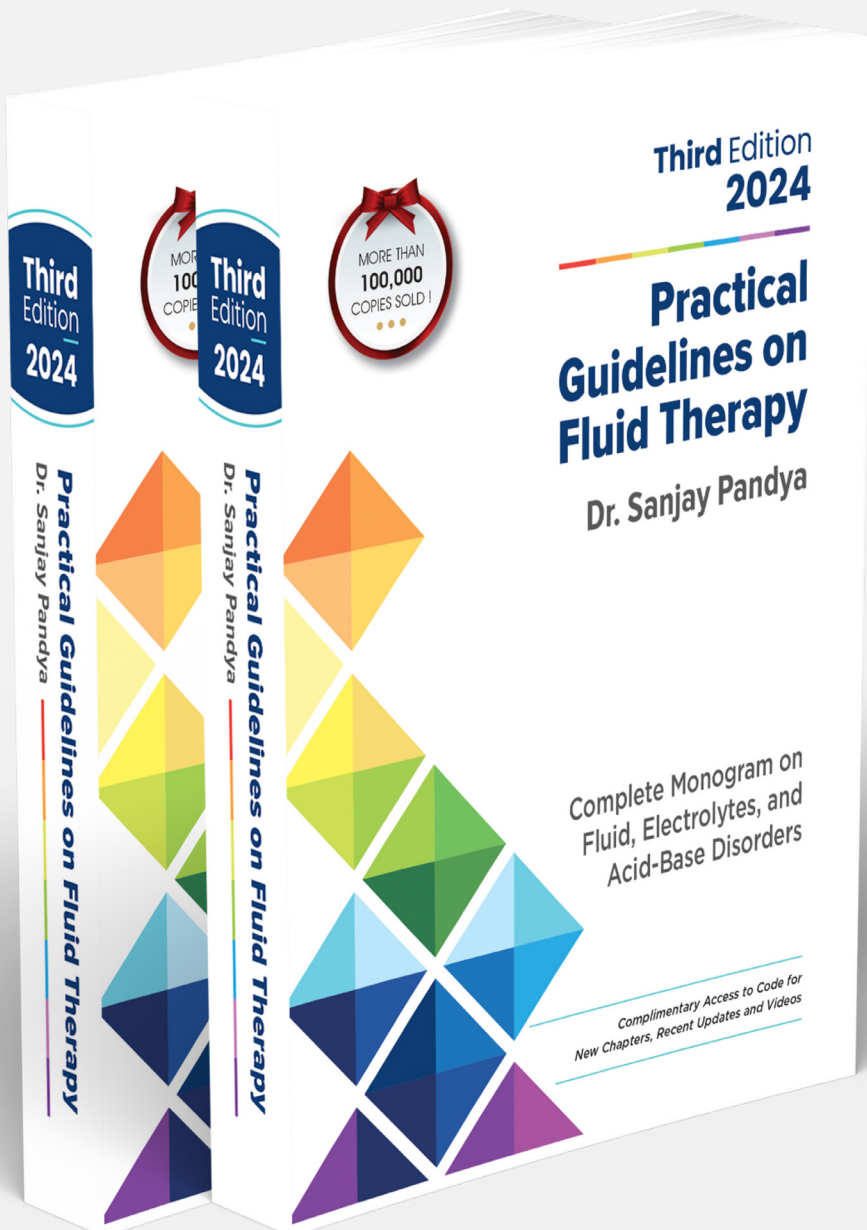




Fluid
therapy.org

Chapter 49:

Replacement Fluid Therapy and its
Monitoring in Children



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

49

Replacement Fluid Therapy and its Monitoring in Children

Assessment of the Severity of Dehydration.....	587	Treatment Based on the Causes	595
Laboratory Assessment.....	588	Diarrhea.....	595
Treatment Based on Type of Dehydration.....	589	Vomiting.....	598
Isonatremic or isotonic dehydration .	590	Diabetic ketoacidosis.....	600
Hyponatremic or hypotonic dehydration.....	592	Monitoring.....	601
Hypernatremic or hypertonic dehydration.....	593	Physical examination and vital signs	601
		Fluid balance and weight chart.....	602
		Laboratory tests.....	602

Replacement fluid therapy represents the third crucial pillar in comprehensive fluid management for children, complementing fluid resuscitation and maintenance strategies. IV fluids replacement aims to replenish preexisting deficits (fluids lost before treatment) and address ongoing losses, such as gastrointestinal issues due to vomiting and diarrhea, by administering the appropriate solutions to correct fluid, electrolyte, and acid-base disorders.

