

**Table 6: Evidence for Timely Fluid Bolus for Treatment of Children with Severe Sepsis or Septic Shock**

Type of Evidence	Key Findings	Level of Evidence (USPSTF Ranking)	Citations
<b>Clinical guidelines</b>	Pediatric considerations in severe sepsis: In children, definitions of sepsis are similar to those for adults but depend on age-specific heart rate, respiratory rate, and white blood cell count cutoff values (See Table 4). Initial resuscitation of shock begins with infusion of isotonic crystalloids or albumin with boluses of up to 20 mL/kg crystalloids (or albumin equivalent) over 5-10 minutes, titrated to reversing hypotension, increasing urine output, and attaining normal capillary refill, peripheral pulses, and level of consciousness without inducing hepatomegaly or rales. [p. 613-614]	III	Dellinger RP, Levy MM, Rhodes A, et al. Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock. <i>Crit Care Med</i> 2013; 41(2): 580-637.
<b>Clinical guidelines</b>	The algorithm proposed by Brierley et al. for the treatment of septic shock in children establishes a sequence for time-sensitive, goal-directed stepwise management of hemodynamic support. Goals for the first hour include restoration and maintenance of heart rate thresholds, establishing capillary refill of 2 seconds or less, and restoring normal blood pressure. The timeline begins when decreased perfusion is recognized in the emergency department as indicative of sepsis and triggers administration of high flow oxygen and the establishment of intravenous/intraosseous access. Initial fluid resuscitation efforts follow, ideally within 5 minutes. Fluid boluses of 20 mL/kg isotonic saline or colloid are administered up to and over 60 mL/kg during the first hour until perfusion improves or unless rales or hepatomegaly develop. Antibiotics are begun and corrections made for hypoglycemia and hypocalcemia. At 15 minutes, fluid refractory shock is identified and inotropic medications are administered. If shock is not reversed by 60 minutes, treatment for catecholamine resistant shock and transfer to the pediatric ICU is initiated. [p 677] Heart rates associated with increased mortality in critically ill (though not necessarily septic) infants include values of less than 90 beats/minute or more than 160 beats per minute and for children include values of less than 70 beats per minute or more than 150 beats per minutes. [p 670]	III	Brierley J, Carcillo JA, Choong K, et al. Clinical practice parameters for hemodynamic support of pediatric and neonatal septic shock: 2007 update from the American College of Critical Care Medicine. <i>Crit Care Med</i> 2009; 37(2):666-688

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	Fluid infusion is best initiated with boluses of 20 mL/kg, titrated to ensure adequate blood pressure and clinical monitors of cardiac output, including heart rate, quality of peripheral pulses, capillary refill, level of consciousness, peripheral skin temperature, and urine output. Initial volume resuscitation commonly requires 40-60 mL/kg but can be as high as 200 mL/kg. [p. 1368] Fluid should be pushed with the goal of attaining normal perfusion and blood pressure. [p. 1371]		Carcillo JA, Fields AI, et al. Clinical parameters for hemodynamic support of pediatric and neonatal patients in septic shock. <i>Crit Care Med</i> 2002; 30(6):1365-1378
<b>Clinical guidelines</b>	Immediate reassessment should occur after initial fluid infusion to check for signs of improved perfusion using clinical criteria, such as a reduction in heart rate and improvement in blood pressure, capillary refill, quality of pulses, and mental status. If the clinical signs of shock persist, another 20 mL/kg of isotonic fluid should be administered and repeated once more, so that a total of 60 mL/kg can be administered in the first 15 to 30 minutes. Decreasing heart rate is a sign of improvement following initiation of fluid resuscitation. [p. 247]	III	Melendez E, Bachur R. Advances in the emergency management of pediatric sepsis. <i>Curr Opin Pediatr</i> 2006; 18:245-253.
<b>Clinical protocol</b>	Once severe sepsis or septic shock has been identified, the highest management priorities are establishment of vascular access and initiation of fluid resuscitation to improve tissue perfusion. Maintenance of tissue perfusion is critical, because global tissue hypoxia is a key step toward multiple organ failure. [p. s18] Frequent monitoring of vital signs (including heart rate) is especially valuable in identifying trends, which can provide a more complete clinical picture than individual measurements. [p. S14]	III	Rivers EP, Ahrens T. Improving outcomes for severe sepsis and septic shock: Tools for early identification of at-risk patients and treatment protocol implementation. <i>Crit Care Clin</i> 2008; S1-S47
<b>Clinical protocol</b>	In children, use adequate tissue perfusion as the principal endpoint of resuscitation, along with normal heart rate and arterial blood pressure. [p. 559] Patients with sepsis and tissue hypoperfusion appear to benefit from a rapid bolus of intravenous crystalloid solution of at least 20 mL/kg. Further fluid resuscitation should be guided by the response to fluid loading. Positive response to fluid loading include: >10% increase of systolic/mean arterial blood pressure, >10% reduction of heart rate, and/or improvement of mental status, peripheral perfusion, and/or urine output. [p.560]	III	Dünser MW, Festic E, Dondorp A, et al. Recommendations for sepsis management in resource-limited settings. <i>Intensive Care Med</i> 2012; 38:557-574.

**Note:** USPSTF criteria for assessing evidence at the individual study level are as follows: I) Properly powered and conducted randomized controlled trial (RCT); well-conducted systematic review or meta-analysis of homogeneous RCTs. II) Well-designed cohort or case-control analytic study. III) Opinions of respected authorities, based on clinical experience; descriptive studies or case reports; reports of expert committees.