Pediatric Sepsis / Septic Shock in Patients > 60 days Clinical Pathway

March 2021

Outcomes/Goals	1. Rapid identification and treatment of pediatric patients ≥ 60 days presenting in septic shock. 2. Create a team-oriented approach to efficient and timely evaluation and work-up. 3. Early and aggressive treatment to stabilize hemodynamic status and reverse shock.
NURSE Documentation	Chief complaint. Onset of symptoms. Presence of high-risk medical condition. Presence of an indwelling catheter, CVC. Assessment including hemodynamic status (core temp, skin changes, cap refill, urine output, pulse quality, neuro status)
Evaluation	Calculate risk score for sepsis (see algorithm)
INTERVENTIONS Initiate on arrival	ESI Triage level II Full set of vitals including core temperature Apply cardiac monitor, continuous pulse oximetry Establish IV (2 if possible, largest size appropriate) Use of IO if cannot obtain IV in 3 attempts or 90 seconds Bedside CBG Oxygen Initiate warming devices if applicable
DIAGNOSTICS	Blood culture (if CVC present, from each lumen) — **prior to antibiotics** CBC with differential CMP, magnesium, phosphate, Ca POC Chem 8, cap blood glucose Coagulopathy panel, Type and Screen ED Blood Gas- Lactate POC Catheter specimen urine dip, UA/Mandatory Culture Consider Chest x-ray (portable) +/- 2 view abdomen Consider LP if hemodynamically stable (gram stain, culture, cell count, protein, glucose, hold extra fluid) Consider influenza, RSV, COVID-19
PHYSICIAN (LIP)	
Fluids	Normal Saline bolus 20 ml/kg in the first 15 minutes -Reassess for normalization of perfusion (HR, BP, cap refill, pulses, mental status) Repeat up to 60ml/kg/first hour until normalization of perfusion or signs of fluid overload
Medication Antibiotics	******GOAL TO ADMINISTER WITHIN 1 HOUR OF ARRIVAL FOR SEVERE SEPSIS, 3 HOURS FOR SEPSIS****** **Suspected Sepsis:** Ceftriaxone 50mg/kg (max 2g) IV **Immunocompromised:** Cefepime 50mg/kg (max 2g) IV **Suspected MRSA or Central Venous Catheter:** Vancomycin 20mg/kg (max 2g) IV **Meningitis:** Ceftriaxone 100mg/kg (max 2g) AND Vancomycin 20 mg/kg (max 2g) **Abdominal infection:** Ceftriaxone 50mg/kg (max 2g) IV AND Metronidazole 10mg/kg (max 1.5g) IV
Vasoactives	Epinephrine 0.05-1 mcg/kg/min (first line for 'cold' shock) Norepinephrine 0.05-1 mcg/kg/min (first line for 'warm' shock) Dopamine 5-20 mcg/kg/min (second line for 'cold' shock)
Calcium	Calcium gluconate 10% 50mg/kg IV over 5 minutes for iCa < 1.1
Dextrose	D10 5ml/kg for CBG <60
Antipyretics	Acetaminophen 12.5 mg/kg PO Acetaminophen 15 mg/kg PR
Corticosteroids	Hydrocortisone 1-2mg/kg (max 100mg) IV
ADMISSION	Admit to hospital, ward vs PICU. Fluid refractory shock should always be admitted as PICU-Tier 1. Contact PICU early if ICU admission anticipated.

Clinical Pathway Decision Making Process

Pediatric Sepsis / Septic Shock in Pts ≥ 60 days

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EVALUATE RISK FOR SEPSIS	Score
High-risk condition	2
Abnormal temperature (by history or measured)	2
Tachycardia	2
Tachypnea	2
Systolic hypotension	3
Capillary refill abnormality	2
Peripheral pulse abnormality	1
Skin exam abnormality	1
Total Sepsis Risk Score	

SCORE ≥6

SCORE <6

***HIGH-RISK CONDITIONS:**

- Asplenia
- Transplant (BMT or organ)
- Malignancy
- Central line present
- Technology dependent (e.g. tracheostomy, VP shunt, etc.)
- Other immunocompromise

MD/RN Huddle: Concern for sepsis?

