Sepsis Overview Webinar
Facilitator: Tina Logsdon
Children’s Hospital Association

March 5, 2015

Today’s presenters

Matthew Niedner, MD
University of Michigan C.S. Mott Children’s Hospital

Charles Macias, MD, MPH
Texas Children’s Hospital

Roni Lane, MD
Primary Children’s Hospital

Tina Willis, MD
University of North Carolina

NOTE: Slides and a recording link will be sent to all webcast registrants and other sepsis contacts

Champions for Children’s Health
# Future sepsis webinars

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Presenters</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 20</td>
<td>2 ET / 1 CT / 12 MT / 11 PT</td>
<td>One Hospital’s Efforts to Improve Sepsis Care: Pete Silver, MD, FCCM Steven and Alexandra Cohen Children's Medical Center of New York</td>
</tr>
<tr>
<td>May 13</td>
<td>12 ET / 11 CT / 10 MT / 9 PT</td>
<td>Rapid Cycle Collaborative Teams: Halden Scott, MD &amp; Beth Wathen, MSN, CCRN Children's Hospital Colorado Toni Wakefield, MD &amp; Dory Collette, RN, CCRN Dell Children’s Medical Center</td>
</tr>
<tr>
<td>June 10</td>
<td>11 ET / 10 CT / 9 MT / 8 PT</td>
<td>System-wide implementation: Tina Willis, MD University of North Carolina</td>
</tr>
<tr>
<td>July 14</td>
<td>11 ET / 10 CT / 9 MT / 8 PT</td>
<td>AAP Section on Emergency Medicine’s Pediatric Septic Shock Collaborative: Charles Macias Texas Children’s Hospital</td>
</tr>
</tbody>
</table>

Mark your calendars! We’ll include details in e-mail. Registration links will open approximately 6-8 weeks before each event.

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**QUALITY AND SAFETY IN CHILDREN’S HEALTH CONFERENCE**

**MARCH 9-11, 2015 • SAN FRANCISCO, CA**

The premier conference for pediatric health care professionals with a passion for improvement.

- 400+ attendees
- 30+ sessions in patient and family engagement, patient safety, medically complex children and becoming a High Reliability Organization
- Two incredible keynotes:
  - Dr. Don Berwick - “The Triple Aim in Pediatrics”
  - Dr. Wendy Sue Swanson - “The Power of Digital Health”

Find information at childrenshospitals.net/quality15
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Pediatric Sepsis
Old Controversies, Contemporary Data, and New Metrics

Dr. Matthew Niedner, MD
Director of Quality & Safety, PICU
Pediatric Critical Care Medicine
Assistant Professor of Pediatrics
CS Mott Children’s Hospital
University of Michigan

March 5, 2015
It’s a Big Deal!

- ~30K children <5 ys die daily of sepsis/complications
  - Most common cause of childhood death in the world
- ~40-80K annual US hospitalizations for severe sepsis
- Prevalence increasing over last decade
  - 3.7→4.4% of hospitalizations (~20% relative increase)
  - Prevalence varies between hospitals (~4-13%)
- 8-14% Hospital Mortality
  - Inter-hospital outcomes vary considerably (2.5-14.5%)
- 75% admitted to an ICU (25% mortality in PICU)
  - Median hospital costs >$50,000

Pediatr Crit Care Med. 2013 Sep;14(7):686-93

What is it?

