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# Hyponatremia

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**Dr. Shadowgazer**  
@DShadowgazer

What is the most widely  
misunderstood topic in all of  
medicine?  
And you can't say hyponatremia.  
Only the salt gods understand that  
one

9:33 PM · 7/8/20 · [Twitter for iPhone](#)



# Objectives

- Review sodium and water physiology
- Review medications that affect sodium excretion
- Discuss symptoms of hyponatremia
- Discuss differential for hyponatremia
- Review management of hyponatremia
- Review Clinical Questions/Cases





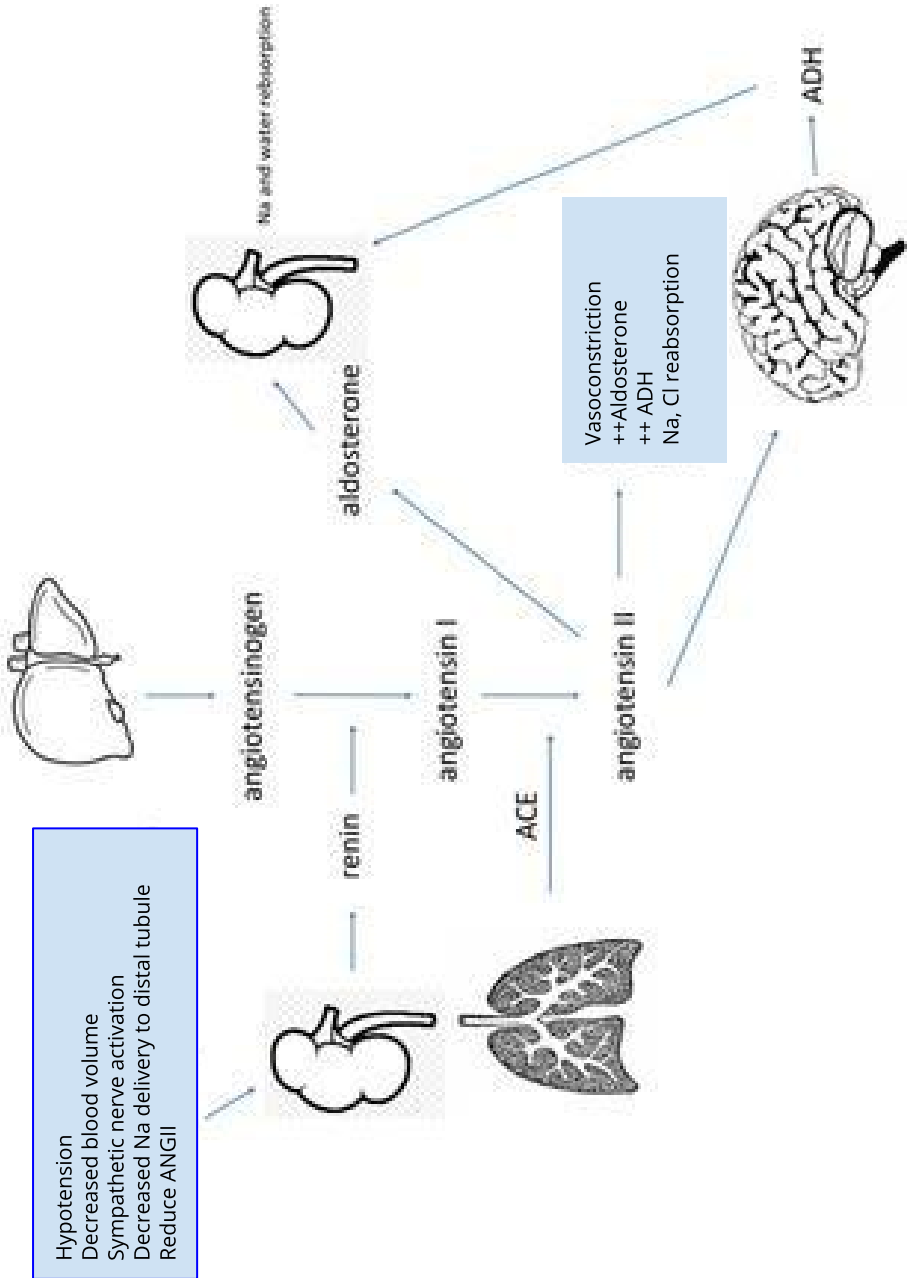
# Body's Goal

Maintain serum osmolality

Maintain blood pressure

Remember:

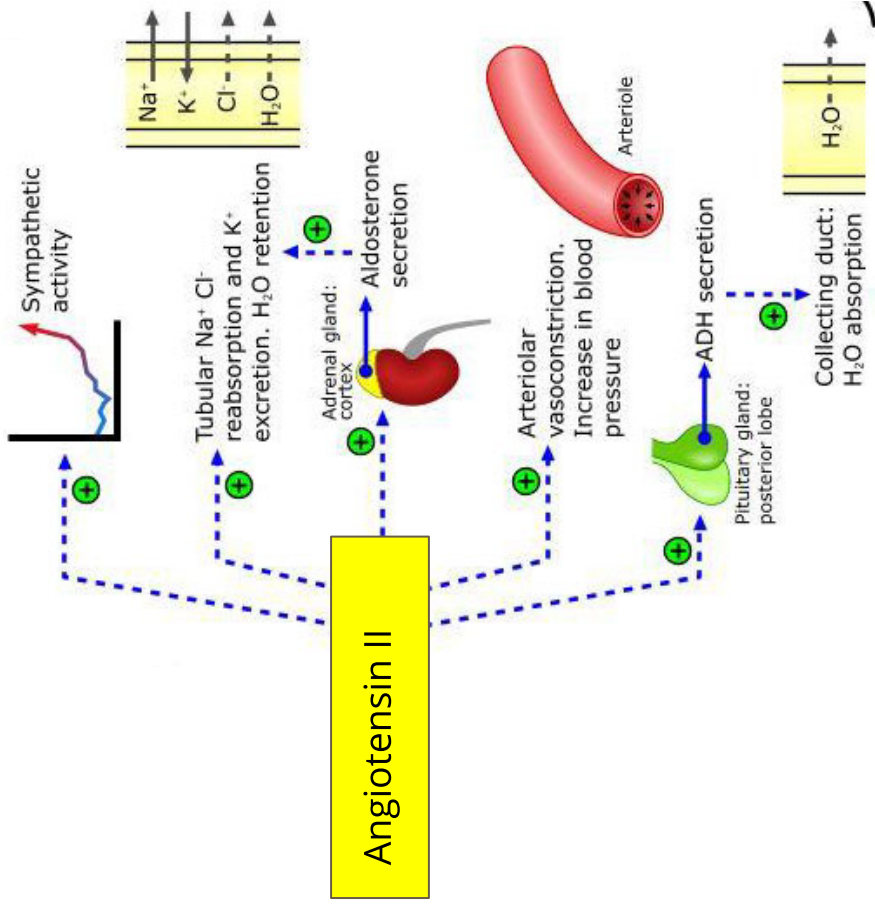
- Water diffuses across membranes
  - Sodium transport is channel dependent
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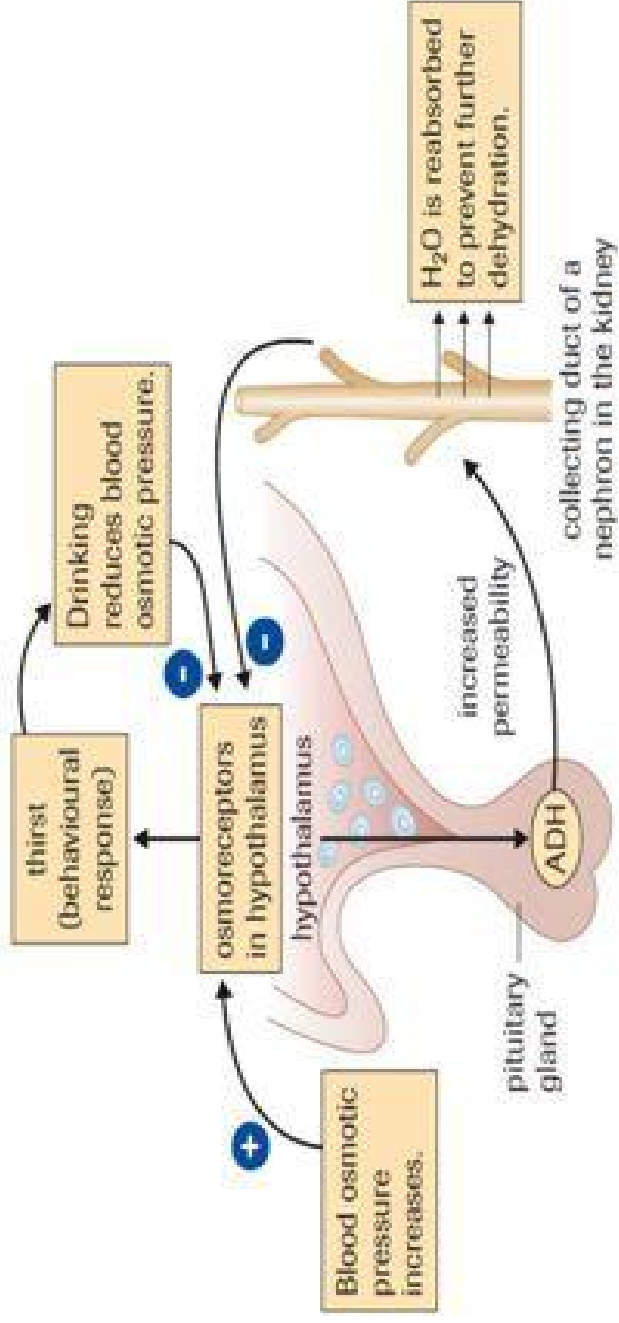
Hypotension  
 Decreased blood volume  
 Sympathetic nerve activation  
 Decreased Na delivery to distal tubule  
 Reduce ANGII