The five crucial steps to planning optimal and effective replacement fluid therapy in children are as follows:

1. Severity assessment: Assess the severity of dehydration, which can be categorized as mild, moderate, or severe.
2. Laboratory assessment: Utilize labo-

ratory tests to evaluate dehydration in children.

3. Establish the type of dehydration: Determine the type of dehydration based on sodium concentration, specifically identifying if it is hyponatremic, isotatremic, or hypernatremic. Plan treatment based on this differentiation.
4. Identifying the underlying cause: Identify the etiology of fluid loss, such as diarrhea, vomiting, diabetic ketoacidosis, etc., and individualize treatment based on it.
5. Monitoring: Close clinical assessments, periodic laboratory tests, strict measurement of urine volume, and maintaining a daily weight chart help to assess the child's response to therapy, facilitating necessary adjustments based on their condition.

ASSESSMENT OF THE SEVERITY OF DEHYDRATION

The first step in replacement fluid management is to assess the severity of dehydration, which helps to decide both the urgency of intervention and the

volume of fluid necessary for effective rehydration.

Determining the extent of dehydration involves three assessment steps: Asking specific questions, looking at visible signs, and physical examinations, as summarized in Table 49.1.

Want to read more?

[Get Printed Version](#)[Get Kindle Version](#)

REFERENCES

1. Gorelick MH, Shaw KN, Murphy KO. Validity and reliability of clinical signs in the diagnosis of dehydration in children. *Pediatrics*. 1997;99(5):E6.
2. National Collaborating Centre for Women's and Children's Health (UK). Diarrhoea and Vomiting Caused by Gastroenteritis: Diagnosis, Assessment and Management in Children Younger than 5 Years. London: RCOG Press; 2009 Apr. (NICE Clinical Guidelines, No. 84.) 5, Fluid management. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK63837/>.
3. Chakravarthi GK, Kumar P. Study on incidences of electrolyte disorders among children with dehydration. *Int J Pediatr Res*. 2019;6(7):352–358.
4. Hoxha TF, Azemi M, Avdiu M, et al. The usefulness of clinical and laboratory parameters for predicting severity of dehydration in children with acute gastroenteritis. *Med Arch* 2014;68(5):304–7.
5. Can YY, Taşar MA, Gökçeoğlu AU. Are the Clinical Evaluation Scales and Laboratory Tests Adequate in Determining Dehydration Degree in Acute Diarrhea? *J Pediatr Emerg Intensive Care Med* 2022;9:85–93.
6. Shankar P, Mahamud S, Aara A. Study of electrolyte disturbances and renal parameters in acute gastroenteritis under 5 years of age in a tertiary care hospital of Bengaluru, India. *Int J Contemp Pediatr*. 2020;7(9):1910–1917.
7. Rashid N, Sadia G, Noor F. Frequency and Outcome of Sodium Imbalance in Dehydrated Children Presenting with Acute Watery Diarrhea PJMHS 2022;14(1):341–343.
8. 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>.
9. Van de Voorde P, Turner NM, Djakow J, et al. European resuscitation council guidelines 2021: paediatric life support. *Resuscitation*. 2021;161:327–387.
10. 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.
11. 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.
12. Powers KS. Dehydration: Isonatremic, Hyponatremic, and Hypernatremic Recognition and Management. *Pediatr Rev*. 2015;36(7):274–85.
13. Baek SH, Jo YH, Ahn S, et al. Risk of Overcorrection in Rapid Intermittent Bolus vs Slow Continuous Infusion Therapies of Hypertonic Saline for Patients With Symptomatic Hyponatremia: The SALSA Randomized Clinical Trial. *JAMA Intern Med*. 2021;181(1):81–92.
14. World Health Organization. The treatment of diarrhoea: a manual for physicians and other senior health

