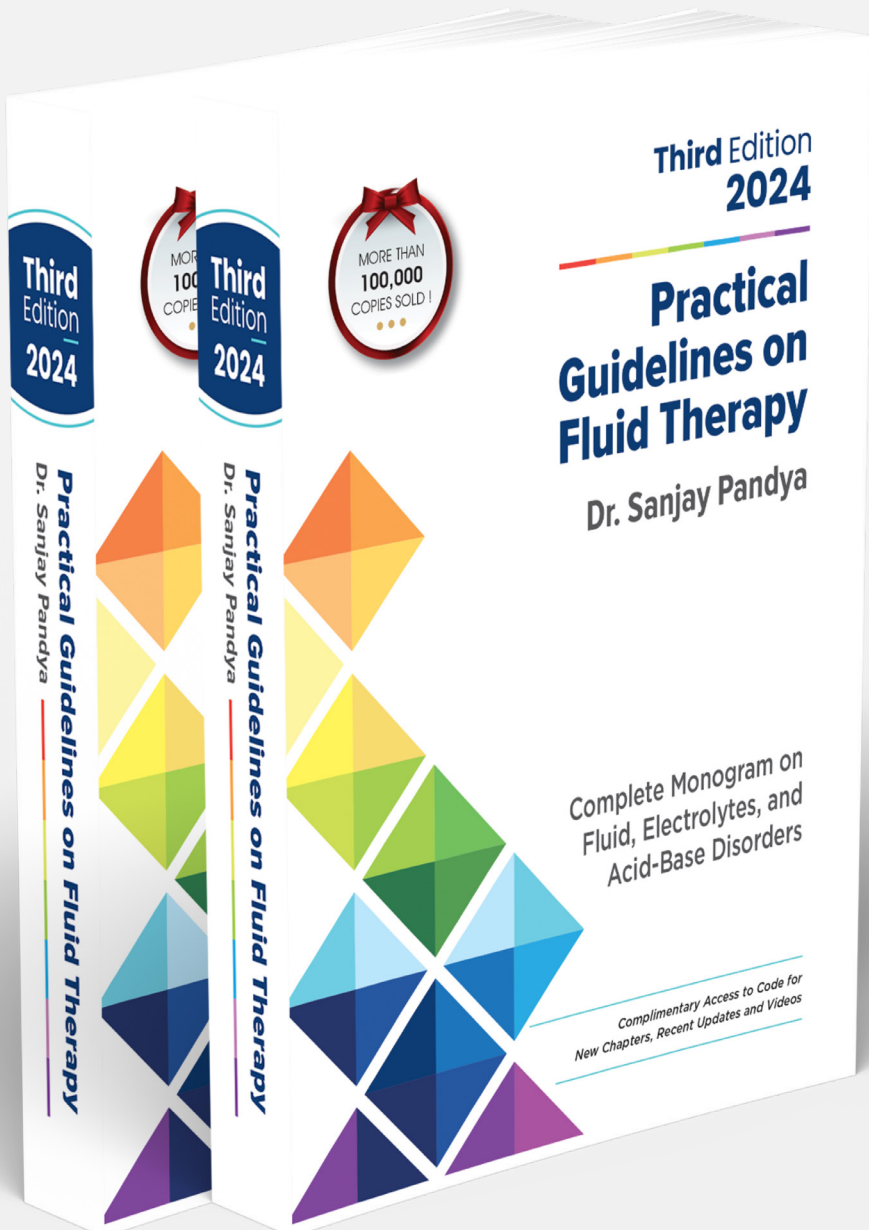




Fluid
therapy.org

Chapter 48:

