Sepsis Management - Pediatric

Disclaimer: This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson’s specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient’s care. This algorithm should not be used to treat pregnant women.

**PRESENTATION**

Patient exhibits 2 or more of the following criteria:
- Temperature < 36°C or > 38.1°C
- Unexplained tachycardia
- Respiratory rate greater than normal for age
- WBC count < 3 or ≥ 15 K/microliter
- Additional criteria:
  - Pediatric early warning score (PEWS) ≥ 6
  - Unexplained bradycardia
  - Nurse or parental concern

Note: If on steroids and/or scheduled acetaminophen, patient might not have temperature elevation

---

**EVALUATION**

- Call CODE Blue Team (x2-7099)
- Notify the following teams:
  - PICU Team (x5-0570) and Inpatient G9 Team
  - Oncology Team for inpatients or Triage APP for outpatients

- Admit to PICU

Is patient unresponsive?

- No
- Yes

- Administer oxygen via nonrebreather face mask at 10 L/minute to maintain O₂ saturation > 92%
- Primary Pediatric Team to evaluate
- Notify PICU Team (x5-0570) if PEWS ≥ 5
- Notify Triage APP for ambulatory patients
- Teams to assess for suspicion of infection

Suspicion of infection?

- Yes
- No

---

PICU = pediatric intensive care unit
APP = advanced practice provider
PACCC = pediatric acute cancer care center

1 See Appendix A: Age Specific Vital Signs
2 See Appendix B: Modified Pediatric Early Warning Signs (PEWS) Tool
3 See Appendix C: Pediatric Primary Teams
4 See Appendix D: Suspicion of Infection
Sepsis Management - Pediatric

Disclaimer: This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson’s specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient's care. This algorithm should not be used to treat pregnant women.

TREATMENT

- Initiate sepsis orders
- Obtain cultures (blood\(^1\) from 2 sites with one set preferably from peripheral site, and other sources as clinically indicated) **STAT**
- Give broad spectrum antibiotics – first dose **STAT** *Do not delay antibiotic therapy if cultures cannot be obtained within 45 minutes*
- Obtain the following **STAT**: CBC with differential, comprehensive metabolic panel, VBG\(^+\), magnesium, phosphorus, calcium, PT, PTT, fibrinogen, cortisol, CRP, procalcitonin, NT-ProBNP, and type and screen
- Initiate cardiac monitoring
- Verify and if needed, obtain adequate IV access
- Give fluid challenge up to 20 mL/kg\(^2\) crystalloids [*e.g.*, plasmalyte, Lactated Ringer’s, sodium chloride 0.9% (NS)]; each fluid challenge should be given over 10 - 30 minutes
- Monitor vital signs every 15 minutes for 1 hour, then every hour for 5 hours, then every 2 hours for 24 hours, then every 4 hours
- Titrate oxygen to maintain Sp\(_2\)O\(_2\) ≥ 92%
- Consider EKG and transthoracic echocardiogram

- **Hypotensive**\(^3\) or lactic acid > 2 mmol/L despite adequate fluid resuscitation?
  - Yes
    - Transfer to PICU for further management
    - Consider placement of arterial line and additional venous access
    - Monitor and maintain respiratory/hemodynamic status
    - May repeat fluid challenge if indicated\(^2\)
    - If lactic acid elevated, repeat level within 4 hours
    - Consider norepinephrine for persistent hypotension\(^4\)
    - Obtain transthoracic echocardiogram if not already completed
  - No
    - See Page 3 for PACCC/PICU Management for Sepsis Management - Pediatric

**Septic Shock**

- Continue to monitor and maintain respiratory/hemodynamic status
- Review stat labs
- Continue broad spectrum antibiotics
- Assess IV fluid provision
- Request appropriate team consults

1 Refer to Central Vascular Access Device (CVAD): Drawing Blood Policy (#CLN0944) for information on blood culture volume collection
2 Considerations for fluid resuscitation:
   - If not hypotensive (See Appendix A) but with history of insensible losses, administer fluid challenge of 10 - 20 mL/kg
   - If history of cardiomyopathy, administer fluid challenge of 10 mL/kg
   - Monitor for signs of fluid overload (*e.g.*, worsening tachypnea/respiratory distress, desaturations) during administration of bolus
3 See Appendix A: Age Specific Vital Signs
4 If inpatient, may start norepinephrine as listed above while awaiting transfer to PICU; may administer peripherally if central access is not available

Department of Clinical Effectiveness V5
Approved by the Executive Committee of the Medical Staff on 12/14/2022
Sepsis Management - Pediatric

Disclaimer: This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson’s specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient’s care. This algorithm should not be used to treat pregnant women.

