

## 1.14 FLUID AND ELECTROLYTE MANAGEMENT

### Introduction

A greater understanding of pediatric fluid therapy is one of the most important advances of pediatric medicine and a cornerstone of current inpatient pediatric practice. Despite the use of rotavirus vaccine, gastroenteritis and dehydration with electrolyte abnormalities remains among the top 10 admission diagnoses nationwide, with annual hospitalization rates of 3 to 5 per 1000 U.S. children under 5 years of age. Although the majority of previously healthy hospitalized children can compensate for errors in calculations of fluid therapy, mistakes – even in healthy children admitted for minor illnesses – can have devastating outcomes. Patients with underlying disease processes are at even greater risk for adverse outcomes, if fluids and electrolytes are not meticulously managed. Pediatric hospitalists should be experts at managing frequently encountered fluid and electrolyte abnormalities.

### Knowledge

Pediatric hospitalists should be able to:

- Discuss the physiology of fluid and electrolyte homeostasis and the changes that occur with growth and development.
- Discuss maintenance fluid calculations for water and electrolyte homeostasis based on body surface area or the Holliday Segar method, considering alterations in the renin-angiotensin system and vasopressin levels in hospitalized children which predispose them to hyponatremia.
- Describe the methods used for calculation of excessive fluid losses due to gastrointestinal, respiratory, renal, or skin abnormalities and identify the best fluid replacement type for each.
- Describe common errors in clinical estimations of dehydration and fluid and electrolyte requirements.
- Explain the rationale, indications, and contraindications for oral rehydration, including the correct glucose and electrolyte composition and technique for administration.
- Discuss the benefits of and barriers to intravenous (IV) versus enteral methods for fluid and electrolyte repletion and the indications, benefits, and barriers for each.
- Review the indications for administering a parenteral fluid bolus for resuscitation and explain the rationale for the use of isotonic fluids for rehydration.
- Discuss the benefits and risks of repeated lab testing and intravenous access placement, including cost, pain, effect on clinical management, the family/caregivers' perceptions, staff time, and others.
- Compare and contrast true hyponatremia with pseudohyponatremia and give examples of conditions in which these exist.
- List differential diagnoses for hyponatremia and hypernatremia.
- Summarize the management of hyponatremia and hypernatremia, attending to duration of corrective therapy and potential complications during correction.
- Distinguish between hyperkalemia and pseudohyperkalemia and give examples of the conditions in which these exist.
- List differential diagnoses for hypokalemia and hyperkalemia.
- Distinguish hypocalcemia from pseudohypocalcemia and give examples of the conditions in which these exist.
- Discuss the etiology and sequelae of hypomagnesemia and secondary hypomagnesemia.
- Discuss the interaction of fluid and electrolytes with acid/base balance.
- Describe common acid/base disturbances that accompany frequently encountered causes of fluid deficit and give examples of exacerbating issues including underlying co-morbidity and use of over-the-counter medications.

### Skills

Pediatric hospitalists should be able to:

- Calculate maintenance fluid and electrolyte requirements for hospitalized infants and children.
- Adjust maintenance fluids for increased insensible losses and ongoing fluid and electrolyte needs.
- Estimate the degree of dehydration for children of various ages based upon clinical symptoms and signs.
- Identify common presenting signs and symptoms associated with an excess or deficit of common electrolytes and glucose in infants and children.
- Correctly estimate osmolar disturbance by interpreting electrolyte, glucose, and blood urea nitrogen results.
- Calculate and administer an isotonic fluid bolus correctly when indicated.
- Obtain IV or intraosseous access in moderate to severely dehydrated patients.
- Assess the success of fluid resuscitation by interpreting clinical changes and laboratory values.
- Calculate and administer maintenance and deficit fluid replacement for isotonic, hypertonic, and hypotonic dehydration.
- Interpret urine and serum electrolytes and osmolality, as well as fluid status (hypo-, hyper-, or isovolemic), to determine the etiology for hyponatremia or hypernatremia.
- Correct hyponatremia using appropriate replacement or restriction of fluids, sodium chloride, and medications depending upon the diagnosis.
- Correct hypernatremia using an appropriate electrolyte composition and rate of fluid replacement, as well as medications depending upon the diagnosis.
- Correct hypoglycemia using an appropriate replacement solution.
- Interpret EKG findings in the context of specific electrolyte abnormalities.
- Prescribe electrolyte replacement therapy and institute proper monitoring for arrhythmias.
- Correct symptomatic hyperkalemia using a combination of therapies to stabilize cardiac conduction, redistribute potassium to the intracellular space, and remove it from the body.

- Consult pediatric subspecialists appropriately to expedite the diagnosis and management of serious electrolyte disorders and transfer to a higher level of care when indicated.

### Attitudes

Pediatric hospitalists should be able to:

- Recognize the benefits of oral rehydration and advocate for its use when indicated and clinically appropriate.
- Realize the importance of collaboration with subspecialty and primary care providers to ensure coordinated follow up for patients with persistent fluid and electrolyte disturbances at discharge.
- Consider cost-effectiveness, pain, and patient safety when creating plans for the treatment of fluid deficits.

### Systems Organization and Improvement

In order to improve efficiency and quality within their organiza-

tions, pediatric hospitalists should:

- Work collaboratively with others such as surgeons, intensivists, and advanced practice nurses to establish institutional protocols for attainment of venous access.
- Lead, coordinate, or participate in plans to develop institutional policies to safely monitor and administer fluids and electrolytes.
- Lead, coordinate, or participate in developing guidelines for the treatment of fluid and electrolyte abnormalities in the hospital and community.

### References

1. Meyers RS. Pediatric fluid and electrolyte therapy. *J Pediatr Pharmacol Ther.* 2009;14(4):204–211. <https://doi.org/10.5863/1551-6776-14.4.204>.
2. Santillanes G, Rose E. Evaluation and management of dehydration in children. *Emerg Med Clin North Am.* 2018;36(2):259-273. <https://doi.org/10.1016/j.emc.2017.12.004>.