- workers, 4th rev. World Health Organization. 2005. <https://apps.who.int/iris/handle/10665/43209>.
15. Friedman JN, Goldman RD, Srivastava R, et al. Development of a clinical dehydration scale for use in children between 1 and 36 months of age. *J Pediatr*. 2004;145(2):201–7.
 16. Hoxha T, Xhelili L, Azemi M, et al. Comparing the Accuracy of the Three Dehydration Scales in Children with Acute Diarrhea in a Developing Country of Kosovo. *Mater Sociomed*. 2015;27(3):140–3.
 17. Mahajan V, Sajan SS, Sharma A, et al. Ringers lactate vs normal saline for children with acute diarrhea and severe dehydration- A double blind randomized controlled trial. *Indian Pediatr* 2012;49(12):963–968.
 18. Kartha GB, Rameshkumar R, Mahadevan S. Randomized double-blind trial of Ringer Lactate versus normal saline in pediatric acute severe diarrheal dehydration. *J Pediatr Gastroenterol Nutr* 2017;65(6):621–626.
 19. Florez ID, Sierra J, Pérez-Gaxiola G. Balanced crystalloid solutions versus 0.9% saline for treating acute diarrhoea and severe dehydration in children. *Cochrane Database Syst Rev* 2023;5(5):CD013640.
 20. Naseem M, Dubey AP, Mishra TK, et al. Effect of Rehydration with Normal Saline versus Ringer Lactate on Serum Sodium Level of Children with Acute Diarrhea and Severe Dehydration: A Randomized Controlled Trial. *Indian Pediatr*. 2020;57(6):519–522.
 21. Cherukuri N, Wadhwa SP. Acute Watery Diarrhea. In: Standard Treatment Guidelines. Indian Academy of Pediatrics (IAP); 2022. Available from: <https://iapindia.org/pdf/Ch-020-STG-Acute-Watery-Diarrhea.pdf>.
 22. Houston KA, Gibb JG, Maitland K. Oral rehydration of malnourished children with diarrhoea and dehydration: A systematic review. *Wellcome Open Res*. 2017;2:66.
 23. Breaux CW Jr, Hood JS, Georgeson KE. The significance of alkalosis and hypochloremia in hypertrophic pyloric stenosis. *J Pediatr Surg*. 1989;24(12):1250–2.
 24. Schmitt Pediatric Guidelines LLC. Vomiting without diarrhea. Seattle Children's. Reviewed September 8, 2023. Available from: <https://www.seattlechildrens.org/conditions/a-z/vomiting-without-diarrhea/>.
 25. American Academy of Pediatrics, Provisional Committee on Quality Improvement, Subcommittee on Acute Gastroenteritis. Practice parameter: the management of acute gastroenteritis in young children. *Pediatrics*. 1996;97(3):424–435.
 26. King CK, Glass R, Bresee JS, et al. Managing acute gastroenteritis among children: oral rehydration, maintenance, and nutritional therapy. *MMWR Recomm Rep*. 2003;52(RR-16):1–16.
 27. Tieder JS, Robertson A, Garrison MM. Pediatric hospital adherence to the standard of care for acute gastroenteritis. *Pediatrics*. 2009;124(6):e1081–e1087.
 28. Cheng A. Emergency department use of oral ondansetron for acute gastroenteritis-related vomiting in infants and children. *Paediatr Child Health*. 2011;16(3):177–182.
 29. Freedman SB, Adler M, Seshadri R, et al. Oral ondansetron for gastroenteritis in a pediatric emergency department. *N Engl J Med*. 2006;354(16):1698–1705.
 30. Hayes W. Ab-normal saline in abnormal kidney function: risks and alternatives. *Pediatr Nephrol*. 2019;34(7):1191–1199.
 31. Duck SC, Wyatt DT. Factors associated with brain herniation in the treatment of diabetic ketoacidosis. *J Pediatr*. 1988;113(1 Pt 1):10–4.
 32. Kuppermann N, Ghetti S, Schunk JE, et al. PECARN DKA FLUID Study Group. Clinical Trial of Fluid Infusion Rates for Pediatric Diabetic Ketoacidosis. *N Engl J Med*. 2018;378(24):2275–2287.
 33. Othman MI, Nashwan AJ, Alfayoumi M, et al. PlasmaLyte-148 Versus Normal Saline 0.9% in Diabetic Ketoacidosis Management: A Review. *Cureus*. 2023;15(6):e41079.
 34. Li H, Sun SR, Yap JQ, et al. 0.9% saline is neither normal nor physiological. *J Zhejiang Univ Sci B*. 2016;17(3):181–7.
 35. Reddy S, Weinberg L, Young P. Crystalloid fluid therapy. *Crit Care*. 2016;20:59.
 36. Goad NT, Bakhr RN, Pirkle JL, et al: Association of hyperchloremia with unfavorable clinical outcomes in adults with diabetic ketoacidosis. *J Intensive Care Med* 2019;35(11):1307–1313.
 37. Oliver WD, Willis GC, Hines MC, et al. Comparison of PlasmaLyte A and Sodium Chloride 0.9% for Fluid Resuscitation of Patients With Diabetic Ketoacidosis. *Hosp Pharm* 2018;53(5):326–330.
 38. Alghamdi NA, Major P, Chaudhuri D, et al. Saline Compared to Balanced Crystalloid in Patients With Diabetic Ketoacidosis: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Crit Care Explor*. 2022;4(1):e0613.
 39. Bergmann KR, Abuzzahab MJ, Nowak J, et al. Resuscitation with Ringer's lactate compared with normal saline for pediatric diabetic ketoacidosis. *Pediatr Emerg Care* 2021;37(5):e236–e242.
 40. Catahay JA, Polintan ET, Casimiro M, et al. Balanced electrolyte solutions versus isotonic saline in adult patients with diabetic ketoacidosis: A systematic review and meta-analysis. *Heart Lung*. 2022;54:74–79.
 41. Jahangir A, Jahangir A, Siddiqui FS, et al. Normal Saline Versus Low Chloride Solutions in Treatment of Diabetic Ketoacidosis: A Systematic Review of Clinical Trials. *Cureus*. 2022;14(1):e21324.
 42. Gripp KE, Trotter ED, Thakore S, et al. Current recommendations for management of paediatric diabetic ketoacidosis. *Paediatr Child Health*. 2023;28(2):128–138.
 43. Tamzil R, Yaacob N, Noor NM, et al. Comparing the clinical effects of balanced electrolyte solutions versus normal saline in managing diabetic ketoacidosis: A systematic review and meta-analyses. *Turk J Emerg Med* 2023;23(3):131–138.
 44. Chua HR, Venkatesh B, Stachowski E, et al. PlasmaLyte 148 vs 0.9% saline for fluid resuscitation in diabetic ketoacidosis. *J Crit Care* 2012;27(2):138–45.