- Infection
- SIRS
- Sepsis
- Septic Shock

Champions for Children’s Health
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis syndrome</td>
<td>Sepsis, severe sepsis or septic shock</td>
</tr>
<tr>
<td>Sepsis</td>
<td>Systemic Inflammatory Response Syndrome (SIRS) in the presence of, or as a result of, suspected or proven infection</td>
</tr>
<tr>
<td>SIRS</td>
<td>The presence of at least two of the following four criteria, one of which must be abnormal temperature or leukocyte count:</td>
</tr>
<tr>
<td></td>
<td>• Core temperature of &gt; 38.5°C or &lt; 36°C.</td>
</tr>
<tr>
<td></td>
<td>• Tachycardia, defined as a mean heart rate &gt; 2 SD above normal for age in the absence of external stimulus, chronic drugs, or painful stimuli; or otherwise unexplained persistent elevation over a 0.5 to 4 hr time period OR for children &lt;1 yr old: bradycardia, defined as a mean heart rate &lt;10th percentile for age in the absence of external vagal stimulus, β-blocker drugs, or congenital heart disease; or otherwise unexplained persistent depression over a 0.5 hr time period.</td>
</tr>
<tr>
<td></td>
<td>• Mean respiratory rate &gt; 2 SD above normal for age or mechanical ventilation for an acute process not related to underlying neuromuscular disease or the receipt of general anesthesia.</td>
</tr>
<tr>
<td></td>
<td>• Leukocyte count elevated or depressed for age (not secondary to chemotherapy-induced leukopenia) or &gt; 10% immature neutrophils.</td>
</tr>
<tr>
<td>Infection</td>
<td>A suspected or proven (by positive culture, tissue stain, or polymerase chain reaction test) infection caused by any pathogen OR a clinical syndrome associated with a high probability of infection. Evidence of infection includes positive findings on clinical exam, imaging, or laboratory tests (e.g., white blood cells in a normally sterile body fluid, perforated viscus, chest radiograph consistent with pneumonia, petechial or purpuric rash, or purpura fulminans).</td>
</tr>
<tr>
<td>Suspected infection</td>
<td>Infection is suspected when one of the following is documented:</td>
</tr>
<tr>
<td></td>
<td>• Orders for antibiotics OR</td>
</tr>
<tr>
<td></td>
<td>• Antibiotics administered OR</td>
</tr>
<tr>
<td></td>
<td>• Orders for urine, blood or spinal culture OR</td>
</tr>
<tr>
<td></td>
<td>• Urine, blood or spinal culture drawn OR</td>
</tr>
<tr>
<td></td>
<td>• Chart notation of:</td>
</tr>
<tr>
<td></td>
<td>• “Rule out infection” OR</td>
</tr>
<tr>
<td></td>
<td>• “Suspected infection” OR</td>
</tr>
<tr>
<td></td>
<td>• “Rule out sepsis” OR</td>
</tr>
<tr>
<td></td>
<td>• “Suspected sepsis”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severe sepsis</th>
<th>Sepsis plus one of the following: cardiovascular organ dysfunction OR acute respiratory distress syndrome OR two or more other organ dysfunctions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organ dysfunctions</td>
<td>Cardiovascular: Despite administration of isotonic intravenous fluid bolus ≥ 40 mL/kg in 1 hour,</td>
</tr>
<tr>
<td></td>
<td>• Decrease in BP (hypotension) &lt; 5th percentile for age or systolic BP &lt; 2 SD below normal for age OR</td>
</tr>
<tr>
<td></td>
<td>• Need for vasoactive drug to maintain BP in normal range (dopamine &gt; 5 μg/kg/min or dobutamine, epinephrine, or norepinephrine at any dose) OR</td>
</tr>
<tr>
<td></td>
<td>• Two of the following:</td>
</tr>
<tr>
<td></td>
<td>- Unexplained metabolic acidosis: base deficit &gt; 5.0 mEq/L</td>
</tr>
<tr>
<td></td>
<td>- Increased arterial lactate &gt; 2 times upper limit of normal</td>
</tr>
<tr>
<td></td>
<td>- Oliguria: urine output &lt; 0.5 mL/kg/hr</td>
</tr>
<tr>
<td></td>
<td>- Prolonged capillary refill: &gt; 5 seconds</td>
</tr>
<tr>
<td></td>
<td>- Core to peripheral temperature gap &gt; 3°C</td>
</tr>
<tr>
<td>Respiratory</td>
<td>• PaO2/FiO2 &lt; 300 in absence of cyanotic heart disease or preexisting lung disease OR</td>
</tr>
<tr>
<td></td>
<td>• PaCO2 &gt; 65 torr or 20 mm Hg over baseline PaCO2 OR</td>
</tr>
<tr>
<td></td>
<td>• Proven need or &gt; 50% FiO2 to maintain saturation ≥ 95% OR</td>
</tr>
<tr>
<td></td>
<td>• Need for non-effective invasive or noninvasive mechanical ventilation</td>
</tr>
<tr>
<td>Neurologic</td>
<td>• Glasgow Coma Score ≤ 11 OR</td>
</tr>
<tr>
<td></td>
<td>• Acute change in mental status with a decrease in Glasgow Coma Score ≥ 3 points from abnormal baseline</td>
</tr>
<tr>
<td>Hematologic</td>
<td>• Platelet count &lt; 80,000/mm³ or a decline of 50% in platelet count from highest value recorded over the past 3 days (for chronic hematology/oncology patients) OR</td>
</tr>
<tr>
<td></td>
<td>• International normalized ratio &gt; 2</td>
</tr>
<tr>
<td>Renal</td>
<td>• Serum creatinine ≥ 2 times upper limit of normal for age or 2-fold increase in baseline creatinine</td>
</tr>
<tr>
<td>Hepatic</td>
<td>• Total bilirubin ≥ 4 mg/dl (not applicable for newborn) OR</td>
</tr>
<tr>
<td></td>
<td>• ALT 2 times upper limit of normal for age</td>
</tr>
</tbody>
</table>

Septic Shock: Sepsis and cardiovascular organ dysfunction
A Rose by any Other Name…
Pediatric Severe Sepsis in U.S. Children’s Hospitals

Northwest
Southwest
Northeast
Southeast
Midwest

B

Combined codes
Sepsis codes

“Sicker” ICD-9 codes
Fewer cases
Higher Mortality

D

Mortality


PEDICRIT Care Med
2014; 15:798–805

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PICU Severe Sepsis – SPROUT / PALISI
Prospective Screening with 2005 Consensus Criteria
on 5 days in 128 PICUs in 26 countries (59 in North America)

Major Sources:
40% Respiratory
20% Bloodstream

Pathogens:
¼ Gram (+)
¼ Gram (−)
¼ Culture Neg.