Septic Shock in the PACCC/PICU (inpatient unit until PICU bed available)

- MAP low for age?
  - Yes: MAP = mean arterial pressure
  - No: Continue

- Check cardiac index or examine for clinical symptoms of diastolic dysfunction/decreased cardiac output
  - Low-output shock?
    - Yes: Packet red blood cell (PRBC) transfusion to maintain hemoglobin ≥ 9 grams/dL
    - No: Consider escalating to high flow nasal cannula or non-invasive positive pressure ventilation if anemic with or without respiratory failure and/or hypoxic

- Check hemoglobin < 9 grams/dL?
  - Yes: Consider escalating to high flow nasal cannula or non-invasive positive pressure ventilation if anemic with or without respiratory failure and/or hypoxic
  - No: Consider further fluid resuscitation as needed based on hemodynamic monitoring variables
    - Norepinephrine (1st line) IV infusion per Pediatric ICU Vasoactive and Inotropic Medications order set
    - Epinephrine (2nd line) IV infusion per Pediatric ICU Vasoactive and Inotropic Medications order set
    - Do not use dopamine

- Check respiratory status
  - Increased work of breathing?
    - Yes: If refractory hypotension, add hydrocortisone 2 mg/kg IV STAT (if not already given) and then 0.5 mg/kg IV every 6 hours
    - No: If SVR high, consider starting milrinone at 0.5 mcg/kg/minute via continuous IV infusion

- Check hemoglobin
  - Yes: Consider escalating to high flow nasal cannula or non-invasive positive pressure ventilation if anemic with or without respiratory failure and/or hypoxic
  - No: Consider further fluid resuscitation as needed based on hemodynamic monitoring variables

- Norepinephrine (1st line) IV infusion per Pediatric ICU Vasoactive and Inotropic Medications order set
- Epinephrine (2nd line) IV infusion per Pediatric ICU Vasoactive and Inotropic Medications order set
- Do not use dopamine

- If refractory hypotension, add hydrocortisone 2 mg/kg IV STAT (if not already given) and then 0.5 mg/kg IV every 6 hours

Resuscitation Goals
- Normalize MAP for age
- Urine output ≥ 1 mL/kg/hour (consider higher target if oliguric)
- Normalization of lactic acid and NT ProBNP if elevated

Sepsis Management Goals
- Use of lung protective strategies (tidal volume for mechanically ventilated patients with ARDS is 6 – 8 mL/kg, and initial upper limit goal for plateau pressures is < 30 cm H2O)
- Hemoglobin after patient stabilization ≥ 9 grams/dL
- Glucose after initial patient stabilization < 180 mg/dL (tight glucose control not recommended)
- Stress ulcer prophylaxis for patients receiving steroids or have other risk factors
- Deep vein thrombosis prophylaxis for adolescents and young adults

MAP = mean arterial pressure
SVR = systemic vascular resistance
ARDS = acute respiratory distress syndrome

1 Refractory hypotension is hypotension despite adequate fluid resuscitation and vasopressors
2 See Appendix A: Age Specific Vital Signs
3 Risk factors for GI bleeding include: mechanical ventilation, coagulopathy, thrombocytopenia, renal failure, liver failure, hypotension, heart failure and arrhythmias

Department of Clinical Effectiveness V5
Approved by the Executive Committee of the Medical Staff on 12/14/2022
### APPENDIX A: Age Specific Vital Signs

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Tachycardia Heart Rate</th>
<th>Tachypnea Respiratory Rate</th>
<th>Hypotension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant 1 month to 1 year</td>
<td>&gt; 180 beats/min</td>
<td>&gt; 34 breaths/min</td>
<td>&lt; 70 mmHg</td>
</tr>
<tr>
<td>Toddler and Preschool 1 to 5 years</td>
<td>&gt; 140 beats/min</td>
<td>&gt; 24 breaths/min</td>
<td>&lt; [70 + (2 x age in years)] mmHg</td>
</tr>
<tr>
<td>School Age 5 to 12 years</td>
<td>&gt; 130 beats/min</td>
<td>&gt; 22 breaths/min</td>
<td>&lt; [70 + (2 x age in years)] mmHg</td>
</tr>
<tr>
<td>Adolescent 12 to 18 years</td>
<td>&gt; 110 beats/min</td>
<td>&gt; 20 breaths/min</td>
<td>&lt; 90 mmHg</td>
</tr>
</tbody>
</table>

1. Minimum goal for Mean Arterial Pressure (MAP) is [55 + (1.5 x age in years)] mmHg
# APPENDIX B: Modified Pediatric Early Warning Signs (PEWS) Tool

