INDIAN JOURNAL OF PRACTICAL PEDIATRICS

IJPP

- **IJPP is a quarterly subscription journal of the Indian Academy of Pediatrics committed to presenting practical pediatric issues and management updates in a simple and clear manner**
- **Indexed in Scopus, CABI Publishing and EMCare.**

Vol.28 No.1 (JAN.- MAR.) 2026

CONTENTS

Journal Office and address for communications: Dr. G.Durai Arasan, Editor-in-Chief, Indian Journal of Practical Pediatrics, 1A, Block II, Krsna Apartments, 50, Thamizh Salai (Halls Road), Egmore, Chennai - 600 008. Tamil Nadu, India. Tel.No. : 044-28190032 E.mail : ijpp_iap@rediffmail.com

Published by Dr. G.Durai Arasan, Editor-in-Chief, IJPP, on behalf of Indian Academy of Pediatrics, from 1A, Block II, Krsna Apartments, 50, Thamizh Salai (Halls Road), Egmore, Chennai - 600 008. Tamil Nadu, India and Printed by Mr. D.Ramanathan, at Alamu Printing Works, 9, Iyyah Street, Royapettah, Chennai - 600 014.

IAP - IJPP CME 2025

PRETERM AND LOW BIRTH WEIGHT CARE - EVIDENCE BASED PRACTICES

***Sindhu Sivanandan**

Abstract: *Preterm and low-birth-weight babies are at higher risk of neonatal morbidity and mortality, particularly in low and middle-income countries. Evidence-based, low-cost, and scalable interventions that can be implemented across all levels of newborn care are essential to improve survival and long-term outcomes. This article shall review evidence-based recommendations issued by World Health Organization on kangaroo mother care, feeding practices, supplementation, probiotics and supportive skin care for this vulnerable population.*

Keywords: *Preterm, Kangaroo mother care, Nutrition, Survival, Feeding practices.*

Points to Remember

- ***Immediate initiation of kangaroo mother care should be routinely provided to all preterm and LBW infants, as it significantly improves survival.***
- ***Mother's own milk is the preferred feed and donor human milk is recommended as the first-line alternative if mother's milk is unavailable.***
- ***Scheduled feeding is appropriate for very preterm infants in facilities; responsive feeding after discharge.***
- ***Early initiation and faster advancement of enteral feeding are safe and beneficial.***
- ***Exclusive breastfeeding until six months is strongly recommended. Complementary feeds should not be initiated before 6 months of age in preterm infants.***
- ***Targeted supplementation addresses micronutrient deficiencies; routine multivitamins are not recommended.***
- ***Probiotics may be considered for selected very preterm infants.***
- ***Gentle emollient therapy may support skin integrity as part of supportive care***.

References

1. Ohuma EO, Moller AB, Bradley E, Chakwera S, Hussain-Alkhateeb L, Lewin A et al. National, regional and global estimates of preterm birth in 2020, with trends from 2010: a systematic analysis. Lancet. 2023; 402(10409):1261-1271. doi: 10.1016/S0140-6736(23)00878-4.
2. World Health Organization. WHO recommendations for care of the preterm or low-birth-weight infant. Geneva: WHO; 2023.https://www.who.int/publications/i/item/9789240058262. Last accessed Jan 1, 2026.
3. Conde-Agudelo A, Díaz-Rossello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. Cochrane Database Syst Rev. 2016;8:CD002771.
4. Sivanandan S, Sankar MJ. Kangaroo mother care for preterm or low birth weight infants: a systematic review and meta-analysis. BMJ Glob Health. 2023 Jun;8(6):e010728

* Chief Neonatologist,
Kauvery Hospital,
Chennai.
email : drsindhusivanandan@gmail.com

Cite as: Sindhu Sivanandan, Preterm and low birth weight care - Evidence based practices, Indian J Pract Pediatr. 2026; 28(1):5-10.

5. WHO Immediate KMC Study Group; Arya S, Naburi H, Kawaza K, Newton S, Anyabolu CH, Bergman N, et al. Immediate "kangaroo mother care" and survival of infants with low birth weight. N Engl J Med. 2021; 384 (21):2028-2038.
6. Chellani H, Mittal P, Arya S. Mother-neonatal intensive care unit (M-NICU): a novel concept in newborn care. Indian Pediatr. 2018; 55(12):1035-1036. doi:10.1007/s13312-018-1436-8.
7. Taylor SN, Buck CO. Post-discharge nutrition to optimize preterm infant short- and long-term outcomes. Semin Fetal Neonatal Med. 2025; 30(2):101637. doi:10.1016/j.siny.2025.101637.
8. Quigley M, Embleton ND, Meader N, McGuire W. Donor human milk for preventing necrotising enterocolitis in very preterm or very low-birthweight infants. Cochrane Database Syst Rev. 2024; 9(9): CD002971. doi:10.1002/14651858.CD002971.pub6.
9. Brown JV, Lin L, Embleton ND, Harding JE, McGuire W. Multi-nutrient fortification of human milk for preterm infants. Cochrane Database Syst Rev. 2020; 6(6): CD000343. doi:10.1002 14651858. CD000343. pub4.
10. Chinnappan A, Sharma A, Agarwal R, Thukral A, Deorari A, Sankar MJ. Fortification of breast milk with preterm formula powder vs human milk fortifier in preterm neonates: a randomized noninferiority trial. JAMA Pediatr. 2021; 175(8):790-796. doi:10.1001/jamapediatrics.2021.0678.
11. Yang WC, Fogel A, Lauria ME, Ferguson K, Smith ER. Fast feed advancement for preterm and low birth weight infants: a systematic review and meta-analysis. Pediatrics. 2022; 150(Suppl 1):e2022057092G. doi:10.1542/peds.2022-057092G.
12. Manapurath RM, Gadapani Pathak B, Sinha B, Upadhyay RP, Choudhary TS, Chandola TR, et al. Enteral iron supplementation in preterm or low birth weight infants: a systematic review and meta-analysis. Pediatrics. 2022; 150 (Suppl 1):e2022057092I. doi:10.1542/peds.2022-057092I.
13. Kumar M, Shaikh S, Sinha B, Upadhyay RP, Choudhary TS, Chandola TR, et al. Enteral vitamin D supplementation in preterm or low birth weight infants: a systematic review and meta-analysis. Pediatrics. 2022; 150(Suppl 1):e2022057092K. doi:10.1542/peds.2022-057092K.
14. Embleton ND, Moltu SJ, Lapillonne A, van den Akker CHP, Carnielli V, Fusch C, et al. Enteral nutrition in preterm infants (2022): a position paper from the ESPGHAN Committee on Nutrition and invited experts. J Pediatr Gastroenterol Nutr. 2023; 76(2):248-268. doi:10.1097/MPG.0000000000003642.
15. Sharif S, Meader N, Oddie SJ, Rojas-Reyes MX, McGuire W. Probiotics to prevent necrotising enterocolitis in very preterm or very low birth weight infants. Cochrane Database Syst Rev. 2020; (10): CD005496.
16. Cleminson J, McGuire W. Topical emollient for preventing infection in preterm infants. Cochrane Database Syst Rev. 2021; 5(5):CD001150. doi:10.1002/14651858. CD001150.pub4.