Major Therapy:
75% Ventilated
55% Pressors

Mortality: 25%...did not differ by age or geography!
Survivors: 17% develop at least moderate disability


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**Early Resuscitation**

<table>
<thead>
<tr>
<th>Therapeutic Intervention</th>
<th>All Patients (n = 91)</th>
<th>Shock Reversed (n = 24)</th>
<th>Persistent Shock (n = 67)</th>
<th>Survivors (n = 65)</th>
<th>Nonsurvivors (n = 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical ventilation (n [%])</td>
<td>44 (48)</td>
<td>9 (38)</td>
<td>35 (52)</td>
<td>25 (38)</td>
<td>19 (73)</td>
</tr>
<tr>
<td>Intravenous line (n [%])</td>
<td>8 (9)</td>
<td>1 (4)</td>
<td>7 (10)</td>
<td>5 (8)</td>
<td>3 (12)</td>
</tr>
<tr>
<td>Central venous line (n [%])</td>
<td>27 (30)</td>
<td>8 (35)</td>
<td>19 (28)</td>
<td>17 (26)</td>
<td>10 (38)</td>
</tr>
<tr>
<td>Fluid therapy (mL)</td>
<td>20 (41.6)±9.49</td>
<td>23.9 (12.2)±4.44</td>
<td>20.0 (5.7)±3.97</td>
<td>20.0 (5.7)±3.97</td>
<td>20.0 (5.7)±3.97</td>
</tr>
<tr>
<td>Appropriate fluid therapy (n [%])</td>
<td>41 (45)</td>
<td>24 (100)</td>
<td>17 (25)</td>
<td>100</td>
<td>2 (8)</td>
</tr>
<tr>
<td>Dopamine or dobutamine (n [%])</td>
<td>24 (26)</td>
<td>5 (21)</td>
<td>19 (28)</td>
<td>15 (23)</td>
<td>11 (42)</td>
</tr>
<tr>
<td>Epinephrine or norepinephrine (n [%])</td>
<td>15 (16)</td>
<td>2 (8)</td>
<td>13 (19)</td>
<td>4 (6)</td>
<td>11 (42)</td>
</tr>
<tr>
<td>Glucose (n [%])</td>
<td>9 (10)</td>
<td>1 (4)</td>
<td>8 (12)</td>
<td>6 (9)</td>
<td>3 (12)</td>
</tr>
<tr>
<td>Bicarbonate (n [%])</td>
<td>23 (25)</td>
<td>6 (25)</td>
<td>10 (15)</td>
<td>10 (16)</td>
<td>10 (38)</td>
</tr>
<tr>
<td>Hydrocortisone (n [%])</td>
<td>12 (13)</td>
<td>6 (25)</td>
<td>6 (9)</td>
<td>8 (12)</td>
<td>4 (15)</td>
</tr>
<tr>
<td>Resuscitation consistent with ACCM-PALS Guidelines (n [%])</td>
<td>27 (30)</td>
<td>24 (100)</td>
<td>3 (42)</td>
<td>100</td>
<td>2 (8)</td>
</tr>
</tbody>
</table>

**Goal:** normal perfusion vs ScvO2 >70%

**Intervention Outcome:** 28 Day Mortality in 102 patients: 39 vs 12% (p<0.003)

*Or is it “Sicker Patients Do Worse”?*

*Pediatrics 2003; 112:793*

*Champions for Children’s Health*
**Pediatric & Neonatal Septic Shock**

**Crit Care Med 2009; 37(2):667**

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**Emergency Department**

0 min

- Recognize decreased mental status and perfusion. Begin high flow O₂. Establish IV/IO access.

**Initial resuscitation:** Push boluses of 20 cc/kg isotonic saline or colloid up to & over 60 cc/kg until perfusion improves or unless rales or hepatomegaly develop.
- Correct hypoglycemia & hypocalcemia. Begin antibiotics.

- **shock not reversed?**

**5 min**

- Fluid refractory shock: Begin inotrope IV/IO.
  - Use atropine/ketamine IV/IO/IM to obtain central access & airway if needed.
  - Reverse cold shock by titrating central dopamine or, if resistant, titrate central epi/norepinephrine.
  - Reverse warm shock by titrating central norepinephrine.

- **shock not reversed?**

**15 min**

- Catecholamine resistant shock: Begin hydrocortisone if at risk for absolute adrenal insufficiency
  - If 2nd PIH start inotrope.
  - Dose range: dopamine up to 10 mcg/kg/min, epinephrine 0.05 to 0.3 mcg/kg/min.