-
45. Van Zyl D, Rheeder P, Delpont E. Fluid management in diabetic-acidosis Ringer's lactate versus normal saline: a randomized controlled trial. *QJM*. 2012;105(4):337–343.
 46. Self WH, Semler MW, Wanderer JP, et al. Balanced Crystalloids versus Saline in Noncritically Ill Adults. *N Engl J Med* 2018;378(9):819–828.
 47. Ramanan M, Attokaran A, Murray L, et al. Sodium chloride or PlasmaLyte-148 evaluation in severe diabetic ketoacidosis (SCOPE-DKA): a cluster, crossover, randomized, controlled trial. *Intensive Care Med*. 2021;47(11):1248–1257.
 48. 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.
 49. 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.
 50. JBDS. JBDS-IP Joint British Diabetes Societies Inpatient Care Group. The Management of Diabetic Ketoacidosis in Adults, March 2023 Update: JBDS Guidelines [Internet]. London: ABCD; 2023 Mar. Available from: https://abcd.care/sites/abcd.care/files/site_uploads/JBDS_Guidelines_Current/JBDS_02_DKA_Guideline_with_QR_code_March_2023.pdf.
 51. BSPED Guideline for the Management of Children and Young People under the age of 18 years with Diabetic Ketoacidosis - 2021 [Internet]. British Society for Paediatric Endocrinology and Diabetes; 2021. Available from: <https://www.bsped.org.uk/clinical-resources/bsped-dka-guidelines/>.
 52. Williams V, Jayashree M, Nallasamy K, et al. 0.9% saline versus PlasmaLyte as initial fluid in children with diabetic ketoacidosis (SPinK trial): a double-blind randomized controlled trial. *Crit Care* 2020;24(1):1.
 53. Yan JW, Slim A, Van Aarsen K, et al. Balanced crystalloids (Ringer's lactate) versus normal Saline in adults with diabetic Ketoacidosis in the Emergency Department (BRISK-ED): a protocol for a pilot randomized controlled trial. *Pilot Feasibility Stud*. 2023;9(1):121.
 54. Meyers RS. Pediatric fluid and electrolyte therapy. *J Pediatr Pharmacol Ther*. 2009;14(4):204–11.
 55. Feld LG, Neuspiel DR, Foster BA, et al. Clinical practice guideline: maintenance intravenous fluids in children. *Pediatrics* 2018;142(6):e20183083.

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.