IAP - IJPP CME 2025

MANAGEMENT OF CHILDHOOD OBESITY

***Dhivyalakshmi J**

Abstract: *Childhood obesity is a chronic, multi-faceted disease driven by a complex interplay of genetic, environmental and socio-economic factors. This review highlights the rising global prevalence and the socio-economic impact associated with childhood obesity. Diagnosis of childhood obesity requires use of accurate anthropometry and age / gender appropriate growth charts. Obesity triggers complications almost in every organ system, especially cardiovascular and metabolic health. Management necessitates a multi-disciplinary approach including lifestyle interventions, advanced pharmacotherapy like glucagon-like peptide-1 receptor agonists, and bariatric surgery for severe cases.*

Keywords: *Childhood obesity, Metabolic complications, Anti-obesity medications, Multidisciplinary management*

* Associate Professor and
Consultant Pediatric Endocrinologist,
Division of Pediatric Endocrinology,
Department of Pediatrics,
Sri Ramachandra Medical College and
Research Institute,
Chennai.

email : laksdhivya@gmail.com

Points to Remember

- ***Defining obesity requires context-specific measures using standard measurements and age, gender appropriate charts.***
- ***The prevalence of childhood obesity continues to rise globally ; most concerning is under five obesity and the increasing prevalence of obesity among rural children.***
- ***The etiology of childhood obesity is a complex, multifactorial web involving genetic, environmental, behavioral and socio-cultural influences.***
- ***Obesity impacts nearly every organ system - proactive screening is required to identify complications / co-morbidities, endocrine and genetic evaluation is to be reserved only for selected cases.***
- ***Management requires a multi-tiered approach - involving multi-disciplinary team focusing on lifestyle modification, with pharmacological, and sometimes surgical interventions when indicated.***
- ***Prevention remains the most effective tool, focusing on the first 1,000 days of life and adherence to the "5-2-1-0" rule.***

References

1. World Obesity Federation. India - Obesity prevalence and country data [Internet]. London: World Obesity Federation; 2024 [updated 2024; cited 2026 Feb 28]. Available from: https://data.worldobesity.org/country/india-95/#data_prevalence
2. Ministry of Health and Family Welfare (India). National Family Health Survey-5 (NFHS-5), Phase-II: India and 14 States/UTs – Key Indicators Fact Sheets [Internet]. New Delhi: Ministry of Health and Family Welfare (Government of India); 2021 [updated 2021 Nov 24; cited 2026 Feb 28]. Available from: https://mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf
3. World Health Organization. Body mass index-for-age (BMI-for-age) - WHO Child Growth Standards [Internet]. Geneva: World Health Organization; 2006 [updated 2024; cited 2026 Feb 28]. Available from:

Cite as: Dhivyalakshmi J, Management of childhood obesity, Indian J Pract Pediatr. 2026; 28(1):11-17.

https://www.who.int/toolkits/child-growth-standards/standards/body-mass-index-for-age-bmi-for-age

4. Indian Academy of Pediatrics Growth Charts Committee. Revised IAP growth charts for height, weight and body mass index for 5- to 18-year-old Indian children. Indian Pediatr. 2015; 52(1):47-55.
5. Zimmet P, Alberti KG, Kaufman F, Tajima N, Silink M, Arslanian S, Wong G, Bennett P, Shaw J, Caprio S; IDF Consensus Group. The metabolic syndrome in children and adolescents - an IDF consensus report. Pediatr Diabetes. 2007 Oct;8(5):299-306. doi: 10.1111/j.1399-5448.2007.00271.x. PMID: 17850473
6. Khadilkar A, Ekbote V, Chiplonkar S, Khadilkar V, Kajale N, Kulkarni S, Parthasarathy L, Arya A, Bhattacharya A, Agarwal S. Waist circumference percentiles in 2-18 year old Indian children. J Pediatr. 2014 Jun;164(6):1358-62.e2.
7. Khadilkar V, Shah N, Harish R, Ayyavoo A, Bang A, Basu S, et al. Indian academy of pediatrics revised guidelines on evaluation, prevention and management of childhood obesity. Indian Pediatr 2023; 60:1013-31.
8. Han JC, Weiss R. Obesity, metabolic syndrome and disorders of energy balance. In: Sperling MA, Majzoub JA, Menon RK, Stratakis CA, editors. Sperling pediatric endocrinology. 5th ed. Philadelphia: Elsevier, 2021; pp939-1003.
9. Hawton K, Shirodkar D, Siese T, Julian JP, Shield JPH. A recent update on childhood obesity: aetiology, treatment and complications. J Pediatr Endocrinol Metab. 2025 Mar 20; 38(5):429-441. doi: 10.1515/jpem-2024-0316.
10. Dennis M. Styne, Silva A. Arslanian, Ellen L. Connor, Ismaa Sadaf Farooqi, M. Hassan Murad, Janet H. Silverstein, Jack A. Yanovski, Pediatric Obesity-Assessment, Treatment, and Prevention: An Endocrine Society Clinical Practice Guideline, J Clin Endocrinol Metab 2017; 102(3):709-757. https://doi.org/10.1210/jc.2016-2573.
11. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents; National Heart, Lung and Blood Institute. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. Pediatrics. 2011; 128 Suppl 5(Suppl 5):S213-S256. doi:10.1542/peds.2009-2107C
12. American Academy of Pediatrics. 5210 Pediatric Obesity Clinical Decision Support Chart [Internet]. 2nd ed. Itasca (IL): American Academy of Pediatrics; 2014 [updated 2014; cited 2026 Feb 28]. Available from: https://doi.org/10.1542/9781581108941.

IAP - IJPP CME 2025

ALLERGIC RHINITIS

***Prasanna R**

Abstract: *Allergic rhinitis is an inflammatory disorder of the nasal mucosa characterized by sneezing, itching, rhinorrhea, and nasal congestion, resulting from immunoglobulin E-mediated responses to environmental allergens. Genetic susceptibility and environmental exposures contribute to disease pathogenesis through a T-helper-2-driven inflammatory cascade. Allergic rhinitis commonly coexists with asthma and other atopic conditions, supporting the unified "one airway, one disease" concept. Diagnosis is primarily clinical, supported by allergy testing when required. Intranasal corticosteroids remain the most effective therapy, while antihistamines, leukotriene receptor antagonists and allergen immunotherapy provide additional control and long-term disease modification.*

Keywords: *Allergic rhinitis, Intra nasal corticosteroids, Allergen immunotherapy.*

* Professor in Pediatrics,
SRM Medical College Hospital and Research Centre, Chennai.
email : prasannr@srmist.edu.in

Points to Remember

- ***Nasal congestion (cardinal symptom), sneezing, itching of nose and eyes and rhinorrhea with postnasal drip are the major symptoms.***
- ***Allergic salute, nasal crease, allergic gape, allergic shiners, Dennie Morgan lines and pale inferior turbinates with hypertrophy are the clinical features to look for.***
- ***Skin prick test (SPT) is the gold standard; specific serum IgE and component-resolved diagnostics (CRD) for molecular allergen components are adjuncts.***
- ***Intranasal corticosteroids (INCS) with or without intranasal antihistamines are the cornerstone of treatment. Long-term use of oral antihistamines and leukotriene receptor antagonists (LTRAs) should be avoided.***

References

1. Baab S, Le PH, Gurnani B, Kinzer EE. Allergic conjunctivitis. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan 26 [cited 2026 Feb 14]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK448118/
2. Bousquet J, Schünemann HJ, Togias A, Erhola M, Hellings PW, Zuberbier T, et al. Next-generation ARIA care pathways for rhinitis and asthma: a model for multimorbid chronic diseases. Clin Transl Allergy. 2019; 9:44. doi:10.1186/s13601-019-0298-x.
3. Chen T, Norbäck D, Deng Q, Huang C, Qian H, Zhang X, et al. Maternal exposure to PM BC during pregnancy predisposes children to allergic rhinitis which varies by regions and exclusive breastfeeding. Environ Int. 2022; 165:107315. doi:10.1016/j.envint.2022. 107315.
4. Ibanez MD, Valero AL, Montoro J, Jauregui I, Ferrer M, Davila I, et al. Analysis of comorbidities and therapeutic approach for allergic rhinitis in a pediatric population in Spain. Pediatr Allergy Immunol. 2013; 24(7):678-684.
5. Wallace DV, Dykewicz. Allergic rhinitis.In:Adkinson NF, Bochner BS, Busse WW, Holgate ST, Lemanske RF Jr, Simons FER, editors. Middleton's Allergy: Principles and

Cite as: Prasanna R, Allergic rhinitis, Indian J Pract Pediatr. 2026; 28(1):18-24.

Practice. 7th ed. Philadelphia (PA): Mosby Elsevier; 2009; p711-738.

