Sepsis Management - Pediatric

Patient exhibits 2 or more of the following criteria:

- Temperature < 36°C or > 38.1°C
- Unexplained tachycardia or bradycardia
- Respiratory rate greater than normal for age
- WBC count < 3 or ≥ 15 K/microliter
- Pediatric early warning score (PEWS) ≥ 6

Nurse or parental concern

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

App = advanced practice provider
PICU = pediatric intensive care unit

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

EVALUATION

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

Admit to PICU

Yes

Is patient unresponsive?

No

- Call MERIT (x2-7090)
- Administer oxygen via nonrebreather face mask at 10 L/minute to maintain O₂ saturation > 92%
- Notify the following teams:
  - PICU team (x5-0570) and
  - Inpatient G9 Team for inpatients or
  - Triage APP for outpatients
- Teams to assess for suspicion of infection

Suspicion of infection?

Yes

See Page 2: Sepsis Management

No

Continue evaluation for further treatment or alternative diagnosis
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 x2 sites with one set preferably from peripheral site, and other sources as 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, complete metabolic panel, VBG+, lactic acid, 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
- Titrate oxygen to maintain SpO2 > 92%
- Consider 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
- Continue to monitor and maintain respiratory/hemodynamic status
- Review stat labs
- Assess IV fluid provision
- Continue broad spectrum antibiotics
- Request appropriate team consults

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

See Page 3 for ACCC/PICU Management

1 Preferable volume includes 5-10 mL per blood culture bottle for children < 20 kilograms and 10 mL for children ≥ 20 kilograms
2 Considerations for fluid resuscitation: if blood culture bottle is not able to be obtained from peripheral site, obtain 10 mL from central venous access
3 Consider fluid bolus in hypotensive patient (See Appendix A) but with history of insensible losses, administer fluid challenge of 10 - 20 mL/kg
4 See Appendix A: Age Specific Vital Signs

ACCC = Acute Cancer Care Center
VBG = venous blood gas

Copyright 2022 The University of Texas MD Anderson Cancer Center
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.

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

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

- Check MAP
- If MAP low for age?
  - No
    - Check cardiac index or examine for clinical symptoms of diastolic dysfunction/decreased cardiac output
  - Yes
    - If SVR high, consider starting milrinone at 0.5 mcg/kg/minute via continuous IV infusion

- Check Hemoglobin
  - If Hgb < 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
    - Yes
      - If respiratory status increased work of breathing?
        - No
          - Do not use dopamine
        - Yes
          - PRBC transfusion to maintain hemoglobin ≥ 9 grams/dL.

- Consider further fluid resuscitation as needed based on hemodynamic monitoring variables
  - Norepinephrine (1st line) 0.05 mcg/kg/minute IV infusion; titrate by 0.01 mcg/kg/minute every 5 minutes to normalize MAP
  - Epinephrine (2nd line) 0.05 – 0.1 mcg/kg/minute IV infusion; titrate by 0.01 mcg/kg/min every 5 minutes to normalize MAP

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

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

Copyright 2022 The University of Texas MD Anderson Cancer Center

Department of Clinical Effectiveness V4 Rev
Approved by the Executive Committee of the Medical Staff on 01/18/2022
## 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>

1Minimum 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></th>
<th>Score&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>Behavior</strong></td>
<td></td>
</tr>
<tr>
<td>Playing</td>
<td></td>
</tr>
<tr>
<td>Appropriate</td>
<td></td>
</tr>
<tr>
<td>Irritable, but consolable</td>
<td></td>
</tr>
<tr>
<td>Irritated, but not consolable</td>
<td></td>
</tr>
<tr>
<td>Lethargic</td>
<td></td>
</tr>
<tr>
<td>Confused</td>
<td></td>
</tr>
<tr>
<td>Reduced response to pain</td>
<td></td>
</tr>
<tr>
<td><strong>Cardiovascular System</strong></td>
<td></td>
</tr>
<tr>
<td>Rate</td>
<td></td>
</tr>
<tr>
<td>Within normal parameters for age</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td></td>
</tr>
<tr>
<td>Pink</td>
<td></td>
</tr>
<tr>
<td>Perfusion</td>
<td></td>
</tr>
<tr>
<td><strong>Respiratory System</strong></td>
<td></td>
</tr>
<tr>
<td>Rate</td>
<td></td>
</tr>
<tr>
<td>Within normal parameters for age</td>
<td></td>
</tr>
<tr>
<td>Effort</td>
<td></td>
</tr>
<tr>
<td>No retractions</td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup> 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

<sup>2</sup> As defined in patient's orders

<sup>3</sup> 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 V4 Rev

Approved by the Executive Committee of the Medical Staff on 01/18/2022
Sepsis Management - Pediatric

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:

Patricia Amado, MSN, RN (Nursing, G9)
Micah Bhatti, MD (Laboratory Medicine)
Jose A. Cortes, MD (Pediatrics)
Natalie Dailey Garnes, MD (Infectious Diseases)
Linette J. Ewing, DO (Pediatrics)§
Olga N. Fleckenstein, BS*T
Rodrigo Mejia, MD (Pediatrics)§
Demetrios Petropoulos, MD (Pediatrics)§
Shehla Razvi, MD (Pediatrics)§
Mary Lou Warren, DNP, APRN, CNS-CC*§

§ Core Development Team
*T Clinical Effectiveness Development Team