



Body System: Nephrologic			
Session Topic: Fluid and Electrolyte Abnormalities			
Educational Format		Faculty Expertise Required	
REQUIRED	Interactive Lecture	Expertise in the field of study. Experience teaching in the field of study is desired. Preferred experience with audience response systems (ARS). Utilizing polling questions and engaging the learners in Q&A during the final 15 minutes of the session are required.	
OPTIONAL	Problem-Based Learning (PBL)	Expertise teaching highly interactive, small group learning environments. Case-based, with experience developing and teaching case scenarios for simulation labs preferred. Other workshop-oriented designs may be accommodated. A typical PBL room is set for 50-100 participants, with 7-8 each per round table. <u>Please describe your interest and plan for teaching a PBL on your proposal form.</u>	
Professional Practice Gap		Learning Objective(s) that will close the gap and meet the need	Outcome Being Measured
<ul style="list-style-type: none"> • Knowledge gaps about the association between hypercalcemia and hyperparathyroidism and malignancy and be able to select the appropriate treatment based on etiology. • Knowledge gaps in being able to identify and treat the underlying etiology of hyponatremia and prescribe appropriate treatment for hyponatremia based on symptoms, degree, and presence of any hypotension. • Knowledge gaps differentiating the etiology of hypernatremia and prescribe appropriate treatment with caution due to the dangers of rapid correction. • Knowledge gaps treating vitamin D deficiency based on serum 25-hydroxyvitamin D levels. • Knowledge gaps in diagnosing hyper- and 		<ol style="list-style-type: none"> 1. Identify the underlying etiology of hypercalcemia and select the appropriate treatment. 2. Identify and treat the underlying etiology of hyponatremia and prescribe appropriate treatment for hyponatremia based on symptoms, degree, and presence of any hypotension. 3. Differentiate the etiology of hypernatremia and prescribe appropriate treatment with caution due to the dangers of rapid correction. 4. Identify the underlying etiology of hyper- and hypokalemia and select appropriate treatment. 	Learners will submit written commitment to change statements on the session evaluation, indicating how they plan to implement presented practice recommendations.



hypokalemia — and the underlying causes — and institute appropriate management.		
<ul style="list-style-type: none"> • Knowledge and performance gaps in evaluating patients at highest risk of drug-induced nephrotoxicity, and adjusting medications as indicated 		

ACGME Core Competencies Addressed (select all that apply)

X	Medical Knowledge		Patient Care
	Interpersonal and Communication Skills		Practice-Based Learning and Improvement
	Professionalism	X	Systems-Based Practice

Faculty Instructional Goals

Faculty play a vital role in assisting the AAFP to achieve its mission by providing high-quality, innovative education for physicians, residents and medical students that will encompass the art, science, evidence and socio-economics of family medicine and to support the pursuit of lifelong learning. By achieving the instructional goals provided, faculty will facilitate the application of new knowledge and skills gained by learners to practice, so that they may optimize care provided to their patients.

- Provide up to 3 evidence-based recommended practice changes that can be immediately implemented, at the conclusion of the session; including SORT taxonomy & reference citations
- Facilitate learner engagement during the session
- Address related practice barriers to foster optimal patient management
- Provide recommended journal resources and tools, during the session, from the American Family Physician (AFP), Family Practice Management (FPM), and Familydoctor.org patient resources; those listed in the References section below are a good place to start
 - Visit <http://www.aafp.org/journals> for additional resources
 - Visit <http://familydoctor.org> for patient education and resources
- Provide recommendations for identifying the underlying etiology of hypercalcemia and select the appropriate treatment.
- Provide recommendations for identifying and treating the underlying etiology of hyponatremia and prescribe appropriate treatment for hyponatremia based on symptoms, degree, and presence of any hypotension.
- Provide recommendations for differentiating the etiology of hypernatremia and prescribe appropriate treatment with caution due the dangers of rapid correction.
- Provide recommendations for identifying the underlying etiology of hyper- and hypokalemia and select appropriate treatment.