6. Byeon H. The association between allergic rhinitis and otitis media: a nationally representative sample of South Korean children. Sci Rep. 2019; 9(1):1610. doi:10.1038/s41598-018-38369-7.
7. Baraniuk IN, Alim MA, Naranch K. Hypertonic saline nasal provocation and acoustic rhinometry. Clin Exp Allergy. 2002; 32(4):543-550.
8. Amin KAM. Allergic respiratory inflammation and remodeling. Turk Thorac J. 2015; 16(3):133-140.
9. Gupta N.Allergy testing In : Gupta N, Ashok N, Pandit GS, et al. A Handbook on Allergic Rhinitis. New Delhi (India): Jaypee Brothers Medical Publishers; 2025; p176-187.
10. Ansotegui IJ, Melioli G, Canonica GW, Caraballo L, Villa E, Ebisawa M, et al. IgE allergy diagnostics and other relevant tests in allergy: a World Allergy Organization position paper. World Allergy Organ J. 2020; 13(2):100080. Erratum in: World Allergy Organ J. 2021; 14(7):100557. doi:10.1016/j.waojou.2021. 100557.
11. Augé J, Vent J, Agache I, Airaksinen L, Campo P, Chaker A, et al. EAACI position paper on the standardization of nasal allergen challenges. Allergy. 2018; 73(8):1597-1608. doi:10.1111/all.13477.
12. Abdulla B, Latiff A. Pharmacological management of allergic rhinitis: a consensus statement from the Malaysian Society of Allergy and Immunology. J Asthma Allergy. 2022; 15:983-1003.

IAP - IJPP CME 2025

NUTRITIONAL ANEMIA

***Karthik Kumar**

Abstract: *Anemia is a major global health problem, affecting approximately one-fourth of the world's population. In India, nearly one-third to one-half of the children are affected by nutritional anemia. Iron deficiency is the most common cause, followed by vitamin B and folate deficiencies. Early screening is crucial for timely diagnosis and intervention, which can prevent long-term complications, including impaired growth and neurodevelopment. Prevention through dietary diversification, iron and micronutrient-rich foods, and national programs such as iron-plus initiative is crucial.*

Keywords: *Anemia, Iron deficiency, Cobalamin deficiency, Iron, B12, Folate.*

* Assistant Professor of Hematology,
Institute of Child Health and Hospital for Children,
Madras Medical College,
Chennai.
email: drkarthikkumar92@gmail.com

Points to Remember

- ***Screening, early diagnosis and patient-centred management are essential to prevent complications.***
- ***Choosing the optimal oral or parenteral iron preparation is critical for effective treatment.***
- ***Megaloblastic anemias are often under recognized; clinicians should maintain a high index of suspicion.***
- ***Consider genetic work-up for megaloblastic anemia if there is a positive family history of B12 deficiency, recurrent deficiency or early-onset seizures.***
- ***Clinical suspicion of B12 deficiency justifies a therapeutic trial to confirm diagnosis and initiate timely treatment.***

References

1. World Health Organization. Anaemia [Internet]. Geneva: World Health Organization; 2025 Feb 10 [cited 2026 Feb 22]. Available from: https://www.who.int/news-room/fact-sheets/detail/ANAEMIA
2. Sarna A, Porwal A, Ramesh S, Agrawal PK, Acharya R, Johnston R, et al. Characterisation of the types of anemia prevalent among children and adolescents aged 1-19 years in India: a population based study. Lancet Child Adolesc Health. 2020; 4(7):515-525.
3. Bhadra P, Deb A. A review on nutritional anemia. Indian J Nat Sci. 2020; 10(59):18466-18474.
4. Silva B, Faustino P. An overview of molecular basis of iron metabolism regulation and the associated pathologies. Biochim Biophys Acta Mol Basis Dis. 2015; 1852(7):1347-1359.
5. Adamson JW. Iron deficiency and other hypoproliferative anemias. In: Loscalzo J, Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, editors. Harrison's principles of internal medicine. 21st ed. New York: McGraw-Hill Education; 2022; pp747-753.
6. Chaber R, Helwich E, Lauterbach R, Mastalerz-Migas A, Matysiak M, Peregud-Pogorzelski J, et al. Diagnosis and treatment of iron deficiency and iron deficiency anemia in children and adolescents: recommendations of the Polish Pediatric Society, the Polish Society of Pediatric Oncology and Hematology,

Cite as: Karthik Kumar, Nutritional anemia, Indian J Pract Pediatr. 2026; 28(1):25-30.

the Polish Society of Neonatology, and the Polish Society of Family Medicine. Nutrients. 2024; 16(21):3623.

7. Ebea-Ugwuanyi PO, Vidyasagar S, Connor JR, Frazer DM, Knutson MD, Collins JF. Oral iron therapy: current concepts and future prospects for improving efficacy and outcomes. Br J Haematol. 2024; 204(3): 759-773.
8. Cohen CT, Powers JM. Intravenous iron therapy in pediatrics: who should get it and when is the right time? Hematology Am Soc Hematol Educ Program. 2023; 2023(1):630-635.
9. Crary SE, Hall K, Buchanan GR. Intravenous iron sucrose for children with iron deficiency failing to respond to oral iron therapy. Pediatr Blood Cancer. 2011; 56(4):615-619.
10. Hoffbrand AV. Megaloblastic anemias. In: Loscalzo J, Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, editors. Harrison's principles of internal medicine. 21st ed. New York: McGraw-Hill Education; 2022; p766-775.
11. Devalia V, Hamilton MS, Molloy AM :British Committee for Standards in Haematology. Guidelines for the diagnosis and treatment of cobalamin and folate disorders. Br J Haematol. 2014; 166(4):496-513.
12. Langan RC, Goodbred AJ. Vitamin B12 deficiency: recognition and management. Am Fam Physician. 2017; 96(6):384-389.
13. Wang H, Li L, Qin L, Song Y, Alaball J, Liu T. Oral vitamin B12 versus intramuscular vitamin B12 for vitamin B12 deficiency. Medicine (Baltimore). 2018; 97(34):e11974.

IAP - IJPP CME 2025

SEIZURE MIMICS

***Shivan Kesavan**

Abstract: *Paroxysmal events in children are common and often mistaken for epileptic seizures, yet 20-40% of referrals to epilepsy clinics prove to be non-epileptic. These seizure mimics, or paroxysmal non-epileptic events, occur across all pediatric age groups and encompass physiologic neonatal movements, movement disorders, syncope, autonomic events, behavioral phenomena, sleep disorders, oculomotor abnormalities and metabolic disorders. Accurate recognition depends on detailed history, age specific patterns and observation of event semiology; often supplemented by care giver recorded videos. While many mimics are benign and self-limited, others such as glucose transporter type 1 deficiency or opsoclonus-myoclonus syndrome require prompt evaluation and targeted therapy. Awareness reduces misdiagnosis, unnecessary investigations, treatment and parental anxiety.*

Keywords: *Paroxysmal non-epileptic events, Seizure mimics, Pediatric paroxysmal disorders.*

Points to Remember

- ***Up to 40% of children referred for suspected seizures actually have nonepileptic paroxysmal events.***
- ***Mimics vary by age group, ranging from neonatal jitteriness and benign sleep myoclonus to adolescent syncope and psychogenic nonepileptic seizures.***
- ***Careful clinical history, recognition of age specific patterns and care giver recorded videos are more valuable than routine investigations.***
- ***Many mimics are benign and self limited, requiring reassurance, while others (e.g., GLUT1 deficiency, opsoclonus-myoclonus syndrome) demand prompt targeted therapy.***

References

1. Epilepsy imitators. Diagnostic manual. International League against epilepsy. From: http://www.epilepsydiagnosis.org/epilepsy-imitators.html. Accessed on Mar13th, 2026.
2. Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec; 50(12):100894. doi: 10.1016/j.cppeds.2020.100894.
3. Zhan FX, Wang SG, Cao L. Advances in hyperekplexia and other startle syndromes. Neurol Sci. 2021; 42(10):4095-4107.
4. Pisanò G, Gnazzo M, Sigona G, Cesaroni CA, Pantani A, Cavalli A, et al. Paroxysmal Dyskinesias in Pediatric Age: A Systematic Review. J Clin Med. 2025; 14(17):5925. doi: 10.3390/jcm14175925.

