

- Earlier recognition
- Optimize approach to resuscitation
In-hospital mortality decreased from 46% (standard care) to 31% (EGDT)

Mortality 39% → 12% with EGDT

Early Goal-Directed Therapy (EGDT) involves:
- Give O₂
- Give Fluid
- Give Vasoactives
- Give Blood

ACCM/PALS haemodynamic support guidelines for paediatric septic shock: an observational comparison with and without monitoring central venous oxygen saturation

Mortality 39% → 12% with EGDT
American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

- **Oxygen**
- **Fluid**
- **Antibiotics (+ source control)**
- **Vasoactives**
- **Blood**
- **Steroids**
CHOP Sepsis Pathway (www.chop.edu)
Is “Early Goal-Directed Therapy” Still Important?

 ORIGINAL ARTICLE

A Randomized Trial of Protocol-Based Care for Early Septic Shock  ProCESS (2014)

 ORIGINAL ARTICLE

Goal-Directed Resuscitation for Patients with Early Septic Shock  ARISE (2014)

 ORIGINAL ARTICLE

Everyone (nearly) gets early, aggressive resuscitation – the precise manner in which this is done may be less important.
Mortality after Fluid Bolus in African Children with Severe Infection


![Graph showing cumulative probability of death for different fluid boluses: Albumin, Saline, No bolus](image)

*No bolus*
N=212 adults with septic shock in Zambia

Andrews et al JAMA 2017
Optimize Fluid Resuscitation

Optimal volume?  
10 mL/kg vs 20 mL/kg boluses  
United Kingdom (Dr. David Inwald)

Optimal duration?  
Usual care vs early norepinephrine  
Canada (Dr. Melissa Parker)

Optimal type?  
Normal saline vs lactated Ringer’s  
United States (Drs. F Balamuth, S. Weiss)
Question #3:
At my hospital, 60 mL/kg of 0.9% saline is the standard resuscitation approach for septic shock?

- YES
- NO
Where Do We Go From Here?
Need More, Better Evidence: First-line Vasoactive for Ped Septic Shock

Ventura et al, Crit Care Med 2015
Ramaswamy et al, Peds Crit Care Med 2016
Align Pathobiology with Clinical Criteria: “Warm” vs “Cold” Shock

**COLD SHOCK**
- Cool extremities
- Delayed cap refill
- Weak peripheral pulses
- Narrow pulse pressure

**WARM SHOCK**
- Warm extremities
- Flash cap refill
- Bounding periph pulses
- Wide pulse pressure

Crit Care Med 2017
Pediatric Crit Care Med 2017
Can We Differentiate Warm vs Cold Shock?

Multimodal Monitoring for Hemodynamic Categorization and Management of Pediatric Septic Shock: A Pilot Observational Study

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Pediatric Critical Care Medicine 2013
(Slide courtesy of S. Ranjit, MD)
Align Pathobiology with Clinical Criteria: Specific Phenotypes to Drive Therapy

Carcillo et al, Pediatric Crit Care Med 2017
Combining Prognostic and Predictive Enrichment Strategies to Identify Children With Septic Shock Responsive to Corticosteroids*

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<table>
<thead>
<tr>
<th>Endotype</th>
<th>PERSEVERE</th>
<th>Mortality RR</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>“A”</td>
<td>High-risk</td>
<td>1.03 (0.24-1.95)</td>
<td>0.96</td>
</tr>
<tr>
<td>“B”</td>
<td>High-risk</td>
<td>0.09 (0.01-0.54)</td>
<td>0.007</td>
</tr>
</tbody>
</table>

Endotype “B: ↑↑↑ Glucocorticoid receptor signaling
Align Pathobiology with Clinical Criteria: Circulatory $\rightarrow$ Cellular Resuscitation

- Increase $O_2$ delivery
- Reverse shock
- Increase $O_2$ utilization,
  Improve bioenergetics

Energy Demand

Energy Production
Longer-Term Outcomes

SPROUT study:

- 17% mod-severe disability at hospital discharge
- 38% disability or death

Pinto et al Pediatric Crit Care Med 2017
Weiss et al AJRCCM 2015
Partner with Local, State, Federal Policymakers: 
*Sepsis QI Bundles → Law*

**CMS SEP-1**
- **Within 3 hours:**
  - Measure serum lactate
  - Obtain blood cultures
  - Administer antibiotics
  - Fluid 30 mL/kg
- **Within 6 hours:**
  - Volume, perfusion status
  - Vasopressor administration

**NY State Regulations**
- **Within 1 hour:**
  - Obtain blood cultures
  - Administer antibiotics
  - Fluid 20 mL/kg
States with Sepsis Legislation
Public Campaigns

www.sepsis.org
Improving Pediatric Sepsis Outcomes (IPSO) aims:

- To reduce sepsis mortality by 75 percent
- To reduce hospital-onset sepsis by 75 percent

47 participating hospitals
Rivers’ EGDT → physiology-based resuscitation
Decreased emphasis on threshold endpoints
RBC transfusion for Hgb <7.0 g/dL
No “Pediatric Considerations”
International Guidelines for Management of Sepsis and Septic Shock in Children (Pediatric Surviving Sepsis Campaign)

- Multidisciplinary effort through SCCM and ESICM
- Six domains:
  - Recognition & management of infection
  - Hemodynamic resuscitation
  - Ventilation
  - Metabolic support
  - Adjunctive therapies
  - Research priorities
- Expected publication – 2019
Conclusions

- Sepsis exists on a spectrum between infection and death, mediated by worsening organ dysfunction
  - Identifying cut-points that define transition to sepsis is largely an epidemiologic necessity
  - Definitions should not drive care, signs/symptoms should

- Guidelines help to focus and implement screening and treatment in a way that saves lives
  - Duty to implement but constantly strive to improve
www.chop.edu/sepsis
Thank you!

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