

IAP - IJPP CME 2025**RATIONAL FLUID THERAPY IN PRACTICE*****Poovazhagi V**

Abstract: Fluid therapy is the cornerstone of pediatric care; however, its complexity makes it a frequent source of adverse events. This article outlines the evolution of fluid management, emphasizing the shift towards isotonic balanced salt solutions and away from hypotonic fluids to mitigate risks such as iatrogenic hyponatremia and fluid overload. The principles of fluid stewardship are highlighted using the “4 D’s” (Drug, Dose, Duration, De-escalation) and the R.O.S.E. (Resuscitation, Optimization, Stabilization, Evacuation) models, which guide dynamic management based on the patient’s phase of illness. Key indications namely resuscitation, maintenance and replacement are discussed, incorporating recent guidelines for specific conditions such as sepsis, dengue, burns, renal dysfunction and trauma. The importance of frequent clinical assessments and point-of-care ultrasound monitoring is emphasized, reinforcing the critical balance; hypovolemia is harmful, but hypervolemia is often more detrimental.

Keywords: Fluid therapy, Children, Critical care, Sepsis, Dengue.

Points to Remember

- *Crystalloids are the preferred first-line intravenous fluids over colloids in children.*
- *Isotonic fluids are the standard of care; balanced salt solutions may reduce the need for renal replacement therapy compared to 0.9% saline.*
- *A goal-directed, phased approach using the R.O.S.E. model minimizes the risks of both under-resuscitation and iatrogenic fluid overload.*
- *Continuous clinical and laboratory monitoring is essential to ensure patient safety.*

References

1. Rivers E, Nguyen B, Havstad S, Ressler J, Muzzin A, Knoblich B, et al. Early Goal-Directed Therapy Collaborative Group. Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Engl J Med.* 2001 Nov 8; 345(19):1368-1377.
2. Maitland K, George EC, Evans JA, Kiguli S, Olupot-Olupot P, Akech SO, et al. Exploring mortality after early fluid resuscitation in African children with severe infection: a re-analysis of data from the FEAST trial. *Lancet Respir Med.* 2013 Jun; 1(4):283-291.
3. Meyhoff TS, Hjortrup PB, Wetterslev J, Sivapalan P, Laake JH, Cronhjort M, et al. Restriction of intravenous fluid in ICU patients with septic shock. *N Engl J Med.* 2022 Jun 30; 386(26):2459-2470.
4. Brossier DW, Goyer I, Verbruggen SCAT, Jotterand Chaparro C, Rooze S, Marino LV, et al. Intravenous maintenance fluid therapy in acutely and critically ill children: state of the evidence. *Lancet Child Adolesc Health.* 2024 Mar; 8(3):236-244.
5. Brossier DW, Tume LN, Briant AR, Jotterand Chaparro C, Moullet C, Porcheret F, 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 Dec; 48(12):1691-1708.
6. Foster BA, Tom D, Hill V. Hypotonic versus isotonic fluids in hospitalized children: a systematic review and meta-analysis. *J Pediatr.* 2014 Jul; 165(1):163-169.e2.

* Professor and Head,
Department of Pediatric Intensive Care,
Institute of Child Health and Hospital for Children,
Madras Medical College, Chennai.
email : poomuthu@gmail.com

7. National Institute for Health and Care Excellence. Intravenous fluid therapy in children and young people in hospital [NG29]. London: NICE; 2020 Jun 11.
8. Lewis SR, Pritchard MW, Evans DJW, Butler AR, Alderson P, Smith AF, et al. Colloids versus crystalloids for fluid resuscitation in critically ill people. *Cochrane Database Syst Rev*. 2018 Aug 3; 8(8):CD000567.
9. Silva C, Marcos P. Intravenous fluid therapy: essential components and key considerations. *Porto Biomed J*. 2025 Jul-Aug; 10(4):e296
10. Weiss SL, Peters MJ, Alhazzani W, Agus MSD, Flori HR, Inwald DP, 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 Feb; 21(2):e52-e106.
11. Weiss S, Peters MJ, Oczkowski SJ, Tissieres P, Choong K, Ranjit S, et al. Surviving Sepsis Campaign international guidelines for the management of sepsis and septic shock in children 2026. *Pediatr Crit Care Med*. 2026 Mar 23. doi: 10.1097/PCC.0000000000003928. Online ahead of print
12. Chandelia S, Angurana SK, Prasad S, Tiwari MK, Jayashree M, Nallasamy K, et al. Balanced salt solution versus normal saline as resuscitation fluid in pediatric septic shock: a systematic review and meta-analysis of randomized controlled trials. *J Intensive Care Med*. 2025 Jan; 40(1):45-54.
13. Amer BE, Abdelwahab OA, Abdelaziz A, Soliman Y, Amin AM, Sayed AK, 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*. 2024 Jan; 39(1):57-84.
14. Yuniar I, Sihotang J, Suriadi R, June D. The correlation of fluid creep with fluid and electrolyte imbalance in pediatric intensive care unit Dr. Cipto Mangunkusumo National Central Public Hospital. *Turk Arch Pediatr*. 2024 Jul; 59(4):353-357.
15. Feld LG, Neuspiel DR, Foster BA, Leu MG, Garber MD, Austin K, et al. Clinical practice guideline: maintenance intravenous fluids in children. *Pediatrics*. 2018 Dec; 142(6):e20183083.
16. Fuhrman D, Crowley K, Vetterly C, Hoshitsuki K, Koval A, Carcillo J. Medication use as a contributor to fluid overload in the PICU: a prospective observational study. *J Pediatr Intensive Care*. 2018 Jun; 7(2):69-74.
17. Lintz VC, Vieira RA, Carioca FL, Ferraz IS, Silva HM, Ventura AMC, et al. Fluid accumulation in critically ill children: a systematic review and meta-analysis. *EClinicalMedicine*. 2024 Jul 3; 74:102714. doi: 10.1016/j.eclinm.2024.102714. PMID: 39070177; PMCID: PMC11278930.
18. Carioca FL, de Souza FM, de Souza TB, Rubio AJ, Brandão MB, de Souza FM, et al. Point-of-care ultrasonography to predict fluid responsiveness in children: a systematic review and meta-analysis. *Pediatr Anaesth*. 2023 Jan; 33(1):24-37.
19. Malbrain MLNG, Marik PE, Witters I, Cordemans C, Kirkpatrick AW, Roberts DJ, et al. Principles of fluid management and stewardship in septic shock: it is time to consider the four D's and the four phases of fluid therapy. *Ann Intensive Care*. 2018 May 22; 8(1):66.
20. Gripp KE, Trottier ED, Thakore S, Sniderman J, Lawrence S. Current recommendations for management of pediatric diabetic ketoacidosis. *Pediatr Child Health*. 2023 May 4; 28(2):128-138.
21. Basavaraja GV, editor. IAP national treatment guidelines. Scalds and burns 1st ed. New Delhi: Jaypee Brothers Medical Publishers; 2026; pp105-111.
22. Diaz F, Riderelli J, Jabornisky R. Pediatric fluid resuscitation: an oxymoron? *Front Pediatr*. 2025 Jun 10; 13:1594336. doi: 10.3389/fped.2025.1594336. PMID: 40557258; PMCID: PMC12185475.