<table>
<thead>
<tr>
<th>Cardiovascular System</th>
<th>Rate</th>
<th>Effort</th>
<th>Oxygen</th>
<th>Score¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>● Within normal parameters</td>
<td>● No retractions</td>
<td>● N/A</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>for age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Tachycardia &lt; 20 above</td>
<td></td>
<td>● Oxygen required to</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>normal parameters for age</td>
<td></td>
<td>maintain normal² SpO₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>○ FiO₂ 24-40%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>○ 2 L/minute O₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>○ Any assisted ventilation³</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>○ initiation of O₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Tachycardia 20-29 above</td>
<td>● Mild retractions/accessory muscle use</td>
<td>○ Oxygen required to maintain normal² SpO₂</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>normal for age</td>
<td></td>
<td>○ FiO₂ 40-49%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>○ O₂ ≥ 3 L/minute</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Tachycardia ≥ 30 above or bradycardia ≥ 10 below normal for age</td>
<td>● Moderate retractions/accessory muscle use (including tracheal tugging)</td>
<td>○ Oxygen required to maintain normal² SpO₂</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Capillary refill 4 seconds</td>
<td>○ FiO₂ ≥ 50%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Tachycardia ≥ 30 above or bradycardia ≥ 10 below normal for age</td>
<td>● Capillary refill 3 seconds</td>
<td>○ Oxygen required to maintain normal² SpO₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Capillary refill 2-3 seconds</td>
<td>○ FiO₂ 40-49%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Capillary refill 1-2 seconds</td>
<td>○ O₂ ≥ 3 L/minute</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Capillary refill 1-2 seconds</td>
<td>○ Any assisted ventilation³or initiation of O₂</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Playing</th>
<th>Irritable, but consolable</th>
<th>Irritated, but not consolable</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>● Appropriate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>● Lethargic</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>● Confused</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>● Reduced response to pain</td>
<td></td>
</tr>
</tbody>
</table>

---

1. Add 2 extra points if patient requires frequent interventions (e.g., suctioning, positioning, change in O₂ needs, multiple IV attempts required, or every 15-minute or continuous nebulized treatments) or has persistent post-op vomiting
2. As defined in patient’s orders
3. Includes home bilevel positive airway pressure (BiPAP)/continuous positive airway pressure (CPAP) or home ventilator at baseline settings

---

Disclaimer: This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson’s specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient's care. This algorithm should not be used to treat pregnant women.

Department of Clinical Effectiveness V5
Approved by the Executive Committee of the Medical Staff on 12/14/2022
APPENDIX C: Pediatric Primary Teams

**Inpatient G9 Team: For pediatric inpatients on G9 or other floors**
- AM Team (7am-5pm) – G9 Resident + Fellow + APP + Attending
- PM Team (5pm-7am) – G9 Resident + Nocturnalist + Fellow + APP + Attending

APPENDIX D: Suspicion of Infection

- Fever or hypothermia
- Recent surgical procedure
- Immunocompromised
  - Chemotherapy
  - Steroids/immunosuppressed
  - Loss of skin integrity
  - HIV/suspected HIV
- Skin wound
- Invasive device
  - Central line
  - Foley catheter
- Infiltrate on chest x-ray
- Cough with sputum production
- Diarrhea with or without abdominal pain
- Diabetes mellitus
- Unilateral sinusitis (and/or facial swelling)
Suggested Readings


Sepsis Management - Pediatric

Disclaimer: This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson's specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient's care. This algorithm should not be used to treat pregnant women.

DEVELOPMENT CREDITS

This practice consensus statement is based on majority opinion of the Pediatric Sepsis work group at the University of Texas MD Anderson Cancer Center for the patient population. These experts included:

**Core Development Team Leads**
Demetrios Petropoulos, MD (Pediatrics)  
Shehla Razvi, MD (Pediatrics)

**Workgroup Members**
Ali Ahmad, DO (Pediatrics)  
Micah Bhatti, MD (Laboratory Medicine)  
Jose A. Cortes, MD (Pediatrics)  
Natalie Dailey Garnes, MD (Infectious Diseases)  
Olga N. Fleckenstein, BS  
Mary Katherine Gardner, MSN, RN (Pediatrics)  
Suzanne Gettys, PharmD (Pharmacy Clinical Programs)  
Neetha Jawe, MSN, RN (Healthcare Systems Engineering)  
Jessica Johnson, MSN, RN (Nursing)  
Imrana Malik, MD (Critical Care Medicine)  
Rodrigo Mejia, MD (Pediatrics)  
Rachna Sheth, MD (Pediatrics)  
Mary Lou Warren, DNP, APRN, CNS-CC

*Clinical Effectiveness Development Team*