Vasoconstriction  
 ++Aldosterone  
 ++ ADH  
 Na, Cl reabsorption

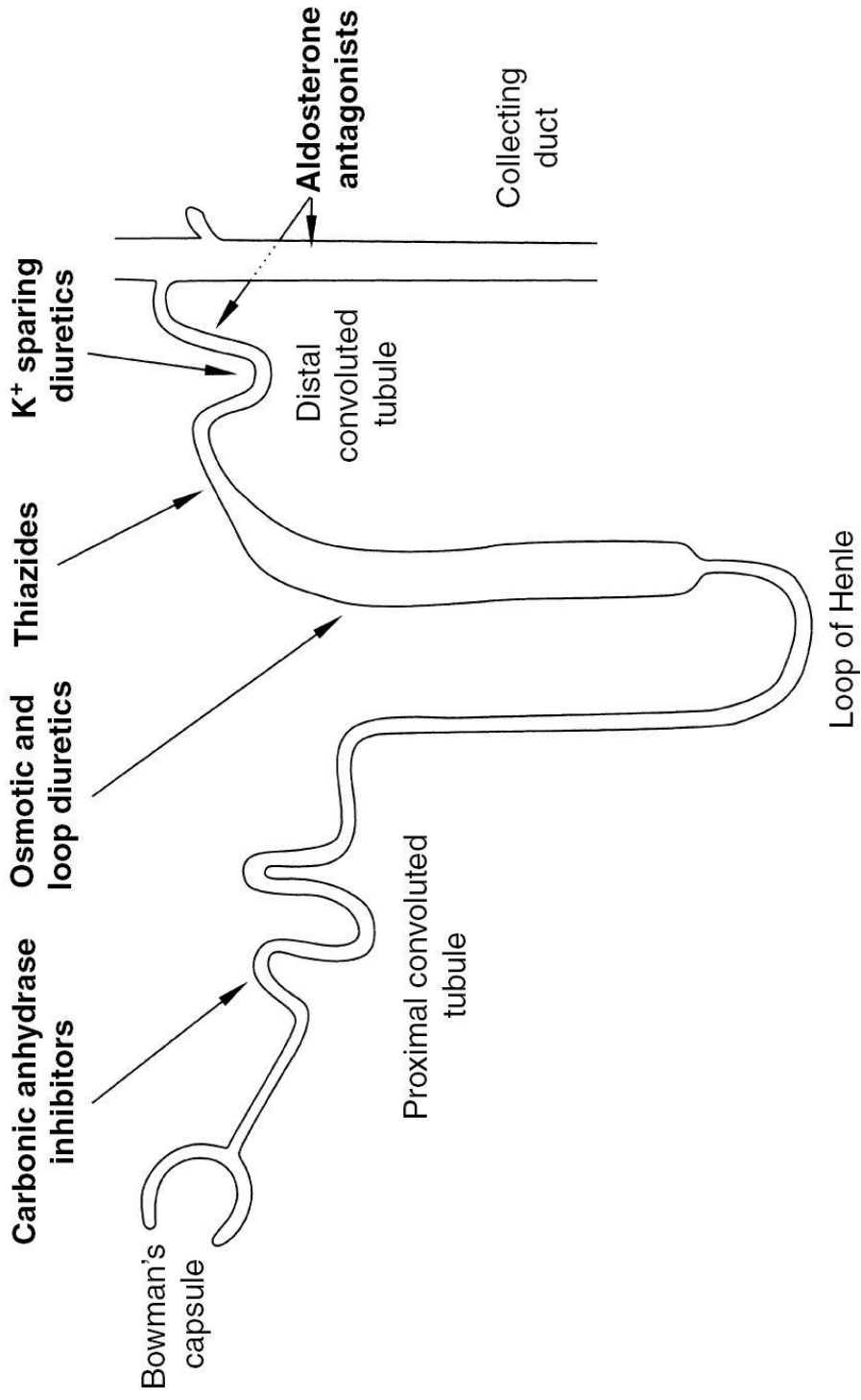




# Anti-Diuretic Hormone (ADH)







# Hyponatremia

- What is hyponatremia
- Symptoms of hyponatremia
  - Because of osmotically driven water flow across the blood-brain barrier, acute onset of hyponatremia can result in life-threatening cerebral edema