Resuscitation and Maintenance Fluid Therapy in Children



To get a copy of the book, visit: www.fluidtherapy.org

48

Resuscitation and Maintenance Fluid Therapy in Children

Indications and Goals	567		
Reasons for Special Considerations	568		
Resuscitation IV Fluids for Children..	569		
Selection of resuscitation fluids	569		
Crystalloids vs. colloids debate...	569		
Normal saline vs. balanced crystalloids debate.....	569		
Role of blood transfusion.....	571		
Resuscitation fluid administration ..	572		
Timing.....	572		
Bolus vs. continuous infusion	572		
Volume of fluid bolus	572		
Avoiding volume overload	572		
Maintenance IV Fluids for Children...573			
Goals	573		
Maintenance requirements of IV fluids.....	573		
Prescribing maintenance IV fluids ..	574		
Hypotonic fluids outdated	574		
		Basis of shift from hypotonic to isotonic fluids.....	575
		Current recommendation:	
		Isotonic maintenance fluids	575
		Commercial vs. custom-made solutions	576
		Choosing appropriate isotonic maintenance fluids	576
		Considerations of dextrose and potassium content	577
		Exceptions to standard recommendations.....	577
		Rate of maintenance fluids - controversy.....	577
		Avoid fluid overload	577
		Maintenance IV Fluids for Neonates..578	
		Physiological considerations	578
		Prescribing maintenance fluids	579
		Prescription Summary of Maintenance Fluid Therapy	581

Fluid therapy in children is an essential aspect of managing critically ill individuals, and appropriate fluid therapy can be lifesaving. The primary goal of resuscitation fluids is to establish hemodynamic stability, ensuring adequate intravascular volume and tissue perfusion. Maintenance fluids, on the other hand, are administered to achieve proper hydration and maintain electrolyte balance.

INDICATIONS OF IV FLUID THERAPY

Oral fluid replacement is always a safe and preferred mode. The indications of IV fluid therapy include correcting or maintaining fluid and electrolyte balance in conditions such as shock, severe dehydration, uncontrolled vomiting or diarrhea, inability to drink, paralytic

ileus leading to abdominal distension, impaired sensorium, and other serious complications.

Goals: IV fluid replacement aims can be broadly categorized into three groups: Resuscitation, maintenance, and replacement [1]. Distinguishing these reasons is

crucial because the choice of fluids, their composition, volume, and administration rates vary depending on the patient's clinical status and specific indications. It's essential to select the appropriate IV fluids tailored to each situation.

Want to read more?

Get Printed Version

Get Kindle Version

REFERENCES

1. National Clinical Guideline Centre. IV Fluids in Children: Intravenous Fluid Therapy in Children and Young People in Hospital. Quality standard. London: National Institute for Health and Care Excellence (UK); 2016 Sep 21. Accessed 2023 Aug 22. Available from: <https://www.nice.org.uk/guidance/qs131>.
2. Lewis SR, Pritchard MW, Evans DJ, et al. Colloids versus crystalloids for fluid resuscitation in critically ill people. *Cochrane Database Syst Rev*. 2018;8(8):CD000567.
3. Weiss SL, Peters MJ, Alhazzani W, et al. Executive Summary: Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children. *Pediatr Crit Care Med* 2020;21(2):e52–e106.
4. Van de Voorde P, Turner NM, Djakow J, et al. European Resuscitation Councils Guidelines 2021: Paediatric Life Support. *Resuscitation*. 2021;161:327–387.
5. Skellett S, Maconochie I, Bingham B, et al. Paediatric advanced life support Guidelines. Resuscitation Council UK. Published May 2021. Visit: <https://www.resus.org.uk/library/2021-resuscitation-guidelines/paediatric-advanced-life-support-guidelines>.
6. Myburgh J, Cooper DJ, Finfer S, et al. Saline or albumin for fluid resuscitation in patients with traumatic brain injury. *NEJM* 2007;357(9):874–884.
7. Brackney C, Diaz L, Milbrandt E, et al. Is albumin use SAFE in patients with traumatic brain injury? *Crit Care* 2010;14(2):307.
8. Cooper DJ, Myburgh J, Heritier S, et al. Albumin resuscitation for traumatic brain injury: is intracranial hypertension the cause of increased mortality? *J Neurotrauma* 2013;30(7):512–518.
9. Rossi S, Picetti E, Zoerle T, et al. Fluid management in acute brain injury. *Curr Neurol Neurosci Rep* 2018;18(11):74.
10. SAFE Study Investigators, Finfer S, McEvoy S, et al. Impact of albumin compared to saline on organ function and mortality of patients with severe sepsis. *Intensive Care Med*. 2011;37(1):86–96.
11. Caironi P, Tognoni G, Masson S, et al. Albumin replacement in patients with severe sepsis or septic shock. *N Engl J Med*. 2014;370(15):1412–1421.
12. Charpentier J, Mira JP. Efficacy and tolerance of hyperoncotic albumin administration in septic shock patients: the EARSS study. *Intensive Care Med*. 2011;37(Suppl 1):S115–S0438.
13. Xu JY, Chen QH, Xie JF, et al. Comparison of the effects of albumin and crystalloid on mortality in adult patients with severe sepsis and septic shock: A meta-analysis of randomized clinical trials. *Crit Care* 2014;18(6):702.
14. Perner A, Haase N, Guttormsen AB, et al. Hydroxyethyl starch 130/0.42 versus ringer's acetate in severe sepsis. *N Engl J Med* 2012;367(2):124–134.
15. Myburgh JA, Finfer S, Bellomo R, et al. Hydroxyethyl starch or saline for fluid resuscitation in intensive care. *N Engl J Med* 2012;367(20):1901–1911.
16. Zarychanski R, Abou-Setta AM, Turgeon AF, et al. Association of hydroxyethyl starch administration with mortality and acute kidney injury in critically ill patients requiring volume resuscitation: a