---

**60 min**

- Monitor CVP in PICU, attain normal MAP-CVP & ScvO₂ > 70%

**Cold shock with normal blood pressure:**
- 1. Titrate fluid & epinephrine, ScvO₂ > 70%, Hgb > 10 g/dL
- 2. If ScvO₂ still < 70%
  - Add vasodilator with volume loading (nitrosovasodilators, milrinone, inunitane, & others)
  - Consider levosimendan

**Cold shock with low blood pressure:**
- 1. Titrate fluid & epinephrine, ScvO₂ > 70%, Hgb > 10 g/dL
- 2. If still hypotensive consider norepinephrine
- 3. If ScvO₂ still < 70%
  - Consider dobutamine, milrinone, enoximone or levosimendan

**Warm shock with low blood pressure:**
- 1. Titrate fluid & norepinephrine, ScvO₂ > 70%
- 2. If still hypotensive consider vasopressin, terlipressin or angiotensin
- 3. If ScvO₂ still < 70%
  - Consider low dose epinephrine

**Persistent catecholamine resistant shock:** Rule out and correct pericardial effusion, pneumothorax, & intra-abdominal pressure >12 mmHg.
- Consider pulmonary artery, PICCO, or FATD catheter, &/or doppler ultrasound to guide fluid, inotrope, vasopressor, vasodilator and hormonal therapies.
- Goal C.I. > 3.3 & < 6.0 L/min/m²

**shock not reversed?**

**Refractory shock:** ECMO

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Pediatric & Neonatal Septic Shock

Crit Care Med 2009; 37(2):667
BUT...

2 Recent Large, Well-Designed RCTs → NEGATIVE

Goal-Directed Resuscitation for Patients with Early Septic Shock

The ARISE Investigators and the ANZICS Clinical Trials Group

![Graph showing probability of survival over days since randomization. N = 1600 patients, 2 limbs. EGDT received: more IVF, more pressors, more PRBC.]

WHAT GIVES?

• Has some EGDT been “absorbed” into Standard Care so hard to discriminate intervention?

• Better recognition now?

Study Dilemmas:

• Abx mandated before randomization, but ~3h to randomization! VS.

• 1 hour to randomization but ~25% no antibiotics by 1h
Controversial Evidence From Early 2000’s

- Ongoing Association Trials (+) vs reporting bias.
- Unclear driving elements of “bundled” algorithmic care.
- Negative large RCTs (NEJM x2).
- Conflicting studies.
- Early vs Late.
- Less vent time, more infections.
- Less mortality, more bleeding.
- Meta-analysis: more mortality, less bleeding.
- Conflicting studies / meta-analyses.
- Is lower better or is higher harmful?
- Marketing vs Science.
- Pediatric risks.

Bernard et al. NEJM 2001; 344.
Van den Berghe et al. NEJM 2001; 345.
Rivers et al. NEJM 2001; 345.
Annane et al. JAMA 2002; 288.

Surviving Sepsis Campaign

Sepsis Resuscitation (6 H) Bundle
- Measure Serum Lactate
- Administer broad-spectrum antibiotics (<3 h)
- Early resuscitation to EGDT Targets

Sepsis Management Bundle
- Low-dose corticosteroids
- Drotrecogin alfa
- Tight glucose control
- Plateau Pressure < 30 cm H2O

N=15,022
Crit Care Med 2010; 38:367
Surviving Sepsis Campaign

- 30,000 patients
- 200 hospitals
- 3 continents (US, SA, Europe)

But if the “care” isn’t getting better (and the compliance is quite low),
Why are the outcomes improving?

Are we dichotomizing bundle components that are continuous variables?

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Back to Basics: Early Antibiotics

Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock.

- N=2,731 adults with septic shock
- Only 50% of pts received antimicrobial therapy within 6 h of documented hypotension!

Crit Care Med 2006; 34:1589

You CAN move the needle!

“Door to antibiotics” decreased from 143 to 38 minutes

TCH Sepsis Protocol
Cruz et al. Pediatrics 2011; 127:e758

Champions for Children’s Health
## Antibiotic Effects & Effect Size

<table>
<thead>
<tr>
<th></th>
<th>Appropriate (n=4579)</th>
<th>Inappropriate (n=1136)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survived</td>
<td>52%</td>
<td>10.3%</td>
<td>9.45 (7.74 – 11.54)</td>
</tr>
</tbody>
</table>

### Mortality Rate

<table>
<thead>
<tr>
<th></th>
<th>Monotherapy (n=1223)</th>
<th>Combination Rx (n=1223)</th>
<th>HR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-Day, %</td>
<td>36.3%</td>
<td>29%</td>
<td>0.77 (0.67 – 0.88)</td>
</tr>
<tr>
<td>ICU, %</td>
<td>35.7%</td>
<td>28.8%</td>
<td>0.75 (0.63 – 0.88)</td>
</tr>
<tr>
<td>Hospital, %</td>
<td>47.8%</td>
<td>37.4%</td>
<td>0.69 (0.59 – 0.81)</td>
</tr>
</tbody>
</table>

### Standardized Order Sets

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate antibiotics, %</td>
<td>71.7</td>
<td>86.7</td>
<td>0.043</td>
</tr>
<tr>
<td>28-day mortality, %</td>
<td>48.3</td>
<td>30</td>
<td>0.04</td>
</tr>
</tbody>
</table>

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**Low volume ~ worse outcomes**

- Collaboration could “↑” volume

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**Champions for Children’s Health**
2014 PQMP: 5 Pediatric Sepsis Measures  
CHIPRA-Funded / AHRQ-Endorsed (PI: Gary Freed)