NO → Continue to monitor

YES

0 - 5 MINUTES

Immediate Action (5 minutes):

Oxygen
Pulse Ox/Cardiac Monitor
IV/IO Access/Blood Culture/Urine Cx
Capillary glucose, Chem8, POC BG/lactate
Fluid bolus 20ml/kg over 5-10 minutes

****SIGNS OF NORMAL PERFUSION:**

- Normal Mental Status
- Warm extremities
- Cap refill <2 seconds
- Normal HR, BP for age
- UOP > 1 ml/kg/hr

5 - 15 MINUTES

SIGNS OF FLUID OVERLOAD:#

- Rales
- Gallop rhythm
- Hepatomegaly

PERFUSION NORMALIZED?**

YES → Administer Antibiotics based on suspected source[†]
Correct hypoglycemia
Correct coagulopathy
Correct hypocalcemia
Admit for observation (PICU vs ward) – If PICU Tier 2

NO

SIGNS OF FLUID OVERLOAD?[#]

YES

NO

COMPLETED 60 ML/KG FLUID?

YES

NO

Repeat 20 ml/kg fluid bolus
Reassess vital signs, perfusion

[†]ANTIBIOTIC CHOICE:
Suspected Sepsis: Ceftriaxone
Immunocompromised: Cefepime
Suspected MRSA/CVC: Vancomycin
Meningitis: Ceftriaxone AND Vancomycin
Abdominal infection: Ceftriaxone AND Metronidazole

15 - 60 MINUTES

Fluid refractory shock

Warm shock
Warm extremities, flash CR
Bounding pulses
Wide pulse pressure

Norepinephrine: Start at 0.05 mcg/kg/min; titrate

Consider hydrocortisone if catechol refractory: 1-2mg/kg

Cold shock
Cold extremities, prolonged CR
Faint pulses
Narrow pulse pressure

Epinephrine: Start at 0.05 mcg/kg/min; titrate

Administer Antibiotics based on suspected source[†]
Correct hypoglycemia
Correct coagulopathy
Correct hypocalcemia
Admit to PICU Tier 1

Pediatric Sepsis / Septic Shock Rationale and Data

Goals of Clinical Pathway

1. Rapid identification and treatment of pediatric patients presenting in sepsis/septic shock.
2. Create a team-oriented approach to efficient and timely evaluation and work-up.
3. Early and aggressive treatment resulting in stabilization of hemodynamic status and reversal of shock.

Rapid Recognition

The 2005 International Pediatric Consensus Conference definition of sepsis remains the most widely used for children. According to this definition:

Sepsis: ≥2 Systemic Inflammatory Response Syndrome (SIRS) criteria (abnormal temperature, heart rate, respiratory rate, and white blood cell count) AND suspected or confirmed infection

Severe Sepsis: Sepsis criteria AND either cardiovascular dysfunction (hypotension or any two of the following: metabolic acidosis, elevated lactate, oliguria, or prolonged capillary refill), acute respiratory distress syndrome, or ≥2 other criteria for end organ dysfunction due to sepsis

Septic Shock: Severe sepsis and hypotension or tissue hypoperfusion (cap refill <1 second (flash) or ≥3 seconds, lactate ≥ 4)

Though these definitions are useful, sepsis presentations represent a continuum and it can be clinically difficult to identify transitions through stages. Also note that hypotension is a late sign of cardiovascular dysfunction and is not necessary for a diagnosis of shock.

Current guidelines recommend each institution develop a systematic screening tool to evaluate pediatric patients for possible sepsis.

Clinical Considerations Suggestive of Sepsis to Guide Initial Assessment

1. **Temperature dysregulation:** Fever or hypothermia
2. **Mental status**: Restless, agitated, anxious, progressive lethargy
3. **Skin findings**: petechial rash below nipple line, purpura, macular rash with mucosal changes
4. **Cardiovascular dysfunction**: Tachycardia (especially that does not resolve with normalization of temperature), abnormal pulses (diminished, weak, bounding), prolonged or flash capillary refill, hypotension (late finding)
5. **Respiratory**: Tachypnea, grunting (even in absence of pulmonary disease 2/2 metabolic acidosis)
6. **Presence of High-Risk medical conditions**: Patients with immunocompromise and other high risk medical conditions are especially susceptible to sepsis and may have more subtle physiologic derangements

Physical findings will vary according to the stage of shock. Frequent vital sign and physical reexamination is therefore necessary.

