What’s the difference between neonatal, pediatric, and adult sepsis?

Joseph Carcillo, MD
Associate Professor of medicine
Critical Care Medicine and Pediatrics
University of Pittsburgh
Adult Sepsis

• Recognition - qSOFA Abnormal Mental Status and Respiratory Distress and suspicion of infection

• Empiric Broad Spectrum Antibiotics in first 1-3 hours

• Respiratory Distress supported with oxygen/mechanical ventilation

• Septic Shock = Hypotension

• Hemodynamic stabilization = Fluid bolus, central norepinephrine infusion
Newborn Sepsis

• Recognition – Poor tone, poor suck/nippling/feeding, bradycardia or tachycardia, hypothermia, or fever, maternal risk factor (eg PROM > 24 hours or chorioamnionitis) plus suspicion of infection

• Empiric Antibiotics 1st hour (cover community and maternal urogenital)

• Continuous IVF containing D10 with isotonic sodium, follow D-stix

• Respiratory distress – High flow nasal cannula oxygen, mechanical ventilation

• Septic Shock – Capillary refill > 3 seconds or hypotension

• Hemodynamic stabilization – Prostaglandin E1, fluid bolus, peripheral (UVC/IO) epinephrine, iNO (Level III hospitals).
Pediatric Sepsis

• Recognition – 2 or more of 4; fever or hypothermia, tachypnea, tachycardia, elevated or low white blood cell count PLUS suspicion of infection.

• Empiric Antibiotics in First hour (Low Risk and High Risk Regimen)

• Respiratory distress – high flow oxygen/ mechanical ventilation

• Septic Shock – capillary refill > 3 seconds or hypotension

• Hemodynamic Stabilization – fluid bolus, peripheral/IO epinephrine until central access attained
**PEDIATRIC SEPTIC SHOCK COLLABORATIVE TRIAGE TRIGGER TOOL**

**Table 1: High Risk Conditions**
- Malignancy
- Anemia (including SCD)
- Bone marrow transplant
- Central or indwelling line/catheter
- Solid organ transplant
- Sepsis MHCAP
- Immunodeficiency, immunocompromise or immunosuppression

<table>
<thead>
<tr>
<th>Table 2: Vital Signs (PALS)</th>
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<tr>
<td>Age</td>
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</tr>
<tr>
<td>0-3 mo</td>
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<tr>
<td>3 mo-&lt;1 yr</td>
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<td>1-2 yr</td>
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<td>4-8 yr</td>
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<td>&gt;8 yr</td>
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**Table 3: Exam Abnormalities**
- Cold Shock
  - Decreased (if weak)
  - Prolonged (≤ 3 sec
  - Fracture below the nipple, any popliteal
- Warm Shock
  - Tachycardia
  - Rash
  - Fatigue
  - Decreased alertness, confusion, inappropriate crying or drowsiness, poor interaction with parents, lachrymation, diminished arousability, obtundation

**Diagram:**
- Patient presents to the ED with concerns for infection and/or temperature abnormality in the ED or within 4 hrs of presentation?
- Exclude from shock triage tool. Continue routine triage process.
- General assessment: Is patient critically ill?
- YES: Transfer patient to an isolation room and immediately alert physician/initial triage team.
- NO: Continue assessment at triage.
- Transfer patient to an isolation room and immediately alert physician/initial triage team.
- YES: Initiate/continue the septic shock protocol (Chest X-ray, broad spectrum antibiotics).
- NO: Continue routine triage process.
- Does patient meet 3 or more of the 8 clinical criteria?
Figure 1. Pediatric intensive care unit empiric antibiotic pathway including risk factors for infection due to healthcare-associated bacteria. aMinimum 7 days in previous 6 weeks. bMalignancy, chemotherapy, chronic steroid/immunosuppressants, organ transplant, immunodeficiency, or acute steroids >5 days in the past month. C Piperacillin-tazobactam, cefepime, and meropenem. dGentamicin, tobramycin, and amikacin. Annals ATS, 2014 http://www.atsjournals.org/doi/abs/10.1513/AnnalsATS.201408-389OC Published in: Todd J. Karsies; Cheryl L. Sargel; David J. Marquardt; Nadeem Khan; Mark W. Hall; Annals ATS 11, 1569-1575. DOI: 10.1513/AnnalsATS.201408-389OC Copyright © 2014 by the American Thoracic Society
Five time points evaluated for adherence from 2006 PALS algorithm.