<table>
<thead>
<tr>
<th>Q-METRIC</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED Protocol Exists at Institution (n=27 hospitals)</td>
<td>41%</td>
</tr>
<tr>
<td>Basic sepsis: Antibiotics &lt;4h (n=274 patients at 3 hospitals)</td>
<td>70%</td>
</tr>
<tr>
<td>Sev. Sepsis/Shock: Antibiotics &lt;60m (n=26 patients at 3 hospitals)</td>
<td>69%</td>
</tr>
<tr>
<td>Sev. Sepsis/Shock: IVF Bolus &lt;60m (n=30 patients at 3 hospitals)</td>
<td>50%</td>
</tr>
<tr>
<td>Sev. Sepsis/Shock: HR response w/ IVF Resus. (n=17 patients at 3 hospitals)</td>
<td>18%</td>
</tr>
</tbody>
</table>

Levels of Reliability (IHI)

<table>
<thead>
<tr>
<th>LVL</th>
<th>Fail Rate</th>
<th>Features in Healthcare QI</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>&gt;20%</td>
<td>Chaotic (most of healthcare*)</td>
</tr>
<tr>
<td>I</td>
<td>5-20%</td>
<td>Team building, education, “trying harder next time”</td>
</tr>
<tr>
<td>II</td>
<td>1-5%</td>
<td>Checklists, standardization, make right way easy, observation</td>
</tr>
<tr>
<td>III</td>
<td>&lt;1%</td>
<td>Preoccupation with failure (RCA), Avoid simplifying interpretations,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“High Reliability Organization”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Support the front line, Commitment to resilience,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Culture of safety</td>
</tr>
</tbody>
</table>

Resar RK. Health Services Research 2006. 41:1677-89.  
Today’s presenters

Matthew Niedner, MD
University of Michigan C.S. Mott Children’s Hospital

Charles Macias, MD, MPH
Texas Children’s Hospital

Roni Lane, MD
Primary Children’s Hospital

Tina Willis, MD
University of North Carolina

Pediatric Shock / Rapid Cycle Collaboratives: A Partnership

Charles Macias, MD, MPH
Chief Clinical Systems Integration Officer
Texas Children’s Hospital/Baylor College of Medicine
Organizational learning: 3 phases of PSSC

• Phase I: The American Academy of Pediatrics, Section on Emergency Medicine
  • Needs assessment: practice patterns in North America for PEM physicians
    • AAP SOEM, Pediatric Emergency Research Canada
    • Diagnosis and management strategies, resource needs
      Championed by Dr. Graham Thompson
  • 47 participating hospitals, best practices identified

Phase II: Collaborative Aim

• AAP PSSC partnered with the Association
• The aim of this collaborative was to reduce mortality and rapid transfers to a higher level of care due to sepsis, as well as achieve 95% compliance with the following key sepsis diagnosis and management processes:
  • Initial clinical assessment
  • Fluid bolus administration
  • Antibiotic administration
    by June 30, 2013
Project scope

13 Hospitals selected their own target populations from within these parameters:

- Target hospital units
  - Emergency Department
  - Medical/surgical units, including hem/onc
  - Critical care (PICU, CICU, CTICU)
  - NOT included: NICU, outpatient clinics
- All patients who meet criteria for suspected septic shock (compensated or uncompensated)

The Improvement Engine

Call for participation

Select Topic/scope

Participant enrollment

Advisory Meetings

- Aim & goals
- Change package
- Measurement strategy

Participant pre-work

Develop Framework:

LS 1 Virtual Jun 2012
LS 2 Virtual Nov 2012
LS 3 Virtual Feb 2013
LS 4 Virtual May 2013


Project Deliverable

Sustain & Spread

Supports

- Conference calls
- Listserv & Website
- Coaching

- Monthly Team Reports
- Association programs
- Advisory Panel
Key driver diagram

**Aim:**
Reduce mortality and rapid transfers to a higher level of care due to sepsis & achieve 95% compliance with
- Initial clinical assessment
- Fluid bolus administration
- Antibiotic administration

**1st hour of resuscitation**
- Understand compensated vs. uncompensated shock
- Identify patients with abnormal vital signs
- Rapidly evaluate high-risk patients
- Perform standardized studies (lab, microbiology, radiology)
- Rapidly escalate to senior physician
- Consider moving patient to high-acuity bed
- Assign adequate personnel
- Empower clinical staff to initiate response
- Provide support for families (Child Life or Social Work)
- Communicate about and review if protocol stopped

**Transfer**
- Maintain/restores serum, CI, and ventilatory support
- Obtain vascular access quickly
- Maintain/restores macro & micro circulation and HR
- Obtain lab studies, microbiology, and radiology
- Rapid medication delivery
- Comply with guidelines for warm and cold shock
- Rapid physician notification of study results

**Ongoing Management**
- Ensure patient is stable for transfer
- Move stable patients out of high-acuity ICU beds
- Alert ICU and transport team of potential admission
- Admit lower acuity children to non-critical care unit
- Use a standardized system for transferring patients
- Use standardized handoff communication process

**Recognition**
- Continue vital signs monitoring until stable
- Use standardized guideline/protocol/algorithm
- Perform ongoing studies (lab, microbiology, radiology)
- Maintain metabolic control
- Adjust treatments according to physiologic response
- Identify and control infection source
- Address potentially reversible morbidities
- Consider ECMO only if cannot support patient