- systematic review and meta-analysis. *JAMA*. 2013;309(7):678–88.
17. EMA. PRAC confirms that hydroxyethyl-starch solutions (HES) should no longer be used in patients with sepsis or burn injuries or in critically ill patients. 11 October 2018. <https://www.ema.europa.eu/en/news/prac-confirms-hydroxyethyl-starch-solutions-hes-should-no-longer-be-used-patients-sepsis-burn>.
 18. National Institute for Health and Care Excellence. Intravenous fluid therapy in children and young people in hospital. NICE guideline. Published: December 9, 2015. Last updated: June 11, 2020. Available from: www.nice.org.uk/guidance/ng29.
 19. Upadhyay M, Singhi S, Murlidharan J, et al. Randomized evaluation of fluid resuscitation with crystalloid (saline) and colloid (polymer from degraded gelatin in saline) in pediatric septic shock. *Indian Pediatr* 2005;42(3):223–231.
 20. Thomas-Rueddel DO, Vlasakov V, Reinhart K, et al. Safety of gelatin for volume resuscitation—a systematic review and meta-analysis. *Intensive Care Med*. 2012;38(7):1134–42.
 21. Moeller C, Fleischmann C, Thomas-Rueddel D, et al. How safe is gelatin? A systematic review and meta-analysis of gelatin-containing plasma expanders vs crystalloids and albumin. *J Crit Care* 2016;35:75–83.
 22. Farooque S, Kenny M, Marshall SD. Anaphylaxis to intravenous gelatin based solutions: a case series examining clinical features and severity. *Anaesth*. 2019;74(2):174–9.
 23. World Health Organization. Pocket book of hospital care for children. 2nd ed. Guidelines for the management of common childhood illnesses. WHO, 2013.
 24. Leung LCK, So LY, Ng YK, et al. Initial intravenous fluid prescription in general paediatric in-patients aged >28 days and <18 years: consensus statements. *Hong Kong Med J*. 2021;27(4):276–286.
 25. Yunos NM, Bellomo R, Story D, et al. Bench-to bedside review: chloride in critical illness. *Crit Care*. 2010;14(4):226.
 26. Moritz ML, Ayus JC. 0.9% saline and balance crystalloids in acute ill patients: Trading one problem for another. *Journal of Critical Care* 2021;63:254–256.
 27. Shin WJ, Kim YK, Bang JY, et al. Lactate and liver function tests after living donor right hepatectomy: a comparison of solutions with and without lactate. *Acta Anaesthesiol Scand*. 2011;55(5):558–64.
 28. Weinberg L, Collins N, Van Mourik K, et al. PlasmaLyte 148: a clinical review. *World J Crit Care Med* 2016;5(4):235–250.
 29. Anantasisit N, Thasanthiah S, Lertbunrrian R. Balanced salt solution versus normal saline solution as initial fluid re-suscitation in pediatric septic shock: A randomized, double-blind controlled trial. *Crit Care Shock* 2020;23(4):158–168.
 30. Hoorn EJ. Intravenous fluids: balancing solutions. *J Nephrol* 2017;30(4):485–492.
 31. Barhight MF, Lusk J, Brinton J, et al. Hyperchloremia is independently associated with mortality in critically ill children who ultimately require continuous renal replacement therapy. *Pediatr Nephrol* 2018;33(6):1079–1085.
 32. Stenson EK, Cvijanovich NZ, Anas N, et al. Hyperchloremia Is Associated With Complicated Course and Mortality in Pediatric Patients With Septic Shock. *Pediatr Crit Care Med* 2018;19(2):155–160.
 33. Ginter D, Gilfoyle E, Wade A, et al. Hyperchloremia and association with acute kidney injury in critically ill children. *Pediatr Nephrol*. 2023;38(7):2233–2242.
 34. Emrath ET, Fortenberry JD, Travers C, et al. Resuscitation With Balanced Fluids Is Associated With Improved Survival in Pediatric Severe Sepsis. *Crit Care Med* 2017;45(7):1177–1183.
 35. Semler MW, Self WH, Wanderer JP, et al. Balanced crystalloids versus saline in critically ill adults. *N Engl J Med* 2018;378(9):829–839.
 36. Self WH, Semler MW, Wanderer JP, et al. Balanced crystalloids versus saline in noncritically ill adults. *N Engl J Med* 2018;378:819–828.
 37. Lehr AR, Rached-d’Astous S, Barrowman N, et al. Balanced Versus Unbalanced Fluid in Critically Ill Children: Systematic Review and Meta-Analysis. *Pediatr Crit Care Med* 2022;23(3):181–191.
 38. Sankar J, Muralidharan J, Lalitha AV, et al. Multiple Electrolytes Solution Versus Saline as Bolus Fluid for Resuscitation in Pediatric Septic Shock: A Multicenter Randomized Clinical Trial. *Crit Care Med* 2023.
 39. Kight BP, Waseem M. Pediatric Fluid Management. [Updated 2023 Jan 16]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK560540/>.
 40. Chong SL, Ong GY, Venkataraman A, et al. The golden hours in paediatric septic shock—current updates and recommendations. *Ann Acad Med Singap*. 2014;43(5):267–74.
 41. San Geroteo J, Levy M, Gotchac J, et al. Fluid bolus therapy in pediatric sepsis: a narrative review. *Eur J Med Res*. 2022;27(1):246.
 42. Fernández-Sarmiento J, De Souza DC, Martínez A, et al. Latin American Consensus on the Management of Sepsis in Children: Sociedad Latinoamericana de Cuidados Intensivos Pediátricos [Latin American Pediatric Intensive Care Society] (SLACIP) Task Force: Executive Summary. *J Intensive Care Med*. 2022;37(6):753–763.
 43. Maitland K, Kiguli S, Opoka RO, et al. Mortality after fluid bolus in African children with severe infection. *N Engl J Med*. 2011;364(26):2483–95.
 44. 2022 exceptional surveillance on intravenous fluid therapy in children and young people (NICE guidelines NG29, NG51, NG143, CG84, CG102 and NG18). Surveillance report Published: 21 October 2022 www.nice.org.uk.
 45. World Health Organization. Updated guideline: paediatric emergency triage, assessment and treatment. Geneva: WHO 2016.
 46. Russotto V. Conservative fluid management: Turn off the tap after use? European Society of Intensive