PALS (2006)  Carcillo et al. algorithm goal

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

5 min
- 5 min
- 15 min
  - 60 min
  - Ideal
  - Adequate
- 60 min

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Severe Sepsis / Septic Shock

Severe Sepsis
30 day mortality: 11% → 3%
(p<0.03)
Recognition Bundle (see AAP Trigger tool example Figure 2)

- Screen patient for septic shock using an institution trigger tool.
- Clinician assessment within 15 minutes for any patient who screens positive in the trigger tool.
- Initiate *Resuscitation Bundle* within 15 minutes for patient identified by the trigger tool whom the assessing clinician confirms suspicion of septic shock.
Resuscitation Bundle (see Algorithm Figure 3 and 4)

- Attain IV/IO access within 5 minutes.
- Appropriate fluid resuscitation begun within 30 minutes.
- Initiation of broad-spectrum empiric antibiotics within 60 minutes.
- Begin peripheral or central inotrope infusion therapy for fluid-refractory shock within 60 minutes.
Stabilization Bundle (see Algorithm Figure 3 and 4)

- Use multimodal monitoring to optimize fluid, hormonal, and cardiovascular therapies to attain hemodynamic goals.
- Confirm administration of appropriate antimicrobial therapy and source control.
Performance Bundle

- Measure adherence to Trigger, Resuscitation, and Stabilization Bundles.
- Perform root cause analysis to identify barriers to adherence.
- Provide an action plan to address identified barriers.
Recognize decreased mental status and perfusion. Begin high flow O₂ and establish IO/IV access according to PALS.

If no hepatomegaly or rales / crackles then push 20 mL/kg isotonic saline boluses and reassess after each bolus up to 60 mL/kg until improved perfusion. Stop for rales, crackles or hepatomegaly. Correct hypoglycemia and hypocalcemia. Begin antibiotics.

**Fluid refractory shock?**

- Begin IV/IO inotrope infusion, preferably Epinephrine 0.05 – 0.3 μg/kg/min
- Use Atropine / Ketamine IV/IO/IM if needed for Central Vein or Airway Access

**Catecholamine-resistant shock?**

- Begin IV/IO inotrope infusion, preferably Epinephrine 0.05 – 0.3 μg/kg/min for Cold Shock.
  - (Titrate central Dopamine 5 – 9 μg/kg/min if Epinephrine not available)
- Titrating central Norepinephrine from 0.05 μg/kg/min and upward to reverse Warm Shock.
  - (Titrate Central Dopamine ≥ 10 μg/kg/min if Norepinephrine not available)

**Catecholamine-resistant shock?**

- Normal Blood Pressure Cold Shock
  - ScvO₂ < 70%* / Hgb > 10g/dL on Epinephrine?
  - Begin Milrinone infusion.
  - Add Nitroso-vasodilator if CI < 3.3L/min/m² with High SVRI and/or poor skin perfusion.
  - Consider Levosimendan if unsuccessful.

- Low Blood Pressure Cold Shock
  - ScvO₂ < 70%* / Hgb > 10g/dL on Epinephrine?
  - Add Norepinephrine to Epinephrine to attain normal diastolic blood pressure. If CI < 3.3 L/min/m² add Dobutamine, Enoximone, Levosimendan, or Milrinone.

- Low Blood Pressure Warm Shock
  - ScvO₂ > 70%* on Norepinephrine?
  - If euvolemic, add Vasopressin, Terlipressin, or Angiotensin.
  - But, if CI decreases below 3.3 L/min/m² add Epinephrine, Dobutamine, Enoximone, Levosimendan.

**Persistent Catecholamine-resistant shock?**

- Evaluate Pericardial Effusion or Pneumothorax, Maintain IAP < 12mmHg

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**Refractory Shock?**

- ECMO
Recognize decreased perfusion, cyanosis, RDS. Maintain airway and establish access according to NRP guidelines.

Push 10mL/kg isotonic crystalloid or colloid boluses to 40mL/kg until improved perfusion or unless hepatomegaly. Correct hypoglycemia and hypocalcemia. Begin antibiotics. Begin prostaglandin infusion until r/o ductal-dependent lesion.

**Fluid refractory shock?**
Infuse Dopamine (< 10 μg/kg/min) ± Dobutamine

**Fluid refractory-dopamine resistant shock?**
Titrate Epinephrine 0.05 – 0.3 μg/kg/min

**Catecholamine-resistant shock?**

ATTAIN
Normal MAP-CVP, ScvO₂ > 70%, SVC flow > 40 mL/kg/min or CI > 3.3 L/min/m²

**Cold Shock**
Normal Blood Pressure
Poor LV function
ScvO₂ < 70%* / Hgb > 12g/dL
SVC flow < 40mL/kg/min or

Add Nitravasodilator
Milrinone/Imrinone
With volume loading

**Cold Shock**
Poor RV function
PPHN
ScvO₂ < 70%*
SVC flow < 40mL/kg/min or CI < 3.3 L/min/m²?

Inhaled Nitric Oxide
Inhaled iloprost / IV Adenosine
IV milrinone / amrinone

**Low Blood Pressure Warm Shock**

Titrate Volume
Add Norepinephrine
?Vaso / Teri pressin
? Angiotensin
Keep ScvO₂ > 70%, SVC flow > 40 mL/kg/min, or CI > 3.3 L/min/m² with inotropic support

**Refractory Shock?**
Evacuate pneumothoraces and pericardial effusion. Give Hydrocortisone if Absolute Adrenal Insufficiency and T₃ if Hypothyroid. Begin Pentoxyfylline if VLBW newborn. Consider Closing PDA if hemodynamically significant

ECMO