**Change Package Overview**

Focus mostly here
**Process compliance**

- **P1. Initial clinical assessment compliance**
  - Baseline: 46%
  - Q4 - 2012: 50%
  - Q1 - 2013: 59%
  - Q2 - 2013: 60%
  - Q3 - 2013: 66%
  - 23 percentage point improvement

- **P2A. Fluid bolus administration - 1st bolus**
  - Baseline: 38%
  - Q4 - 2012: 40%
  - Q1 - 2013: 41%
  - Q2 - 2013: 41%
  - Q3 - 2013: 46%
  - 8 percentage point improvement

- **P2B. Fluid bolus administration - 1st hour**
  - Baseline: 50%
  - Q4 - 2012: 57%
  - Q1 - 2013: 58%
  - 8 percentage point improvement

- **P3. Timely antibiotic administration**

**Mortality rates**

- **Severe sepsis or septic shock mortality**

- **Total sepsis mortality**

*p<.05

Champions for Children’s Health
Key Challenges

• Case identification/ascertainment varied
• Determining time zero
• Variable ability to implement in areas outside the ED
• Opportunity for improvement remained at the end of one-year improvement project
• Results might have been impacted by secular change and/or improved recognition of sepsis
• However, net effect was better attention to timely diagnosis and escalation of therapy

Rapid cycle collaborative: a team perspective
Roni Lane, MD
Primary Children’s Hospital
Our site’s results during the collaborative

- **Mortality – all sepsis**
  - Baseline vs. Q1-2013 vs. Q2-2013
  - Comparison: 3 days vs. 30 days

- **P2A. Fluid bolus administration - 1st bolus**
  - Baseline vs. Q1-2012 vs. Q2-2012 vs. Q1-2013 vs. Q2-2013

- **P2B. Fluid bolus administration - 1st hour**
  - Baseline vs. Q1-2012 vs. Q2-2012 vs. Q1-2013 vs. Q2-2013

- **P3. Timely antibiotic administration**
  - Baseline vs. Q1-2012 vs. Q2-2012 vs. Q1-2013 vs. Q2-2013

**A PDSA Story: Decreasing Antibiotic Administration Time**

**DOCTOR FUN**

- **HEY! IF YOU TWO SOREHEADS DON’T SETTLE DOWN I’M GOING TO CALL THE LANCER!**

Late night at the “Boil-er Room”
Decreasing Antibiotic Administration Time

- For the first 5 1/2 years our process required antibiotics to be administered within 3 hours of ED presentation
- To be more consistent with national standards, in October 2012, we implemented a new goal of antibiotic administration within 1 hour of ED presentation

Decreasing Antibiotic Administration Time

- **Plan**
  - Started approximately 3 months prior to implementation
  - Brought in additional key stakeholders: mainly pharmacy representatives to troubleshoot the most efficient means of achieving our goal
    - One key point of discussion was whether to have the antibiotics physically in the ED, mixed and drawn up by nurses or have the antibiotics prepared and delivered by central pharmacy
    - After reviewing practical aspects, clinical impact on the nurses, and safety issues of both approaches, the latter was chosen
  - Provided education to all ED personnel regarding the change using myriad of venues and methods to ensure multiple exposures to the same message
  - Updated the written guideline and order set and made sure they were available for use when the change was implemented
Decreasing Antibiotic Administration Time

- **Do**
  - Implemented the change on a predetermined date then watched and waited . . . . . .

- **Study**
  - Analyzed compliance
    - The ED pharmacist started collecting real time data on each patient placed on the protocol.
    - He performed a time-step analysis on cases that did not meet the antibiotic administration goal to determine which step(s) in the process caused the greatest delay (Pareto Principle).
    - Our team collected data bi-monthly and analyzed reasons for compliance.
  - Non-compliant cases were sent to all providers (MD, LIP and RN's) and to pharmacy to elicit barriers that prevented achieving the goal.
Decreasing Antibiotic Administration Time

- **Act**
  - We focused our efforts on a few barriers that accounted for the majority of non-compliant cases: postponing antibiotics for procedures (i.e. LP or joint aspiration), delays in scanning the order set
  - Educational endeavors (multiple venues and methods)
    - Included all ED personnel as well as targeted clinical teams
    - Provided positive and negative feedback to care-givers
    - Individual and group discussion included
      - Case review targeting antibiotic administration time
      - Reviewed aggregate compliance data (run charts and Pareto graphs)
      - Highlighted evidence based guidelines supporting early administration of antibiotics independent of procedures or culture acquisition (blood culture before antibiotics is recommended)
  - Narrowed responsibility for order scanning to the MDs
Antibiotic Administration Compliance Run Chart

Before the protocol change in October 2012, we saw a significant increase in antibiotic compliance with the introduction of an ED Septic Shock Order Set in January 2011 (another PDSA story . . .).

PCH ED Septic Shock Bundle Compliance Annotated Run Chart
QI and PDSA Never Ends . . . . . . .