* Consultant Pediatric Neurologist,
Mehta's Multispeciality Hospitals India Pvt. Ltd.
Chennai.
email : shivankesavan@gmail.com

Cite as: Shivan Kesavan, Seizure mimics, Indian J Pract Pediatr. 2026; 28(1):31-34.

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

Cite as: Poovazhagi V, Rational fluid therapy in children, Indian J Pract Pediatr. 2026; 28(1):35-40.

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.

IAP - IJPP CME 2025

INBORN ERRORS OF IMMUNITY IN CLINICAL PRACTICE - A PATTERN BASED PRACTICAL APPROACH

***Sarath Balaji B**

Abstract: *Inborn errors of immunity, formerly known as primary immunodeficiency disorders, comprise over 550 genetically defined conditions characterized by immune dysregulation including autoimmunity leading to susceptibility to infection, autoinflammation, lymphoproliferation, and malignancy. Early recognition relies primarily on clinical suspicion and pattern recognition rather than advanced molecular diagnostics. Severe, persistent, unusual, or recurrent infections, early-onset autoimmunity, unexplained cytopenias, chronic inflammation, and vaccine-related complications should prompt evaluation. Initial assessment with complete blood count, differential counts, and peripheral smear often provides key clues guiding immunoglobulin assays, lymphocyte subset analysis, neutrophil oxidative burst testing, complement evaluation, and genetic studies. A phenotype-driven, cell-based diagnostic approach facilitates early referral.*

Keywords: *Inborn errors of immunity, Primary immunodeficiency, Pattern recognition, Recurrent infections, Autoimmunity, Pediatric immunology.*

Points to Remember

- ***Inborn errors of immunity (IEI) are not uncommon among children admitted with severe, recurrent, unusual or persistent infections.***
- ***Non-infectious clues like autoimmunity, immune dysregulation and inflammatory patterns are increasingly recognized as IEI presentations.***
- ***Pattern recognition remains the cornerstone of early diagnosis.***
- ***Secondary causes, particularly HIV infection, must be excluded before labelling IEI.***
- ***A simple complete blood count (CBC) with differential often provides crucial clues to the immune cell involved and helps guide targeted immunological testing.***
- ***Early diagnosis alters outcomes - curative options such as hematopoietic stem cell transplantation and disease-modifying therapies including IVIG replacement and biologics are increasingly available.***
- ***In IEI, vaccine decisions must be individualized***

References

1. Tangye SG, Al-Herz W, Bousfiha A, Cunningham-Rundles C, Franco JL, et al. Human Inborn Errors of Immunity: 2022 Update on the Classification from the International Union of Immunological Societies Expert Committee. J Clin Immunol. 2022 Oct; 42(7):1473-1507.
2. Bousfiha A, Jeddane L, Picard C, Ailal F, Bobby Gaspar H, Al-Herz W, et al. The 2017 IUIS Phenotypic Classification for Primary Immunodeficiencies. J Clin Immunol. 2018; 38(1):129-143.
3. Modell V, Quinn J, Orange JS, Notarangelo LD, Modell F. Primary immunodeficiencies worldwide: an updated overview. J Clin Immunol. 2018; 38(1):129-143.
4. Bonilla FA, Khan DA, Ballas ZK, Chinen J, Frank MM, Hsu JT, et al. Practice parameter for the diagnosis and management of primary immunodeficiency. J Allergy Clin Immunol. 2015; 136(5):1186-1205.
5. Notarangelo LD. Primary immunodeficiencies. J Allergy Clin Immunol. 2010; 125 (2 Suppl 2):S182-S194.

* Associate Professor,
Department of Pediatrics,
Chengalpattu Medical College,
Chengalpattu, Tamil Nadu.
email: sarath1731@gmail.com

Cite as: Sarath Balaji B, Inborn errors of immunity in clinical practice - A pattern based practical approach, Indian J Pract Pediatr. 2026; 28(1):41-48.

IAP - IJPP CME 2025

COCHLEAR IMPLANTS IN CHILDREN - EXPANDING INDICATIONS AND THEIR CLINICAL IMPLICATION

***Raghu Nandhan S**
***Kiran Natarajan**
***Nikhil Kumar P**
***Mohan Kameswaran**

Abstract: *Congenital severe to profound sensorineural hearing loss is one of the most common sensory impairments in childhood, significantly affecting speech, language, cognitive development and quality of life. Cochlear implantation has emerged as the safest and most effective option for hearing restoration in such children. Early identification through universal newborn hearing screening is vital as it enables timely diagnosis and intervention. Advances in screening tools have today expanded eligibility criteria for early implantation. Recent advances in biomedical engineering have improved implantation strategies. Further, comprehensive structured auditory verbal habilitation program has resulted in optimal speech and language development, when performed during the critical period of neural plasticity which is ideally less than 6 years of age. Thus, early and appropriate intervention remains the cornerstone for successful establishment of hearing.*

Keywords: *Cochlear implants, Universal newborn hearing screening, Early intervention, Auditory verbal habilitation.*

* Consultant ENT Surgeon,
Department of Neuro-Otology and Auditory Implantation,
Madras ENT Research Foundation, Chennai .
email: raghunandhansampath@gmail.com

Points to Remember

- ***Congenital sensorineural hearing loss is a major yet remediable childhood disability.***
- ***Cochlear implants bypass the damaged cochlear hair cells and directly stimulate the auditory nerve, making them the most effective treatment for severe to profound sensorineural hearing loss.***
- ***Early cochlear implantation during the period of auditory neural plasticity (preferably between 1 to 6 years of age) results in superior speech and language outcomes.***
- ***The joint committee on infant hearing, 1-3-6 guideline-screening by 1 month, diagnosis by 3 months and intervention by 6 months-remains the global standard for optimal intervention and auditory verbal habilitation.***
- ***Successful outcomes of cochlear implantation solely depend on a multidisciplinary approach.***
- ***Multi-centric government and NGO collaboratives to create widespread awareness with screening programs will pave the way forward.***

References

1. Ansari MS, Sood AS, Gill JS. National Infant Screening for Hearing Program in India: Necessity, Significance and Justification. Indian J Otolaryngol Head Neck Surg. 2022; 74(Suppl 3):6497-6512.
2. Raghu Nandhan, Mohan Kameswaran. Deafness Screening & Cochlear Implantation in the Indian Subcontinent - "The Hub & Spoke Model of Tamil Nadu". ENT UK Global Health Journal 2022; pg: 38-41, publishers- www.beamreachuk.co.uk, https://www.entuk.org/global-health-journals.
3. Vincenti V, Bacciu A, Guida M, Marra F, Bertoldi B, Bacciu S, et al. Pediatric cochlear implantation: an update. Ital J Pediatr. 2014; 40:72.
4. Elizabeth H. Toh, William M. Luxford. Cochlear and brainstem implantation. Otolaryngol Clin N Am. 2002; 35: 325-342.

Cite as: Raghu Nandhan S, Kiran Natarajan, Nikhil Kumar P, Mohan Kameswaran. Cochlear implants in children - Expanding indication and their clinical implications, Indian J Pract Pediatr. 2026; 28(1):49-54.