- Care Medicine (ESICM) [Internet]. April 25, 2017. Available from: <https://www.esicm.org/article-review-conservative-fluid-management-april-2017/>.
47. Sinitsky L, Walls D, Nadel S, et al. Fluid overload at 48 hours is associated with respiratory morbidity but not mortality in a general PICU: retrospective cohort study. *Pediatr Crit Care Med*. 2015;16(3):205–209.
 48. Alobaidi R, Morgan C, Basu RK, et al. Association between fluid balance and outcomes in critically ill children: a systematic review and meta-analysis. *JAMA Pediatr*. 2018;172(3):257–268.
 49. Feld LG, Neuspiel DR, Foster BA, et al. Clinical practice guideline: maintenance intravenous fluids in children. *Pediatrics* 2018;142(6):e20183083.
 50. Brossier DW, Tume LN, Briant AR, et al. ESPNIC clinical practice guidelines: intravenous maintenance fluid therapy in acute and critically ill children- a systematic review and meta-analysis. *Intensive Care Med*. 2022;48(12):1691–1708.
 51. Friedman JN. Risk of acute hyponatremia in hospitalized children and youth receiving maintenance intravenous fluids. Canadian Paediatric Society. Posted: 2018 Dec 18. Last updated: May 5, 2021. [Accessed 2023 Aug 28]. Available from: <https://cps.ca/en/documents/position/acute-hyponatremia-in-hospitalized-children-and-youth>.
 52. Saba TG, Fairbairn J, Houghton F, et al. A randomized controlled trial of isotonic versus hypotonic maintenance intravenous fluids in hospitalized children. *BMC Pediatrics*. 2011;11:82.
 53. Holliday MA, Segar WE. The maintenance need for water in parenteral fluid therapy. *Pediatrics* 1957;19(5):823–32.
 54. Moritz ML, Ayus JC. Prevention of hospital-acquired hyponatremia: A case for using isotonic saline. *Pediatrics* 2003;111(2):227–230.
 55. Hoorn EJ, Geary D, Robb M, et al. Acute hyponatremia related to intravenous fluid administration in hospitalized children: An observational study. *Pediatrics* 2004;113(5):1279–84.
 56. Moritz MI, Ayus JC. Preventing neurological complications from dysnatremias in children. *Pediatr Nephrol*. 2005;20(12):1687–700.
 57. Choong K, Kho ME, Menon K, et al. Hypotonic versus isotonic saline in hospitalised children: a systematic review. *Arch Dis Child*. 2006;91(10):828–35.
 58. Beck CE. Hypotonic versus isotonic maintenance intravenous fluid therapy in hospitalized children: a systematic review. *Clin Pediatr (Phila)*. 2007;46(9):764–70.
 59. Koczmaro C, Hyland S, Greenall J. Hospital-acquired acute hyponatremia and parenteral fluid administration in children. *Can J Hosp Pharm*. 2009;62(6):512–5.
 60. Choong K, Arora S, Cheng J, et al. Hypotonic versus isotonic maintenance fluids after surgery for children: a randomized controlled trial. *Pediatrics*. 2011;128(5):857–66.
 61. Rey C, Los-Arcos M, Hernández A, et al. Hypotonic versus isotonic maintenance fluids in critically ill children: a multicenter prospective randomized study. *Acta Paediatr*. 2011;100(8):1138–43.