- Project compliance is reviewed monthly
- There is always room to improve
- Slippage from the target goal will/does happen

Latest PDSA: Improving IV Access

Reasons for Failure to meet IVF Administration Goals by Year 2012-2014

Delay due to patient complexity
Order written for 20 cc/kg, provider dictated 40 ml/kg was...
Mode of delivery not indicated by MD
Ordered appropriately, but not given as ordered
Ordered, not administered
Other
Parent obstructed administration of IVF
MD Team Communication Breakdown
Administered but not documented
Failure to recognize patient status
IV malfunction / Infiltrated
Delay in Administration
Delay in IV access
Delay in Ordering
Unknown / No reason given

Focus Efforts Here!
Latest PDSA: Improving IV Access

**PLAN**
- Bedside RN immediately performs a Vocera Urgent broadcast for **“Code Sepsis”**
- Team response changes include
  - Trauma Charge Nurse-assists with IV access and fluid administration
  - ED Pharmacy-assists in antibiotic ordering and acquisition
  - ED Techs-brings IO supplies and iStat supplies
- Bedside RN will Vocera the IV Team requesting assistance and indicate- “code sepsis”- bedside RN
  - May be delegated to a tech or other RN
  - In the event IV Access is achieved prior to IV team arrival, RN will Vocera them to kindly disregard the request
- Emphasis on considering other access options including an IO, EJ, central line after failed 2 PIV attempts
  - Bedside RN to alert attending if IV access is not achieved after 2 PIV attempts
Latest PDSA: Improving IV Access

- Discuss the PDSA project with the ED Charge nurses
  - Ask them to highlight the project, as the start date approaches, in the Safety Huddles held twice per day
- Discuss project with ED techs
  - Bring IO equipment to the bedside
  - Elicit feedback
- Meet with IV team
  - Ensure that they will be okay to respond to a Vocera page
  - Query the team for additional ideas to achieve goals
  - Inform: on average, 1 patient every-other-day is treated for suspected septic shock in the ED
  - Start date-ensure that the entire IV team group is informed

Thank You

Questions?
Pediatric Shock Collaborative - continued

Charles Macias, MD, MPH
Chief Clinical Systems Integration Officer
Texas Children’s Hospital/Baylor College of Medicine

Phase III: PSSC

- The Pediatric Septic Shock Collaborative (PSSC) phase III kicked off in Fall 2013 with 25 institutions.

- The primary aim of the PSSC is to reduce mortality in septic shock by a relative 20%.

- The collaborative has three task forces
  - Data management and analytics
  - Intervention
  - Education, including MOC Level 4 credit

- Cross cutting: reporting and research
Driving improvement in the diagnosis and management of sepsis/septic shock


Champions for Children’s Health
Today’s presenters

Matthew Niedner, MD
University of Michigan C.S. Mott Children's Hospital

Charles Macias, MD, MPH
Texas Children's Hospital

Roni Lane, MD
Primary Children's Hospital

Tina Willis, MD
University of North Carolina

UNC Sepsis Program

Tina Schade Willis, MD
Associate CMO for Quality UNC Hospitals
Associate Director UNC Institute for Healthcare Quality Improvement
Pediatric Critical Care Medicine
Why are we doing this?

2013 Pediatric Deaths

- Sepsis 24%

38% of deaths in the PICU involved Sepsis

Approximately 45% of all ages deaths at UNC involved a sepsis diagnosis in 2013
MORTALITY REDUCTION STRATEGY

- Healthcure Acquired Conditions
- Failure to Rescue
- Appropriate Palliative Care

SEPSIS

Improve Early Warning Systems and Response Systems
Implement Early Suspicion and Accurate Recognition Sepsis
Implement Prompt and Accurate Sepsis First Hour Treatment
Implement Antibiotic Stewardship in Sepsis Program

Reliable Sepsis Recognition and Assessment

**Primary Drivers**
- *Reliable* Recognition and Assessment
- Reliable Care Delivery
- Education and Awareness
- Culture of Safety and Quality Improvement
- Patient and Family Centered Care

**Secondary Drivers**
- *Reliable Sepsis Screening*
- Early Warning System + SIRS
- Ensure reliable communication SBAR
- Ensure timely rescue of deteriorating patient by *competent team*
- Involve patient and family advisors in design
UNC Sepsis Program Implementation

• Goal: to reduce the raw mortality rate by 10% at UNC Hospitals by June 2016 when compared to 2013 baseline
  – Scope: Children’s Hospital, ED, ICU’s and all areas of ARRT activation
  – Phase I: Children’s Hospital implementation complete by June 30, 2015
  – Phases II-IV: ED, Critical Care Units, Inpatient Units complete by January 2016

• UNC Health System = 7 additional hospitals committed to sepsis program collaborative that began February 2015

Why Children’s Hospital First?
Sepsis Project Structure

- Children’s Hospital Implementation
- Adult Patient Implementation
- Sustainability Plan
- Toolkit Development
- Pediatric Bundle*
- Adult Bundle*
- PRRT, ED Training
  - Classroom and SIM
- ARRT, ED Training
  - Classroom and SIM
- ARRT, ED uses pediatrics bundle when sepsis is recognized
- PRRT, ED uses pediatrics bundle when sepsis is recognized
- Screening education for all staff*
- Go-Live
- Children’s Hospital Go-Live