5. Naik AN, Varadarajan VV, Malhotra PS. Early pediatric Cochlear implantation: An update. Laryngoscope Investig Otolaryngol. 2021; 6(3):512-521.
6. Sharma A, Campbell J, Cardon G. Developmental and cross-modal plasticity in deafness: evidence from the P1 and N1 event related potentials in cochlear-implanted children. Int J Psychophysiol. 2015; 95(2):135-144.
7. Joint Committee on Infant Hearing. Year 2019 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs. J. early hear. detect. interv. 2019; 4(2):1-44
8. Dang JC, Hsu NM. Hearing Loss Screening Guidelines. 2023 Nov 5. In: Stat Pearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. PMID: 37983360.
9. Heman-Ackah SE, Roland JT Jr, Haynes DS, Waltzman SB. Pediatric cochlear implantation: candidacy evaluation, medical and surgical considerations, and expanding criteria. Otolaryngol Clin North Am. 2012; 45(1):41-67.
10. Balkany TJ, Hodges A, Miyamoto RT, Gibbin K, Odabasi O. Cochlear implants in children. Otolaryngol Clin North Am. 2001 Apr; 34(2):455-467. doi: 10.1016/s0030-6665(05)70342-x. PMID: 11382581.
11. Cejas I, Hoffman MF, Quittner AL. Outcomes and benefits of pediatric cochlear implantation in children with additional disabilities: a review and report of family influences on outcomes. Pediatr Health Med Ther. 2015; 6:45-63.
12. William M. Luxford. Surgery for Cochlear Implantation. Brackmann, Shelton, Arriaga, Otologic Surgery. 2001: 341-346.
13. Waltzman SB. Speech perception in children with cochlear implants. In: Niparko JK, editor. Cochlear implants: principles and practices. 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 2009; p201-216.
14. Cohen NL. Surgical techniques for cochlear implants. In: Waltzman SB, Cohen NL, editors. Cochlear implants. New York: Thieme; [2000]: pp155-163.
15. Niparko JK, Mertes JL. Cochlear implantation. In: Cummings CW, Flint PW, Haughey BH, Robbins KT, Schuller DE, Thomas JR, editors. Cummings otolaryngology: head and neck surgery. Vol 4. 4th ed. Philadelphia: Elsevier Mosby; 2005; p3650-3667.
16. Wu SS, Sbeih F, Anne S, Cohen MS, Schwartz S, Liu YC, et al. Auditory Outcomes in Children Who Undergo Cochlear Implantation Before 12 Months of Age: A Systematic Review. Otolaryngol Head Neck Surg. 2023; 169(2):210-220.
17. Colletti V, Carner M, Miorelli V, Guida M, Colletti L, Fiorino F. Auditory brainstem implant (ABI): new frontiers in adults and children. Otolaryngol Head Neck Surg. 2005; 133(1):126-138.

GENERAL ARTICLE

NEONATAL JAUNDICE : NEW THRESHOLDS, NEW TOOLS AND NEW MODELS OF CARE

***Mangalabharathi Sundaram**

Abstract: *Neonatal hyperbilirubinemia is a common problem even today. Bilirubin related brain injury still occurs, especially when early detection and follow-up fail. The American Academy of Pediatrics 2022 update changed routine practice by shifting to a treatment-threshold model and planning follow-up based on the distance from the phototherapy threshold (Δ-bilirubin), with week-specific gestational age curves and a defined escalation-of-care window. Several advances after 2022 are relevant for India, including updated risk framing for G6PD deficiency, better recognition of hemolysis beyond direct antiglobulin test alone, increasing use of rapid point-of-care confirmation and emerging family-centered, home-based phototherapy models. The practical message for Indian settings is that higher thresholds are safe only when objective screening, fast confirmation and dependable follow-up systems are in place.*

Keywords: *Hyperbilirubinemia, Neonatal jaundice, Phototherapy, Point-of-Care testing, Transcutaneous bilirubinometry, Smartphones.*

* Professor and Head,
Department of Neonatology,
Institute of Obstetrics and Gynecology (IOG),
Madras Medical College,
Chennai.
email : drmangalabharathi@gmail.com

Points to Remember

- ***The safest prevention strategies are simple:***
  - ***Measure bilirubin before discharge,***
  - ***Plan follow-up based on Δ-bilirubin,***
  - ***Confirm high/near-line values with blood testing,***
  - ***Deliver truly intensive phototherapy when indicated,***
  - ***Treat escalation as an emergency.***
- ***Higher thresholds do not mean relaxed care.***
- ***Smartphone tools to be treated as screening aids only, not for treatment decisions.***
- ***Home phototherapy: should be treated as a supervised care model, not just a device (needs selection, monitoring and escalation plan).***

References

1. Vidavalur R. Neonatal hyperbilirubinemia: past lessons, current practices, and future directions. Eur J Pediatr. 2025 Oct 2; 184(10):653.
2. Kemper AR, Newman TB, Slaughter JL, Maisels MJ, Watchko JF, Downs SM, et al. Clinical Practice Guideline Revision: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation. Pediatrics. 2022;150(3): e2022058859. doi: 10.1542/peds.2022-058859. PMID: 35927462.
3. Bhardwaj U, Kohli V, Thukral A. Management of Hyperbilirubinemia in Newborn Infants 35 or More Weeks of Gestation: American Academy of Pediatrics, 2022. Indian Pediatr. 2023 Jan;60(1):63-66.
4. Watchko JF, Bhutani VK. Revised World Health Organization (WHO) classification of G6PD gene variants: Relevance to neonatal hyperbilirubinemia. Semin Fetal Neonatal Med. 2025 Mar; 30(1):101619.
5. Parastatidou S, Tsantes AG, Emmanouil CC, Konstantinidi A, Kapetanaki A, Sokou R. Neonatal Hemolytic Jaundice: Causes, Diagnostic Approach, and Management. Children. 2025 May 23; 12(6):666.

Cite as: Mangalabharathi Sundaram, Neonatal jaundice : New thresholds, new tools and new models of care, Indian J Pract Pediatr. 2026; 28(1):55-60.