 62. Grissinger M. Hyponatremia and death in Healthy children From plain dextrose and Hypotonic Saline Solutions after Surgery. *P T*. 2013;38(7):364–88.
 63. Foster BA, Tom D, Hill V. Hypotonic versus isotonic fluids in hospitalized children: a systematic review and meta-analysis. *J Pediatr* 2014;165(1):163–169.
 64. Flores Robles CM, Cuello García CA. A prospective trial comparing isotonic with hypotonic maintenance fluids for prevention of hospital-acquired hyponatraemia. *Paediatr Int Child Health*. 2016;36(3):168–74.
 65. McNab S. Intravenous maintenance fluid therapy in children. *J Paediatr Child Health*. 2016;52(2):137–40.
 66. Torres SF, Iolster T, Schnitzler EJ, et al. Hypotonic and isotonic intravenous maintenance fluids in hospitalised paediatric patients: a randomised controlled trial. *BMJ Paediatr Open*. 2019;3(1):e000385.
 67. Hasim N, Bakar MAA, Islam MA. Efficacy and Safety of Isotonic and Hypotonic Intravenous Maintenance Fluids in Hospitalised Children: A Systematic Review and Meta-Analysis of Randomised Controlled Trials. *Children*. 2021;8(9):785.
 68. Ratnjeet K, Pallavi P, Jhamb U, et al. 0.45% Versus 0.9% Saline in 5% Dextrose as Maintenance Fluids in Children Admitted With Acute Illness: A Randomized Control Trial. *Pediatr Emerg Care*. 2022;38(9):436–441.
 69. National Patient Safety Agency. Patient Safety Alert 22. Reducing the risk of hyponatraemia when administering intravenous infusions to children. 2007. <https://www.sps.nhs.uk/wp-content/uploads/2018/02/2007-NRLS-0409-Hyponatraemia-cen-PSA-2007-03-28-v1.pdf>.
 70. Moritz ML, Ayus JC. Maintenance intravenous fluids in acutely ill patients. *N Engl J Med*. 2015;373(14):1350–1360.
 71. Duke T. Maintenance intravenous fluids for children: enough evidence, now for translation and action. *Paediatr Int Child Health* 2016;36(3):165–7.
 72. Padua AP, Macaraya JR, Dans LF, et al. Isotonic versus hypotonic saline solution for maintenance intravenous fluid therapy in children: a systematic review. *PediatrNephrol* 2015;30(7):1163–72.
 73. Narsaria P, Lodha R. Isn't it time to stop using 0.18% saline in dextrose solutions for intravenous maintenance fluid therapy in children? *Indian Pediatr*. 2014;51(12):964–6.
 74. Hall AM, Ayus JC, Moritz ML. Things We Do For No Reason: The Default Use of Hypotonic Maintenance Intravenous Fluids in Pediatrics. *J Hosp Med*. 2018;13(9):637–640.
 75. Steele A, Gowrishankar M, Abrahamson S, et al. Postoperative hyponatremia despite near-isotonic saline infusion: A phenomenon of desalination. *Ann Intern Med*. 1997;126(1):20–25.
 76. Skippen P, Adderley R, Bennett M, et al. Iatrogenic hyponatremia in hospitalized children: can it be avoided? *Paediatr Child Health*. 2008;13(6):502–506.
 77. Kannan L, Lodha R, Vivekanandhan S, et al. Intravenous fluid regimen and hyponatraemia among children: a randomized controlled trial. *Pediatr*