Needs Assessment

Fluid and electrolyte abnormalities, such as hyper/hypo-calcemia, hyper/hypo-natremia, and hyper/hypo-kalemia are commonly encountered by family physicians in inpatient and outpatient



settings.^{1,2} Electrolyte disorders are especially common among older, community dwelling patients, and is especially associated with diabetes mellitus and diuretics.³ Approximately one in 500 patients who are treated in a general medicine clinic have undiagnosed primary hyperparathyroidism, the leading cause of hypercalcemia. The principal challenges in the management of hypercalcemia are distinguishing primary hyperparathyroidism from conditions that will not respond to parathyroidectomy and knowing when it is appropriate to refer the patient for surgery.⁴ Primary hyperparathyroidism, the most common cause of hypercalcemia in outpatients, is often discovered incidentally during evaluation of serum electrolyte levels. Most patients are asymptomatic, and it is therefore important to be aware that subtle and nonspecific symptoms may be present.⁵ Elderly hospitalized patients with ionized hypocalcemia and hypophosphatemia, with or without an elevated parathyroid hormone level, are most likely deficient in vitamin D.² The prevalence of severe hyponatremia (serum sodium level less than 125 mEq per L) was 4.5%, 0.8%, and 10.3%, respectively. It is estimated that hyponatremia occurs in 4% to 7% of the ambulatory population, with rates of 18.8% in nursing homes.¹ The prevalence of hyperkalemia in hospitalized patients is between 1 and 10 percent.⁶

The management of the hypovolemic patient includes the assessment of sepsis, hypovolemia, myocardial infarction, tamponade, pulmonary embolism, and trauma via a set of vital signs and ultrasonography. A review of the literature suggests the following practice gaps:

- Trauma resuscitation errors occur during the initial minutes of patient reception because of time pressure, inexperience, reliance on memory, multitasking, and failures in trauma team coordination.^{7,8}
- Use of prehospital ultrasound, particularly Focused Assessment with Sonography for Trauma (FAST), is beneficial in the diagnosis of a hypovolemic patient; however, it is underutilized, in part due to lack of training.⁹⁻¹¹
- The evidence supporting the choice of intravenous colloid vs crystalloid solutions for management of hypovolemic shock remains unclear.^{12,13}
- The primary limitation to clinician ultrasonography is difficulty obtaining adequate images.¹⁴
- One of the more challenging distinctions to make with clinician ultrasonography is differentiating hypovolemic shock from septic shock.¹⁴
- In a recent AAFP CME Needs Assessment Survey of Common Medical Procedures, nearly 1 in 5 family physicians would like additional training in ultrasonography.¹⁵

Physicians should be knowledgeable about electrolyte abnormalities and be able to make a diagnosis through physical exam, history taking, or laboratory tests when applicable. However, data from the 2012 American Academy of Family Physicians (AAFP) CME Needs Assessment Survey indicates that family physicians have gaps in the medical skill necessary to provide optimal patient management of electrolyte abnormalities, dehydration, and oral rehydration.¹⁶ More specifically, CME outcomes data from 2013 and 2015 AAFP FMX (formerly Assembly): *Fluid and Electrolyte Abnormalities* sessions suggest that physicians have knowledge and practice gaps with regard to understanding different presentations of fluid imbalances; evaluation after diagnosis; ordering appropriate lab work; knowing when to check for imbalances; being aware of calculation tools; and when to refer.^{17,18}



In order to address identified knowledge gaps related to the diagnosis and management of fluid and electrolyte abnormalities, family physicians should engage in continuing education that facilitates the use of evidence-based recommendations and guidelines. Physicians are encouraged to consider the following evidence-based recommendations:^{1,2,6,19,20}

