

PCCN Clinical Practice Guideline: Septic Shock
CONSENSUS DRAFT (July 11, 2006)

Primary Author: Dr. Lennox Huang

Preamble

Sepsis is a common pediatric problem that is the fourth most common reason for admission to a pediatric hospital in the United States. Severe sepsis and septic shock form a leading cause of death in children and have an overall associated pediatric mortality rate of 8-10 %. Early aggressive fluid resuscitation and empiric antibiotic therapy have been shown to improve outcome from septic shock. Septic shock may present with normal, high or low cardiac output. A high suspicion for sepsis in children with abnormal vital signs is key to early recognition and treatment.

Key Principles

- Assess and manage ABCs according to PALS /ACCM guidelines
- Early rapid fluid resuscitation is associated with improved outcomes
- Do not delay treatment in order to obtain diagnosis
- Inotropic therapy should be reserved for shock that is refractory to multiple fluid boluses
- Activated protein C is not recommended for pediatric use
- Clinical endpoints include improvement in vital signs, peripheral and end-organ perfusion
- Biochemical endpoints may include serum lactate, metabolic acid/base balance, central venous O₂ saturation
- Both clinical and biochemical therapeutic endpoints should be used to assess efficacy of therapy

Age	Normal Heart Rate	Upper limit resting Respiratory Rate	Abnormal Leukocyte count
Newborn	100-180	> 50	> 34
1 mo – 1yr	90-180	> 34	> 17.5 or < 5
2-5 yr	80-140	> 22	> 15.5 or < 6
6-12 yrs	60-130	> 18	> 13.5 or < 4.5
> 13 yrs	60-100	> 14	> 11 or < 4.5

Modified from Goldstein et al, *Pediatr Crit Care Med* 2005

References

Carcillo JA, Davis AL, Zaritsky A. Role of early fluid resuscitation in pediatric septic shock. *JAMA* 1991;266:1242-5.

Goldstein B, et al. International pediatric sepsis consensus conference: Definitions for sepsis and organ dysfunction in pediatrics. *Pediatr Crit Care Med* 2005;6(1).

Carcillo JA, Fields AI. Clinical practice parameters for hemodynamic support of pediatric and neonatal patients in septic shock. *Crit Care Med* 2002;30(6).

Ham Y, Carcillo JA, Dragotta M, et al. Early reversal of pediatric-neonatal septic shock by community physicians is associated with improved outcome. *Pediatr* 2003;112(4).

Saladino R. Management of septic shock in the pediatric emergency department in 2004. *Clin Ped Emerg Med* 5:20-7.

Initial suspicion of Sepsis

- core body temperature $>38.5^{\circ}\text{C}$ or $<36^{\circ}\text{C}$ or leukocytes elevated or depressed for age
- *plus* tachypnea or tachycardia for age
- immunocompromised state (e.g., malignancy, sickle cell, cystic fibrosis, technology dependent) – diagnose fever if temperature $>38^{\circ}\text{C}$ if neutropenic/immunosuppressed

Assess & manage ABCs according to PALS guidelines
Vascular access is essential

- CBC and differential
- venous blood gas, lactate
- electrolytes, BUN, creatinine
- serum/bedside glucose
- blood cultures
- CXR if any respiratory symptoms

If immediate IV access not available, obtain Intraosseous (IO) access

Do not delay treatment if unable to obtain bloodwork

Signs of shock? (cap refill > 2 sec, altered mental status, urine output <1 mL/kg/hr, \downarrow BP)

\downarrow BP = decompensated shock
Minimum systolic BP for age

newborn	60 mmHg
1 mo - 1 yr	70 mmHg
1 - 10 yrs	70 mmHg + age*2
>10 yrs	90 mmHg

Resuscitation

- consider early intubation for refractory shock
- initiate fluid boluses immediately
- 20 mL/kg - IV 0.9% NaCl over 15-20 min
- may repeat up to and over 60 ml/kg to achieve therapeutic endpoint
- give empiric antibiotics early

Empiric IV Antibiotics

0-2 mo Ampicillin 50 mg/kg q8h + Gentamicin 2.5 mg/kg q8h

> 2 mo Ceftriaxone 80-100 mg/kg q12h or Cefotaxime 50 mg/kg q6h

if immunocompromised Piperacillin-tazobactam 100 mg/kg q8h

*Antibiotics should not delay fluid resuscitation and may be administered concomitantly

Early referral to tertiary care centre for any decompensated or persistent shock state

Evaluate response to treatment (expect improved HR, RR, BP, cap refill, urine output)

Ongoing management:

- use of activated protein C is not recommended in pediatrics
- tight glycemc control is not recommended in pediatrics
- sodium bicarbonate is not recommended for routine correction of acidosis $\text{pH} \geq 7.15$
- correct hypoglycemia and hypercalcemia
- for catecholamine resistant shock consider hydrocortisone 1-2 mg/kg/day
- monitor vital signs at least hourly
- urine output should be 1 mL/kg/hr
- follow mental status exam
- consider repeat blood gas
- transfuse PRBC if Hb < 100 g/L + persistent shock after initial resuscitation

Fluid refractory shock (> 60 mL/kg fluid and persistent shock state)

- Continue aggressive fluid resuscitation
- Initiate inotrope therapy with dopamine 5-10 mcg/kg/min
- Establish central venous access as soon as possible (ideally before inotropes)
- Consider arterial line for BP monitoring

Continued resuscitation for dopamine and fluid refractory shock

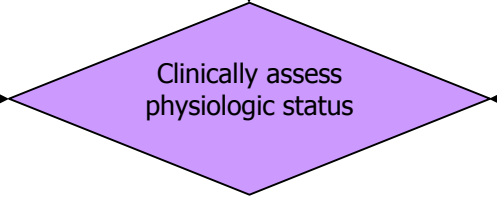
- Institute and titrate medications with the guidance of a paediatric tertiary care centre
- Continue aggressive fluid resuscitation
- Monitor clinical and biochemical endpoints for progress

“Warm” shock

- Low BP
- Bounding pulses
- Vasodilated
- Warm extremities
- Presumed normal / high cardiac output

“Cold” shock

- Low or normal BP
- Cool extremities
- Weak pulses
- Vasoconstricted
- Presumed low cardiac output



Titrate norepinephrine

Titrate epinephrine
or other vasopressor
+ milrinone