6. Kumar Krishnegowda V, Ramaswamy VV, Abiramalatha T, Bandyopadhyay T, S AKP, Kannan Loganathan P. Direct antiglobulin test for the prediction of neonatal hyperbilirubinemia needing an intervention: a systematic review and diagnostic test accuracy meta-analysis. Front Pediatr. 2025 Jan 28; 12:1475623.
7. Christensen RD, Bahr TM, Wong RJ, Vreman HJ, Bhutani VK, Stevenson DK. A "Gold Standard" Test for Diagnosing and Quantifying Hemolysis in Neonates and Infants. J Perinatol. 2023 Dec; 43(12):1541-1547.
8. Hegyi T. Unbound bilirubin: Aa call to reframe neonatal care and clinical decision-making. Pediatr Res. 2025 Dec 2. doi: 10.1038/s41390-025-04667-w. Epub ahead of print. PMID: 41331365
9. Arnold CC, Maric I, Wong RJ, Tyson JE, Stevenson DK. Unbound bilirubin and risk of severe neurodevelopmental impairment in extremely low birthweight newborns. Pediatr Res. 2025; 98(3):1066-1074.
10. Simões JF, Simão M, Rocha P, Ferreira S, da Câmara RP, Amaral D, et al. Severe neonatal hyperbilirubinemia in European and Indian subcontinent descendent newborns: Aa retrospective cohort study. Eur J Pediatr. 2025; 184(1):51. doi: 10.1007/s00431-024-05892-x. PMID: 39609276; PMCID: PMC11604767.
11. Kair LR, Phillipi CA, Wood KE. Long-Awaited AAP Hyperbilirubinemia Guidelines Have Arrived. Hosp Pediatr. 2022 Dec 1;12(12): e443-445.
12. Vidavalur R, Bhutani VK. Managing the Historic Burden of Kernicterus Mortality in India. Indian J Pediatr. 2024 Dec; 91(12):1262-1267.
13. Shaw SC, Negi V, Bhat V, Kumar A, Joshi RK, Venkatnarayan K, et al. Gestational Age-Specific Nomogram of Transcutaneous Bilirubin in First 120h of Life for Term and Late Preterm Indian Neonates. J Trop Pediatr. 2022 Jun 6; 68(4): fmac047. doi: 10.1093/tropej/fmac047. PMID: 35666181.
14. ten Kate L, van Oorschot T, Woolderink J, Teklenburg-Roord S, Bekhof J. Transcutaneous Bilirubin Accuracy Before, During, and After Phototherapy: A Meta-Analysis. Pediatrics. 2023 Nov 22;152(6): e2023062335. TO ADD - doi: 10.1542/peds.2023-062335. PMID: 37990609.
15. Saloojee H. Innovative approaches to neonatal jaundice diagnosis and management in low-resourced settings. S Afr Fam Pract (2004). 2024 Feb 29;66(1):e1-e5. doi: 10.4102/safp.v66i1.5833. PMID: 38572885; PMCID: PMC10913041.
16. Thomas DH, Warner JV, Jones GRD, Chung JZY, Macey DJ, Screnci A, et al. Total bilirubin assay differences may cause inconsistent treatment decisions in neonatal hyperbilirubinemia. Clin Chem Lab Med CCLM. 2022 Oct 26;60(11):1736-1744.
17. Hulzebos CV, Camara JE, Van Berkel M, Delatour V, Lo SF, Mailloux A, et al. Bilirubin measurements in neonates: uniform neonatal treatment can only be achieved by improved standardization. Clin Chem Lab Med CCLM. 2024 Sep 25; 62(10):1892-1903.
18. Xu A, Francis B, Choy KW, Dargaville GF, Surkitt A, Tran D, et al. Point-of-Care Bilirubin Testing in Neonates: Comparative Performance of Blood Gas Analysis and Transcutaneous Bilirubinometry. Healthcare. 2026 Feb 1;14(3):370. doi: 10.3390/healthcare14030370. PMID: 41682220; PMCID: PMC12897715.
19. Sundaram M, Muthusamy A, Balachandran A, Natarajan M. Diagnostic performance of point-of-care bilirubin testing with Bilistick 2.0 device at a South Indian clinical site. Pediatr Res [Internet]. 2025 Oct 8 [cited 2026 Feb 15]; Available from: https://www.nature.com/articles/s41390-025-04431-0
20. Bhutani VK, Wong RJ, Turkewitz D, Rauch DA, Mowitz ME, Barfield WD, et al. Phototherapy to Prevent Severe Neonatal Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation: Technical Report. Pediatrics. 2024 Aug 26;154(3): e2024068026. doi: 10.1542/peds.2024-068026. PMID: 39183672.
21. Ebbesen F, Vreman HJ, Hansen TWR. Blue Green (~480 nm) versus Blue (~460 nm) Light for Newborn Phototherapy-Safety Considerations. Int J Mol Sci. 2022 Dec 27; 24(1):461. doi: 10.3390/ijms24010461. PMID: 36613904; PMCID: PMC9820095.
22. Patel A, Vagha JD, Meshram RJ, Taksande A, Khandelwal R, Jain A, et al. Illuminating Progress: A Comprehensive Review of the Evolution of Phototherapy for Neonatal Hyperbilirubinemia. Cureus. 16(3): e55608. doi: 10.7759/cureus.55608. PMID: 38586621; PMCID: PMC10995653.
23. Spaan J, Been JV, Wallé Y, Reiss IKM, Wagenaar JHL, Hulzebos CV, et al. First in-human pilot study of wearable phototherapy for neonatal hyperbilirubinemia. Eur J Pediatr. 2025; 184(7):407.
24. Gottimukkala SB, Lobo L, Gautham KS, Bolisetty S, Fiander M, Schindler T. Intermittent phototherapy versus continuous phototherapy for neonatal jaundice. Cochrane Database Syst Rev. 2023 Mar 2; 2023(3):CD008168. doi: 10.1002/14651858.CD008168.pub2. PMID: 36867730; PMCID: PMC9979775.
25. Zhang Y, Zhang Y, Huang Q, Yi S, Guan X, Li H, et al. Evolution and contemporary landscape of neonatal hyperbilirubinemia management guidelines: a narrative review. Front Pediatr 2026 Feb 6;14:1745769. doi: 10.3389/fped.2026.1745769. PMID: 41727764; PMCID: PMC12920545.
26. Sakaleshpur Kumar V, Gadgeesh PB, Naik P, Mathew G. Impact of the 2022 American Academy of Pediatrics Hyperbilirubinemia Guideline on Phototherapy Utilization in a Resource-Limited Setting: A Single-Center Pre-Post Study. Cureus. 17(11): e97846. doi: 10.7759/cureus.97846. PMID: 41458674; PMCID: PMC12742236.

DRUG PROFILE

ANTIMALARIALS

***Jeeson C Unni**
****Irshad M**

Abstract: *Treatment options for malaria, especially falciparum malaria, are continuously changing due to the rapid development of resistance to individual drugs used as monotherapy. Artemisinin-based combination therapies are presently considered the drugs of choice for uncomplicated falciparum malaria; however, chloroquine remains the standard therapy for chloroquine sensitive vivax malaria. Artemisinin-based combination therapies are increasingly being considered for the treatment of non-falciparum malaria. Artemisinin resistance has also been increasingly reported in recent years, and further research is necessary to develop novel drugs and combination therapies to address these emerging challenges and to achieve and sustain malaria control, with the ultimate aim of malaria elimination.*

Points to Remember

- ***Artemisinin-based combination therapy is the cornerstone of treatment and is the first-line therapy for P. falciparum malaria, while monotherapy should be avoided due to rapid development of resistance.***
- ***Severe malaria is a medical emergency, and intravenous artesunate should be initiated immediately to reduce mortality.***
- ***Primaquine is essential for the radical cure of P. vivax malaria as it targets liver stages, but G6PD deficiency must be ruled out before use.***
- ***Antimalarial treatment should always be guided by regional resistance patterns to ensure optimal efficacy.***

* Senior Consultant and Editor-in-Chief,
IAP Drug Formulary.
email : jeeson@asianetindia.com

** Associate Consultant,
Department of Pediatrics and Neonatology,
Aster Medcity,
Kochi.

References

1. World Health Organization. World malaria report 2025: addressing the threat of antimalarial drug resistance. Geneva: World Health Organization; 2025. License: CC BY-NC-SA 3.0 IGO.
2. World malaria report 2023. https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2023.
3. Sehgal PN, Sharma MID, Sharma SL, Gogai S. Resistance to chloroquine in falciparum malaria in Assam state, India. J Commun Dis 1973; 5: 175-180.
4. Guha AK, Roy JR, Das S, Roy RG, Pattanayak S. Results of chloroquine sensitivity tests in Plasmodium falciparum in Orissa State. Indian J Med Res 1979; 70 (Suppl): 40-47.
5. Dwivedi SR, Sahu H, Yadava RL, Roy RG, Pattanayak S. In vivo chloroquine sensitivity tests of Plasmodium falciparum in some parts of Uttar Pradesh and Haryana States. Indian J Med Res 1979; 70 (Suppl): 20-22.
6. Choudhury B, Dutt SC, Roy RG, Pattanayak S. Chloroquine resistant P. falciparum in Chandrapur district of Maharastra state. J Commun Dis 1981; 13: 142-144.
7. Directorate General of Health Services. National Vector Borne Disease Control Programme. Malaria drug resistance 2004. New Delhi: Ministry of Health and Family Welfare; Govt. of India 2004.
8. Price RN, von Seidlein L, Valecha N, Nosten F, Baird JK, White NJ. Global extent of chloroquine-resistant Plasmodium vivax: a systematic review and meta-analysis. Lancet Infect Dis 2014; 14(10): 982-991. doi: 10.1016/S1473-3099(14)70855-2. Epub 2014 Sep 8.
9. Kathpalia M, KojomFoko LP, Rawat P, Chaturvedi R, Rahi M, Sharma A. Plasmodium vivax elimination from India may need therapeutic efficacy studies - Informed shift to artemisinin-based treatment. IJID Reg. 2025 Dec 3;18:100822. doi: 10.1016/j.ijregi.2025.100822
10. Malaria. In: IAP Drug Formulary Webb Update 2026)1) Edition 79. Eds Unni JC, Shah S. Project of IAP CMIC

Cite as: Jeeson C Unni, Irshad M, Antimalarials, Indian J Pract Pediatr. 2026; 28(1):61-67.