- Nephrol 2010;25(11):2303–2309.
78. Neville KA, Sandeman DJ, Rubinstein A, et al. Prevention of Hyponatremia during Maintenance Intravenous Fluid Administration: A Prospective Randomized Study of Fluid Type versus Fluid Rate. *J Pediatr* 2010;156(2):313–319.e1–2.
 79. McNab S, Duke T, South M, et al. 140 mmol/L of sodium versus 77 mmol/L of sodium in maintenance intravenous fluid therapy for children in hospital (PIMS): a randomised controlled double-blind trial. *Lancet* 2015;385(9974):1190–7.
 80. Friedman JN, Beck CE, DeGroot J, et al. Comparison of isotonic and hypotonic intravenous maintenance fluids: A randomized clinical trial. *JAMA Pediatr* 2015;169(5):445–51.
 81. McNab S, Ware RS, Neville KA, et al. Isotonic versus hypotonic solutions for maintenance intravenous fluid administration in children. *Cochrane Database Syst Rev* 2014;12:CD009457.
 82. Wang J, Xu E, Xiao Y. Isotonic versus hypotonic maintenance IV fluids in hospitalized children: a meta-analysis. *Pediatrics* 2014;133(1):105–13.
 83. Yang G, Jiang W, Wang X, et al. The efficacy of isotonic and hypotonic intravenous maintenance fluid for pediatric patients: A meta-analysis of randomized controlled trials. *Pediatr Emerg Care* 2015;31(2):122–6.
 84. Amer BE, Abdelwahab OA, Abdelaziz A, et al. Efficacy and safety of isotonic versus hypotonic intravenous maintenance fluids in hospitalized children: an updated systematic review and meta-analysis of randomized controlled trials. *Pediatr Nephrol*. 2023.
 85. Holliday MA. Isotonic saline expands extracellular fluid and is inappropriate for maintenance therapy. *Pediatrics*. 2005;115(1):193–194.
 86. Holliday MA, Ray PE, Friedman AL. Fluid therapy for children: facts, fashions and questions. *Arch Dis Child*. 2007;92(6):546–550.
 87. Kannan L, Lodha R. Appropriate fluid for intravenous maintenance therapy in hospitalized children--current status. *Indian J Pediatr*. 2011;78(3):357–9.
 88. World Health Organization. Hospital Care for Children: Guidelines for the Management of Common Illnesses with Limited Resources, 2nd edn. Geneva:WHO. Available from: http://www.who.int/maternal_child_adolescent/documents/child_hospital_care/en/2013.
 89. Lehtiranta S, Honkila M, Kallio M, et al. Risk of Electrolyte Disorders in Acutely Ill Children Receiving Commercially Available Plasmalike Isotonic Fluids: A Randomized Clinical Trial. *JAMA Pediatr* 2021;175(1):28–35.
 90. Van Regenmortel N, Verbrugghe W, Roelant E, et al. Maintenance fluid therapy and fluid creep impose more significant fluid, sodium, and chloride burdens than resuscitation fluids in critically ill patients: a retrospective study in a tertiary mixed ICU population. *Intensive Care Med*. 2018;44(4):409–417.
 91. Lindén-Søndersø A, Jungner M, Spångfors M, et al. Survey of non-resuscitation fluids administered during septic shock: a multicenter prospective observational study. *Ann Intensive Care*. 2019;9(1):132.
 92. Maes T, Meuwissen A, Diltoer M, et al. Impact of maintenance, resuscitation and unintended fluid therapy on global fluid load after elective coronary artery bypass surgery. *J Crit Care*. 2019;49:129–135.