Resuscitation

Antimicrobials: Data suggests improved outcomes (including reduced hospital length of stay, shorter duration of organ dysfunction, and in some cases improved mortality) with decreasing time to antibiotic. Though the optimal time to antimicrobial is not clear, the Surviving Sepsis Guidelines for Children recommend administration as soon as possible within 1 hour for patients with septic shock and within 3 hours for those with organ dysfunction but without shock. For those without reason to suspect a specific source, combination therapy does not appear to be superior to extended-spectrum monotherapy.

Fluids: Administer crystalloid in 10-20ml/kg boluses up to 40-60ml/kg over the first hour until perfusion normalizes or signs of fluid overload develop. ***Clinical reassessment should occur after each fluid bolus.*** Though no high-quality RCTs exist to support this practice, many observational studies have shown improved patient outcomes with routine aggressive fluid resuscitation. Lactated ringers are preferable though NS is acceptable.

Blood culture: Obtain prior to antibiotics if possible to guide antimicrobial therapy. If blood culture is difficult, do not delay administration of antibiotics.

Lactate: Lactate is a specific but not sensitive marker for CV dysfunction in sepsis. Thresholds of 2 and 4 mmol/L have been used in children.

Vasoactives: Limited evidence from pediatric studies suggests epinephrine is superior to dopamine for fluid refractory shock, while extrapolation from adult studies also suggests norepinephrine is superior to dopamine.

Corticosteroids: No high quality studies exist demonstrating benefit for catecholamine-refractory shock in children, though it ***should*** be used in those who are known or suspected to be adrenally insufficient.

Intubation and Induction agents: Intubation should be considered in those with fluid-refractory, catecholamine resistant septic shock, though no RCTs exist to support this practice. Avoid etomidate as it is known to cause adrenal insufficiency. Ketamine is the preferred agent for sepsis.

Pediatric Sepsis / Septic Shock Rationale and Data

Bacterial Pathogen Consideration

Bacteremia is not necessary for the development of septic shock. Only 30-50% of patients with sepsis have positive blood culture results.

Suspected Source of Sepsis

	Lungs	Abdomen	Skin/Soft Tissue	Urinary Tract	CNS
Major Community Acquired Pathogens	Streptococcus pneumoniae Haemophilus influenzae Legionella sp.	Escherichia coli Bacteroides fragilis	Streptococcus pyogenes Staphylococcus aureus Clostridium sp. Pseudomonas aeruginosa	Escherichia coli Klebsiella sp. Enterobacter sp. Proteus sp.	Streptococcus pneumoniae Neiserria meningitides Listeria monocyogenes Escherichia coli Haemophilus influenzae
Major Nosocomial Pathogens	Aerobic gram negative bacilli	Aerobic gram negative bacilli Anaerobes Candida sp.	Staphylococcus aureus Aerobic gram negative bacilli	Aerobic gram negative bacilli Enterococcus sp.	Pseudomonas aeruginosa Escherichia coli Klebsiella sp. Staphylococcus sp.

Antibiotic Selection

Antibiotic therapy should be directed at the most likely source of infection. For patients without a clear source of infection or heightened risk for specific pathogens (e.g. central venous catheter increasing risk for staphylococcus species), empiric monotherapy with a beta-lactam antibiotic has not been demonstrated to be inferior to combination antimicrobial therapy. The following represent reasonable starting regimens:

Diagnosis/Suspected Source:	Preferred Regimen	Alternative Regimen/Other considerations
Sepsis (respiratory, genitourinary, or no clear source)	Ceftriaxone 50mg/kg IV	If toxic: consider Vancomycin 15mg/kg IV
Immunocompromised	Cefepime 50mg/kg IV	If toxic: add Vancomycin 15mg/kg
Central Venous Catheter, Skin/Soft Tissue infection, or other concern for MRSA	Vancomycin 15mg/kg IV	If concern for toxic shock syndrome: add Clindamycin 10mg/kg IV
Meningitis	Ceftriaxone 100mg/kg IV Vancomycin 20mg/kg IV	
Abdominal infection	Ceftriaxone 50mg/kg IV Metronidazole 10mg/kg IV	Piperacillin-tazobactam 100mg/kg IV

References:

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