- Patients with hyperkalemia who have electrocardiographic (ECG) changes, a rapid rate of rise of serum potassium, decreased renal function, or significant acidosis should be urgently treated.
- Patients with hyperkalemia and characteristic ECG changes should be given intravenous calcium gluconate.
- Acutely lower potassium by giving intravenous insulin with glucose, a beta2 agonist by nebulizer, or both.
- Total body potassium should usually be lowered with sodium polystyrene sulfonate (Kayexalate).
- In patients with severe symptomatic hyponatremia, the rate of sodium correction should be 6 to 12 mEq per L in the first 24 hours and 18 mEq per L or less in 48 hours.
- Consensus guidelines based on systematic reviews
- A bolus of 100 to 150 mL of hypertonic 3% saline can be given to correct severe hyponatremia.
- Consensus guidelines based on small studies
- Vaptans appear to be safe for the treatment of severe hypervolemic and euvolemic hyponatremia but should not be used routinely.
- Consensus guidelines based on observational studies
- Chronic hypernatremia should be corrected at a rate of 0.5 mEq per L per hour, with a maximum change of 8 to 10 mEq per L in a 24-hour period.
- In patients with severe vitamin D deficiency (serum levels of below 8 ng per mL with hypocalcemia), 50,000 IU of vitamin D should be given daily for one to three weeks, followed by weekly doses of 50,000 IU.
- In critically ill patients, albumin-adjusted calcium levels underestimate true or ionized hypocalcemia. Therefore, measured ionized calcium levels are recommended, particularly in patients who are being treated in an intensive care unit.
- If calcium supplementation alone fails to maintain normal serum levels, the patient is vitamin D deficient or resistant and may benefit from a trial of calcitriol (Rocaltrol).
- If the vitamin D deficiency is severe, the patient will require 90 mmol per L in the first 24 hours: 6 mL of K2PO4 added to each liter of fluid and given at 200 mL per hour (1 mL of K2PO4 is equal to 4 mEq of potassium and 3.0 mmol per L or 93 mg of phosphate).
- Adequate fluid balance should be maintained in patients with acute kidney injury by using isotonic solutions (e.g., normal saline) instead of hyperoncotic solutions (e.g., dextrans, hydroxyethyl starch, albumin).

Physicians are encouraged to establish shared decision-making relationships with adult patients with electrolyte abnormalities, and to develop a patient-physician relationship that promotes family-centered shared decision-making. Optimal management requires close collaboration among primary care physicians, nephrologists, hospitalists, and other subspecialists participating in the care of the patient. Physicians can improve patient satisfaction with the referral process by using readily available strategies and tools such as, improving internal office communication,



engaging patients in scheduling, facilitating the appointment, tracking referral results, analyzing data for improvement opportunities, and gathering patient feedback.^{21,22}

Resources: Evidence-Based Practice Recommendations/Guidelines/Performance Measures

- Diagnosis and management of sodium disorders: hyponatremia and hypernatremia¹
- Hyperkalemia⁶
- A Practical Approach to Hypercalcemia⁴
- Undiagnosed vitamin D deficiency in the hospitalized patient²
- Drug-induced nephrotoxicity²³
- Parathyroid disorders⁵
- Management of hyponatremia¹⁹
- Diagnosis, evaluation, and treatment of hyponatremia: expert panel recommendations²⁴
- Acute kidney injury: a guide to diagnosis and management²⁰
- Engaging Patients in Collaborative Care Plans²⁵
- Simple tools to increase patient satisfaction with the referral process²¹
- Adding health education specialists to your practice²⁶
- Envisioning new roles for medical assistants: strategies from patient-centered medical homes²⁷
- The benefits of using care coordinators in primary care: a case study²⁸
- The Use of Symptom Diaries in Outpatient Care²⁹
- Health Coaching: Teaching Patients to Fish³⁰
- Medication adherence: we didn't ask and they didn't tell³¹
- Encouraging patients to change unhealthy behaviors with motivational interviewing³²
- FamilyDoctor.org. Hydration: Why It's So Important (patient education)³³
- FamilyDoctor.org. Artificial Hydration and Nutrition (patient education)³⁴
- FamilyDoctor.org. Athletes: The Importance of Good Hydration (patient education)³⁵
- FamilyDoctor.org. Caregiving: Caring for an Elderly Relative - Managing Medicines (patient education)³⁶
- FamilyDoctor.org. Urinary Incontinence | Overview (patient education)³⁷
- FamilyDoctor.org. Chronic Kidney Disease | Overview (patient education)³⁸

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