 93. Al-Lawati ZH, Sur M, Kennedy CE, et al. Profile of Fluid Exposure and Recognition of Fluid Overload in Critically Ill Children. *Pediatr Crit Care Med*. 2020;21(8):760–766.
 94. Barhight MF, Nelson D, Chong G, et al. Non-resuscitation fluid in excess of hydration requirements is associated with higher mortality in critically ill children. *Pediatr Res*. 2022;91(1):235–240.
 95. Bulfon AF, Alomani HL, Anton N, et al. Intravenous Fluid Prescription Practices in Critically Ill Children: A Shift in Focus from Natrema to Chloremia? *J Pediatr Intensive Care*. 2019;8(4):218–225.
 96. Ingelse SA, Wieggers HM, Calis JC, et al. Early Fluid Overload Prolongs Mechanical Ventilation in Children With Viral-Lower Respiratory Tract Disease. *Pediatr Crit Care Med*. 2017;18(3):e106–e111.
 97. Kong X, Zhu Y, Zhu X. Association between early fluid overload and mortality in critically-ill mechanically ventilated children: a single-center retrospective cohort study. *BMC Pediatr*. 2021;21(1):474.
 98. Naveda Romero OE, Naveda Meléndez AF. Fluid overload and kidney failure in children with severe sepsis and septic shock: A cohort study. *Arch Argent Pediatr*. 2017;115(2):118–124.
 99. Raina R, Sethi SK, Wadhvani N, et al. Fluid Overload in Critically Ill Children. *Front Pediatr*. 2018;6:306.
 100. The Royal Children’s Hospital Melbourne. IV fluids - for children beyond the newborn period. Clinical Practice Guidelines. Updated October 2020. Accessed September 1, 2023. Available from: https://www.rch.org.au/clinicalguide/guideline_index/intravenous_fluids/.
 101. Segar JL. A physiological approach to fluid and electrolyte management of the preterm infant: Review. *J Neonatal Perinatal Med*. 2020;13(1):11–19.
 102. Rutledge A, Murphy HJ, Harer MW, et al. Fluid Balance in the Critically Ill Child Section: “How Bad Is Fluid in Neonates?” *Front Pediatr*. 2021;9:651458.
 103. Lindower JB. Water balance in the fetus and neonate. *Semin Fetal Neonatal Med* 2017;22(2):71–75.
 104. Balasubramanian K, Kumar P, Saini SS, et al. Isotonic versus hypotonic fluid supplementation in term neonates with severe hyperbilirubinemia - a double-blind, randomized, controlled trial. *Acta Paediatr*. 2012;101(3):236–41.
 105. Dathan K, Sundaram M. Comparison of isotonic versus hypotonic intravenous fluid for maintenance fluid therapy in neonates more than or equal to 34 weeks of gestational age - a randomized clinical trial. *J Matern Fetal Neonatal Med*. 2022;35(25):6338–6345.
 106. Tuzun F, Akcura Y, Duman N, et al. Comparison of isotonic and hypotonic intravenous fluids in term newborns: is it time to quit hypotonic fluids. *J Matern Fetal Neonatal Med*. 2022;35(2):356–361.

KidneyEducation

Join the Mission to Fight Kidney Diseases

Explore the world's largest multilingual website created by a global team of over 100 nephrologists.

www.KidneyEducation.com

- » Read online or download the 200-page book "Save Your Kidneys" in 40 languages—completely free.
- » This comprehensive resource offers valuable information on preventing and managing common kidney problems, tailored for kidney patients and their families.
- » It's an authentic guide, prepared by nephrologists and free from any external funding.