11. Worldwide Antimalarial Resistance Network (WWARN) AL Dose Impact Study Group. The effect of dose on the antimalarial efficacy of artemether-lumefantrine: a systematic review and pooled analysis of individual patient data. Lancet Infect Dis 2015. pii: S1473-3099 (15)70024-1. doi: 10.1016/S1473-3099 (15)70024-1. [Epub ahead of print]
12. Isba R, Zani B, Gathu M, Sinclair D. Artemisinin-naphthoquine for treating uncomplicated Plasmodium falciparum malaria. Cochrane Database Syst Rev 2015; 2: CD011547. doi: 10.1002/14651858.CD011547.
13. Visser BJ, Wieten RW, Kroon D, Nagel IM, Bélard S, van Vugt M, et al. Efficacy and safety of artemisinin combination therapy (ACT) for non-falciparum malaria: a systematic review. Malar J 2014; 13: 463. doi: 10.1186/1475-2875-13-463.
14. Esu E, Effa EE, Opie ON, Uwaoma A, Meremikwu MM. Artemether for severe malaria. Cochrane Database Syst Rev 2014; 9: CD010678. doi: 10.1002/14651858.CD010678.pub2.
15. Zwang J, Dorsey G, Mårtensson A, d'Alessandro U, Ndiaye JL, Karema C, et al. Plasmodium falciparum clearance in clinical studies of artesunate-amodiaquine and comparator treatments in sub-Saharan Africa, 1999-2009. Malar J 2014; 13: 114. doi: 10.1186/1475-2875-13-114.
16. Obonyo CO, Juma EA. Clindamycin plus quinine for treating uncomplicated falciparum malaria: a systematic review and meta-analysis. Malar J 2012; 11: 2. doi: 10.1186/1475-2875-11-2.
17. Sinclair D, Donegan S, Isba R, Lalloo DG. Artesunate versus quinine for treating severe malaria. Cochrane Database Syst Rev 2012; 6: CD005967. doi: 10.1002/14651858.CD005967.pub4.
18. vanVugt M, van Beest A, Sicuri E, van Tulder M, Grobusch MP. Malaria treatment and prophylaxis in endemic and nonendemic countries: evidence on strategies and their cost-effectiveness. Future Microbiol 2011; 6(12): 1485-1500. doi: 10.2217/fmb.11.138.
19. Essential Medicines List for children and adolescents in India. In: IAP Pediatric Drug Formulary 2015 with IAP Recommendations on Drug Therapy for Pediatric Illnesses. 4th ed. Ed-in-Chief Jeeson C. Unni Ex edsNair MKC, Menon PSN, Bansal CP; Publication of IAP. 2015 Pixel Studio, Kochi: 26-30.
20. Goel P, Gerriets V. Chloroquine. [Updated 2023 Jul 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK551512/
21. hinappi M, Via A, Marcatili P, Tramontano A. On the mechanism of chloroquine resistance in Plasmodium falciparum. PLoS One. 2010 Nov 19; 5(11):e14064. doi: 10.1371/journal.pone.0014064. PMID: 21124966; PMCID: PMC2988812
22. Goel P, Gerriets V. Chloroquine. [Updated 2023 Jul 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from:https://www.ncbi.nlm.nih.gov/books/NBK551512/
23. Braga CB, Martins AC, Cayotopa AD, Klein WW, Schlosser AR, da Silva AF, et al. Side Effects of Chloroquine and Primaquine and Symptom Reduction in Malaria Endemic Area (Mâncio Lima, Acre, Brazil). Inter discip Perspect Infect Dis. 2015;2015:346853. doi: 10.1155/2015/346853. Epub 2015 Aug 18. PMID: 26357512; PMCID: PMC4556080
24. Achan J, Talisuna AO, Erhart A, Yeka A, Tibenderana JK, Baliraine FN,et al. Quinine, an old anti-malarial drug in a modern world: role in the treatment of malaria. Malar J. 2011 May 24;10:144. doi: 10.1186/1475-2875-10-144. PMID: 21609473; PMCID: PMC3121651
25. Bykowski A, Logan TD. Cinchonism. [Updated 2023 Sep 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK559319/.
26. Nosten F, White NJ. Artemisinin-Based Combination Treatment of Falciparum Malaria. In: Breman JG, Alilio MS, White NJ, editors. Defining and Defeating the Intolerable Burden of Malaria III: Progress and Perspectives: Supplement to Volume 77(6) of American Journal of Tropical Medicine and Hygiene. Northbrook (IL): American Society of Tropical Medicine and Hygiene; 2007 Dec. Available from: https://www.ncbi.nlm.nih.gov/books/NBK1713/
27. Zheng D, Liu T, Yu S, Liu Z, Wang J, Wang Y. Antimalarial Mechanisms and Resistance Status of Artemisinin and Its Derivatives. Trop Med Infect Dis. 2024 Sep 20;9(9):223. doi: 10.3390/tropicalmed9090223. PMID: 39330912; PMCID: PMC11435542
28. Institute of Medicine (US) Committee on the Economics of Antimalarial Drugs; Arrow KJ, Panosian C, Gelband H, editors. Saving Lives, Buying Time: Economics of Malaria Drugs in an Age of Resistance. Washington (DC): National Academies Press (US); 2004. 9, Antimalarial Drugs and Drug Resistance. Available from: https://www.ncbi.nlm.nih.gov/books/NBK215631
29. Belhekar MN, Advani MG, Pawar SR. A prospective study of adverse drug reactions to artemisinin-based combination therapy in a tertiary care hospital in India. Indian J Pharmacol. 2012 Mar;44(2):257-260. doi: 10.4103/0253-7613.93863. PMID: 22529487; PMCID: PMC3326924
30. Yilma D, Stepniewska K, Bousema T, Drakeley C, Eachempati P, Guerin PJ, et al. WWARN Paediatric Primaquine for P falciparum Transmission Blocking Study Group. Safety and efficacy of single-dose primaquine to interrupt Plasmodium falciparum malaria transmission in children compared with adults: a systematic review and individual patient data meta-

analysis. Lancet Infect Dis. 2025 Sep; 25(9):965-976. doi: 10.1016/S1473-3099(25)00078-7. Epub 2025 Apr 23. PMID: 40286803; PMCID: PMC12353880.

31. Thriemer K, Degaga TS, Christian M, Alam MS, Rajasekhar M, Ley B, et al .Primaquine radical cure in patients with Plasmodium falciparum malaria in areas co-endemic for P falciparum and Plasmodium vivax (PRIMA): a multicentre, open-label, superiority randomised controlled trial. Lancet. 2023 Dec 2;402 (10417):2101-2110. doi:10.1016/S0140-6736(23) 01553-2. Epub 2023 Nov 15. PMID: 37979594; PMCID: PMC10714037.
32. Heinberg A, Kirkman L. The molecular basis of antifolate resistance in Plasmodium falciparum: looking beyond point mutations. Ann N Y Acad Sci. 2015 Apr; 1342(1): 10-8. doi: 10.1111/nyas.12662. Epub 2015 Feb 18. PMID: 25694157; PMCID: PMC4405445.
33. Kalra SP, Naithani N, Mehta SR, Kumar R. Resistant Malaria : Current Concepts and Therapeutic Strategies. Med J Armed Forces India. 2002 Jul;58(3):228-33. doi: 10.1016/S0377-1237(02)80136-8. Epub 2011 Jul 21. PMID: 27407388; PMCID: PMC4925349
34. Omari AA, Gamble C, Garner P. Artemether-lumefantrine (four-dose regimen) for treating uncomplicated falciparum malaria. Cochrane Database Syst Rev. 2006 Apr 19;2006(2):CD005965. doi: 10.1002/14651858. CD005965. PMID: 16625646; PMCID: PMC6532603
35. Infectious Diseases Chapter, Indian Academy of Pediatrics. Management of malaria in children: update 2008. Ind Pediatr 2008; 45: 731-735.
36. Guidelines for Diagnosis and Treatment of Malaria in India 2014 of the National Institute of Malaria Research and National Vector Borne Disease Control Programme. https://ncvbdc.mohfw.gov.in/WriteReadData/l892s/ 20627628441542176662.pdf. Accessed on 11/3/2026.
37. Belete TM. Recent Progress in the Development of New Antimalarial Drugs with Novel Targets. Drug Des DevelTher. 2020 Sep 22;14:3875-3889. doi: 10.2147/ DDDT.S265602. PMID: 33061294; PMCID: PMC7519860.
38. Okwu DG, ZolekoManego R, Duparc S, Kremsner PG, Ramharter M, Mombo-Ngoma G. The non-artemisinin antimalarial drugs under development: a review. ClinMicrobiol Infect. 2025 Jun;31(6):941-947. doi: 10.1016/j.cmi.2025.03.009. Epub 2025 Mar 20. PMID: 40120754.
39. Schmitt EK, Ndayisaba G, Yeka A, Asante KP, Grobusch MP, Karita E, et al.Efficacy of Cipargamin (KAE609) in a Randomized, Phase II Dose-Escalation Study in Adults in Sub-Saharan Africa with Uncomplicated Plasmodium falciparum Malaria. Clin Infect Dis. 2022 May 30;74(10):1831-1839. doi: 10.1093/cid/ciab716. PMID: 34410358; PMCID: PMC9155642.

