Pediatric Sepsis Sept 2019. Pediatric sepsis is a high-stakes diagnosis that requires vigilance to make an early, timely diagnosis. Aggressive management, including fluids, antibiotics, and vasopressors, and aggressive management, are often necessary. Rapidly changing clinical signs and symptoms make a diagnosis difficult. —

**Table 1**. Major features of sepsis syndrome (SIRS)1,2

- Hypotension* OR Need for vasoactive drug to maintain blood pressure in the normal range OR Two of the following:
  - PaO2/FiO2 < 300
  - PaCO2 > 65 or 20 mmHg over baseline
  - Need for > 50% FiO2 to maintain oxygen saturation ≥ 92%
  - Need for nonelective mechanical ventilation
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*Hypotension is defined as: < 5th percentile for age or systolic blood pressure < 2 standard deviations below normal for age. ** Often a normal variant in newborns.

**Table 2**. Criteria for organ dysfunction.13

- Respiratory: PaO2/FiO2 < 300
- Neurologic: Coma
- Gastrointestinal: Abdominal pain, distension, diarrhea, and vomiting
- Renal: Urinary tract abnormalities with frequent infection
- Hematologic: Platelet count < 80,000/microliter OR A decline of 50% from the highest value recorded over the previous three days OR Disseminated intravascular coagulopathy

**Table 3**. Site of infection.14

- Respiratory: Productive cough, pleuritic chest pain
- Gastrointestinal: Abdominal pain, distension, diarrhea, and vomiting
- Urinary tract: Fever, urgency, dysuria, loin or back pain, incontinence
- Joint: Pain, warmth, decreased range of motion, limp, crepitus
- Skin: Necrotizing fasciitis, cellulitis, abscess
- Eye: Conjunctivitis, keratitis
- Ears: Otitis media
- Central nervous system: Meningitis, encephalitis, seizures
- Blood stream: Bacteremia, endocarditis
- Other: Peritonitis, pneumonia, peritonitis, pneumonia

**Table 4**. Common causes of sepsis.15

- Bacterial: Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Streptococcus pneumoniae
- Viral: Influenza, RSV, Streptococcus pyogenes
- Fungal: Candida albicans, Aspergillus fumigatus
- Parasitic: Toxoplasma gondii, Plasmodium falciparum

**Table 5**. Normal range of vital signs in children.16

<table>
<thead>
<tr>
<th>Age</th>
<th>HR (bpm)</th>
<th>RR (bpm)</th>
<th>SBP (mmHg)</th>
<th>DBP (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>120-180</td>
<td>30-50</td>
<td>60-90</td>
<td>30-50</td>
</tr>
<tr>
<td>1-3 months</td>
<td>100-140</td>
<td>30-50</td>
<td>60-90</td>
<td>30-50</td>
</tr>
<tr>
<td>1-3 years</td>
<td>100-120</td>
<td>20-30</td>
<td>90-110</td>
<td>40-60</td>
</tr>
<tr>
<td>4-12 years</td>
<td>90-110</td>
<td>20-30</td>
<td>80-100</td>
<td>30-50</td>
</tr>
</tbody>
</table>

**Table 6**. Common causes of sepsis in children.17

- Bacterial: Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Streptococcus pneumoniae
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**Table 7**. Common causes of sepsis in children.17

- Bacterial: Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Streptococcus pneumoniae
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**Table 8**. Common causes of sepsis in children.17

- Bacterial: Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Streptococcus pneumoniae
- Viral: Influenza, RSV, Streptococcus pyogenes
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**Table 9**. Common causes of sepsis in children.17

- Bacterial: Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Streptococcus pneumoniae
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**Table 10**. Common causes of sepsis in children.17

- Bacterial: Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Streptococcus pneumoniae
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**Septic Shock**

A comprehensive review of septic shock, a high-stakes diagnosis with elevated morbidity and mortality if not recognized and treated appropriately. As in adults, the initial resuscitation in children should be directed by the ABC (airway, breathing, circulation) sequence and with the emphasis on circulatory support.

- **Vascular Access.** Initiate IV access within five minutes of recognition of sepsis or septic shock. If possible, place a 20G or larger needle in an antecubital vein. At least two individuals should attempt the IV placement.

- **Normal pulses, equal peripheral and centrally; Warm extremities; Urine output of 1 mL/kg/hr; Normal mental status; Euglycemia; Normal ionized calcium.**

- **Monitor the heart rate.** A decrease in the heart rate suggests an improvement in the intravascular volume. On the other hand, an increase in heart rate is often a result of compensatory peripheral vasoconstriction.

- **Poor cardiac contractility with as wide pulse pressure with diastolic blood pressure < 50% of the systolic pressure.**

- **Respiratory rate ≥ 30 breaths per minute.**

- **Temperature abnormality.**

- **Sweating.**

- **Lacrimation.**

- **Drawing and pushing of fluid.** It is crucial to monitor the response to fluid therapy after each bolus: Look for an increased urine output, and level of consciousness. If there is no or little improvement, administer another bolus of 20 mL/kg of saline or Ringer's lactate.

- **Associated Etiologies**

  - Anaphylaxis, sepsis
  - Malignancy
  - Asplenia
  - Bone marrow transplant
  - Solid organ transplant
  - Central or indwelling catheter
  - Severe MRCP
  - Immunodeficiency/compromise

- **Increased CO**

  - Vasoconstriction at higher dose

  - Arrhythmogenic

*Source: Author adapted.*

### Septic Shock Treatment Guidelines

**Septic Shock Checklist**

- **CRT ≤ 2 seconds; Normal blood pressure for age; Normal pulses, equal peripheral and centrally; Warm extremities; Urine output of 1 mL/kg/hr; Normal mental status; Euglycemia; Normal ionized calcium.**

**Septic Shock Treatment**

- **Early goal-directed therapy.** Consider other causes of shock, such as pneumothorax, pericardial tamponade, or endocrine emergencies, if no improvement is noted.

- **Normal serum lactate levels, which are associated with a survival of more than 7 days.**

- **Administer hydrocortisone IV** for adrenal insufficiency, although evidence is based on studies in adults. However, the role of corticosteroids in the treatment of pediatric septic shock is not well defined.

- **Normal ionized calcium. In cases of hypocalcemia, replete calcium to prevent any further decreases in myocardial contractility.**

- **Improve oxygenation.** If the patient is hypoxic, administer supplemental oxygen to achieve an arterial oxygen saturation of at least 94%.

- **Correct anion gap metabolic acidosis.** In children, metabolic acidosis is more closely associated with shock than acidemia alone. Correcting metabolic acidosis might have additional benefits.

- **Hyperglycemia.** Approximately 38% of pediatric septic shock patients have hyperglycemia. In the absence of diabetes mellitus, hyperglycemia in children with sepsis is likely due to stress induced by sepsis.

- **Antimicrobial therapy.** Consider a pilot study of early antibiotic treatment in children with septic shock, which showed a trend towards improved survival in the early- versus late-therapy group. However, further studies are needed to confirm these findings.


- **Torio CM, Moore BJ. National Inpatient Hospital Costs: Statistical Brief # 204, Health Care Costs and Utilization Project (HCUP) Statistical Briefs. May 2016. Available at:**

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