*Project Deliverable

Children’s Hospital Implementation

- Pediatric Bundle*
- PRRT, ED Training
  - Classroom and SIM
- PRRT, ED uses pediatrics bundle when sepsis is recognized
- Acute Care and ED Screening and Response Implemented

Newborn Nursery (NBN) and NICU Bundle*

- PICU Protocol Development
- PICU Protocol Training
- NICU and NBN use bundle in target populations
- NICU and NBN Screening and Response Implemented

Screening education for all staff*

Children’s Hospital Go-Live
June 2015
Working Pediatric Rapid Response Sepsis Bundle

Includes Recognition, Screening, and Treatment Guidelines
**PEDIATRIC Sepsis HIGH RISK** Patients

- Bone Marrow Transplant
- Solid Organ Transplant
- Malignancy
- Central Line/PICC/Port
- Other Immunocompromise
- Complex Urogenital Anatomy/Repair
- Asplenia (including Sickle Cell Disease)
- Chronic Steroid Dependence (asthma, autoimmune disease)
- Severe Neurologic Impairment or technology dependence

**PEDIATRIC ANTIBIOTICS (STAT one dose upon response to Code Sepsis)**

<table>
<thead>
<tr>
<th>Age &gt; 30 days</th>
<th>Day 1 (q12h)</th>
<th>Day 7 (q24h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary therapy</td>
<td>Ceftriaxone AIO</td>
<td>100 mg/kg/dose</td>
</tr>
<tr>
<td></td>
<td>Vancomycin</td>
<td>15 mg/kg/dose</td>
</tr>
<tr>
<td>Beta lactam allergies</td>
<td>Ceftriaxone AIO</td>
<td>150 mg/kg/dose</td>
</tr>
<tr>
<td></td>
<td>Vancomycin</td>
<td>25 mg/kg/dose</td>
</tr>
<tr>
<td>Imipenem</td>
<td>100 mg/kg/dose</td>
<td>1000 mg</td>
</tr>
<tr>
<td>Ceftriaxone AIO</td>
<td>2000 mg/dose</td>
<td>1000 mg</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>125 mg/kg/dose</td>
<td>500 mg</td>
</tr>
</tbody>
</table>
| Fungal therapy | Fluconazole 
|                | 25 mg/kg/dose  | 1000 mg |
|               | Micafungin     | 5 mg/kg/dose   | 150 mg |

<table>
<thead>
<tr>
<th>Neonate &lt; 28 days</th>
<th>Day 1 (q12h)</th>
<th>Day 7 (q24h)</th>
</tr>
</thead>
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<td></td>
</tr>
</tbody>
</table>

Lessons Learned To Date

- This new system is still in design and will be different in the coming months when we “go live”
- Changing the EHR first is often requested – waiting to do this until late
- Many multidisciplinary teams are needed and are often eager to start
- Robust project management in addition to improvement expertise is a must!
- Adult and pediatric team collaborations are beneficial in many unexpected ways
  - Share screening ideas, learn from each other
  - Share many pharmacy, operator, transport, and laboratory facilities and personnel
  - Blood culture and blood draw differences
  - Share many trainees – good to keep things as consistent as possible
  - Simulation sharing
  - Less waste
  - Keeping unique patient populations in mind – BMT, Burn, Surgical, Technology-Dependent
### Future sepsis webinars

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Presenters</th>
</tr>
</thead>
</table>
| April 20| 2 ET / 1 CT / 12 MT / 11 PT | **One Hospital’s Efforts to Improve Sepsis Care:** Pete Silver, MD, FCCM  
Steven and Alexandra Cohen Children's Medical Center of New York |
| May 13  | 12 ET / 11 CT / 10 MT / 9 PT | **Rapid Cycle Collaborative Teams:**  
Halden Scott, MD & Beth Wathen, MSN, CCRN  
Children’s Hospital Colorado  
Toni Wakefield, MD & Dory Collette, RN, CCRN  
Dell Children’s Medical Center |
| June 10 | 11 ET / 10 CT / 9 MT / 8 PT | **System-wide implementation:** Tina Willis, MD  
University of North Carolina |
| July 14 | 11 ET / 10 CT / 9 MT / 8 PT | **AAP Section on Emergency Medicine’s Pediatric Septic Shock Collaborative:** Charles Macias  
Texas Children’s Hospital |

Mark your calendars! We’ll include details in e-mail.  
Registration links will open approximately 6-8 weeks before each event.
Other opportunities

• Monthly eNewsletter - first edition coming soon
• Quality & Safety in Children’s Health Conference session: Improving Pediatric Sepsis Outcomes
  • March 10 @ 11:00 a.m. -12:00 p.m.
• Coming this fall: Improving Pediatric Sepsis Outcomes (IPSO) Initiative

To add your peers to the distribution list for the eNewsletter, future webcast announcements, etc. send an e-mail to tina.logsdon@childrenshospitals.org

Thank You

• Presenters
• Attendees
• Association staff
Session Evaluation