NEO CAPSULE

NEONATAL RESUSCITATION ALGORITHM

***Sindhu Sivanandan**

Points to Remember

- ***The newborn chain of care starts with prenatal care and extends to recovery and appropriate follow-up in the postnatal period to ensure optimal short- and long-term outcomes.***
- ***Anticipate and prepare for resuscitation. Team briefing, equipment check and antenatal counseling are important steps.***
- ***Discuss cord management plan before birth. Delay clamping cord for a minimum of 60 seconds if the neonate does not require resuscitation at birth***
- ***Effective ventilation of the lungs, indicated by an increasing heart rate, is the most important step in resuscitation.***
- ***Ventilation corrective steps, including the use of an alternative airway (laryngeal mask or endo-tracheal intubation), may be required if the heart rate does not rise with assisted ventilation with a face mask.***
- ***Pulse oximetry is used to guide oxygen therapy and meet oxygen saturation target ranges.***
- ***Chest compressions are indicated if the heart rate remains less than 60 beats per minute after appropriate ventilation corrective steps, including endo tracheal intubation.***
- ***If the heart rate remains less than 60 beats per minute after chest compressions, epinephrine is indicated, preferably via an intravascular route.***
- ***If all steps of resuscitation are effectively completed and there is no heart rate detected by 20 minutes, discontinuation of care may be discussed with the team and family.***

Bibliography

1. Liley HG, Weiner GM, Wyckoff MH, Rabi Y, Schmölzer GM, de Almeida MF, et al. Neonatal Life Support: 2025 International Liaison Committee on Resuscitation Consensus on Science with Treatment Recommendations. Circulation. 2025; 152(16_suppl_1): S165-204.
2. Wyckoff MH, Wyllie J, Aziz K, de Almeida MF, Fabres JW, Fawke J, et al. Neonatal Life Support 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation. 2020; 156:A156-187.

* Chief Neonatologist,
Kauvery Hospital,
Chennai.
email : drsindhusivanandan@gmail.com

Cite as: Sindhu Sivanandan, Neonatal resuscitation algorithm, Indian J Pract Pediatr. 2026; 28(1):68-77.

CASE REPORT

CEREBRAL VASCULITIC INFARCTS IN AN INFANT WITH MENINGOENCEPHALITIS

***Rajaramesh KV**
****Anantha Narasimhacharyulu P**
***Soujanya G**
[@]Santosh Kalyan

Abstract: *Cerebral vasculitis is a serious and potentially devastating complication of bacterial meningoencephalitis. Early recognition using advanced neuroimaging and timely immunomodulatory therapy can significantly influence neurological outcomes. We report an infant with pneumococcal meningoencephalitis, who developed early multifocal cerebral vasculitic infarcts within the first week of fever. He was managed with aggressive antimicrobial therapy, anti-seizure medications and high-dose corticosteroids, resulting in clinical stabilization and successful outcome without neurological sequelae. This case highlights the diagnostic challenges, role of diffusion-weighted magnetic resonance imaging in early diagnosis and therapeutic considerations.*

Keywords: *Pneumococcal meningoencephalitis, Cerebral vasculitis.*

* Consultant Pediatrician

** Consultant Pediatric Neurologist

[@] Consultant Pediatric Intensivist,
Lotus Hospitals,
Vishakapatnam.

email : rajarameshkv@gmail.com

References

1. Abate HJ, Falaschi A, Balbi L, García B. Nineteen-years of pneumococcal invasive disease surveillance in a children's hospital in Mendoza, Argentina. Arch Argent Pediatr. 2014 Aug;112(4):352-357.
2. Scolding NJ, Wilson H, Hohlfeld R, Polman C, Leite I, Gilhus N. EFNS Cerebral Vasculitis Task Force. The recognition, diagnosis and management of cerebral vasculitis: a European survey. Eur J Neurol. 2002 Jul; 9(4):343-347.
3. Mook-Kanamori BB, Geldhoff M, van der Poll T, van de Beek D. Pathogenesis and pathophysiology of pneumococcal meningitis. ClinMicrobiol Rev. 2011 Jul; 24(3):557-591.
4. Schut ES, Brouwer MC, de Gans J, Florquin S, Troost D, van de Beek D. Delayed cerebral thrombosis after initial good recovery from pneumococcal meningitis. Neurology. 2009 Dec 8; 73(23):1988-1995.
5. Tsuchiya K, Katase S, Yoshino A, Hachiya J. Diffusion-weighted MR imaging of encephalitis. AJR Am J Roentgenol. 1999 Oct; 173(4):1097-1099.
6. Kastrup O, Wanke I, Maschke M. Neuroimaging of infections. NeuroRx. 2005 Apr;2(2):324-332. doi: 10.1602/neurorx.2.2.324.
7. Tunkel AR, Glaser CA, Bloch KC, Sejvar JJ, Marra CM, Roos KL, et al. The management of encephalitis: clinical practice guidelines by the Infectious Diseases Society of America. Clin Infect Dis. 2008;47(3):303-327.
8. Leber AL, Everhart K, Balada-Llasat JM, Cullison J, Daly J, Holt S, et al. Multicenter evaluation of BioFireFilmArray meningitis/encephalitis panel for detection of bacteria, viruses, and yeast in cerebrospinal fluid specimens. J Clin Microbiol. 2016; 54(9):2251-2261.
9. Messacar K, Breazeale G, Robinson CC, Dominguez SR. Potential clinical impact of the FilmArray meningitis/encephalitis panel in children with suspected central nervous system infections. J Clin Microbiol. 2016; 54(3):585-589.
10. Sonneville R, Klein I, Wolff M. Post-infectious and infection-associated encephalitis: pathophysiology, diagnosis and management. J Infect. 2009; 58(5):321-328.

Cite as: Rajaramesh KV, Anantha Narasimhacharyulu P, Soujanya G, Santosh Kalyan, Cerebral vasculitic infarcts in an infant with meningoencephalitis, Indian J Pract Pediatr. 2026; 28(1):84-87.

11. Tunkel AR, Glaser CA, Bloch KC, Sejvar JJ, Marra CM, Roos KL, et al. The management of encephalitis: clinical practice guidelines by the Infectious Diseases Society of America. Clin Infect Dis. 2008;47(3):303-327.
12. Katchanov J, Branding G, Stocker H, Luthardt J, Grütz K, Engelhorn T, et al. Cerebrovascular complications and vasculitis in community-acquired bacterial meningitis, particularly due to Streptococcus pneumoniae. Clin Infect Dis. 2010;51(8):927-933.
13. Weisfelt M, van de Beek D, Spanjaard L, Reitsma JB, de Gans J. Clinical features, complications and outcome in adults with pneumococcal meningitis: a prospective case series. Lancet Neurol. 2006; 5(2):123-129.
14. Vergouwen MDI, Schut ES, Troost D, van de Beek D. Diffusion-weighted imaging in bacterial meningitis: a marker for ischemic complications. Neurology. 2010; 74(21):1663-1669.