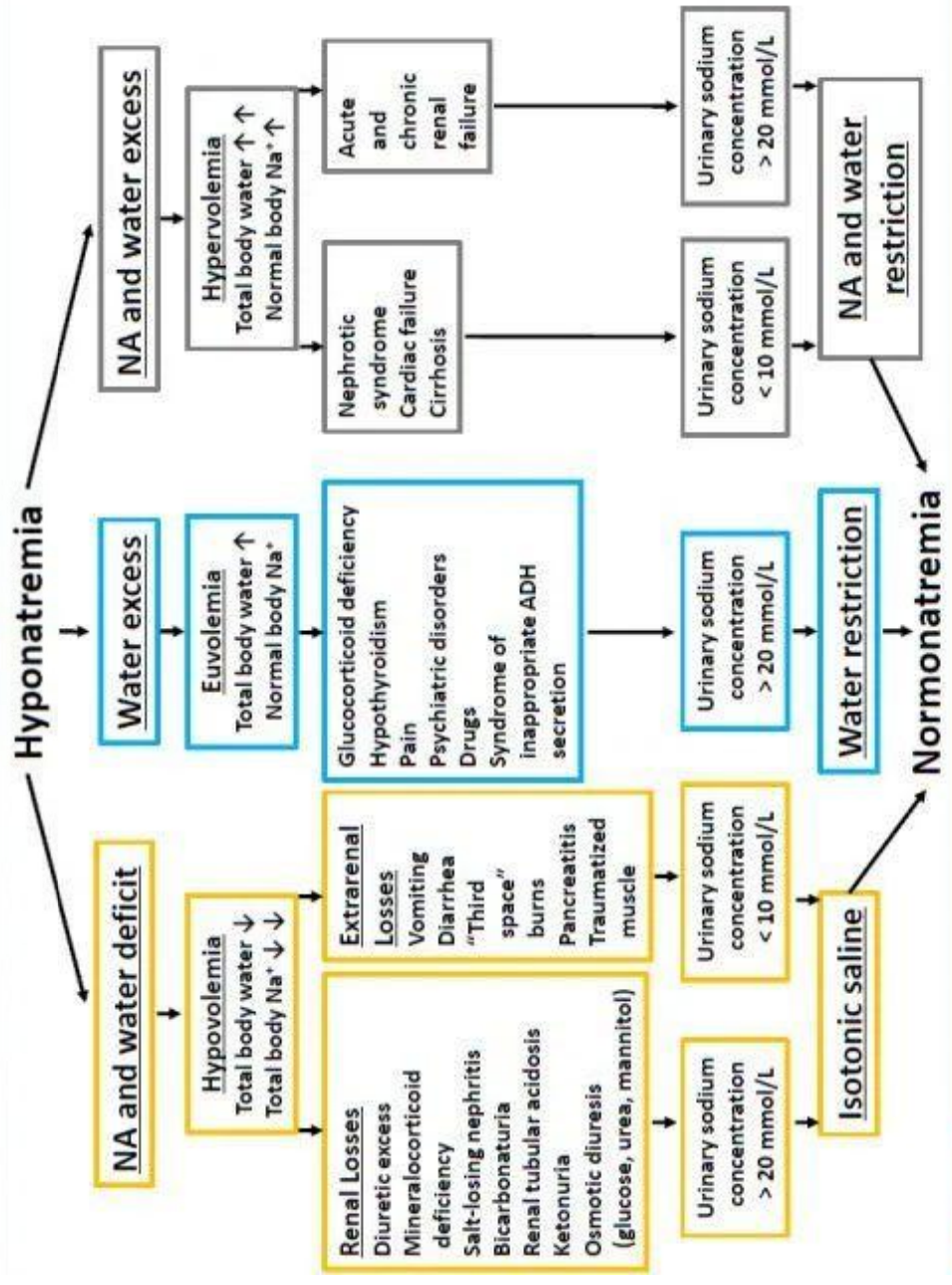


# Hyponatremia Treatment

- Treatment depends on ETIOLOGY



Pseudo-hyponatremia  
 - Lipids  
 - hyperglycemia  
 - paraproteins



# Severe Hyponatremia Treatment

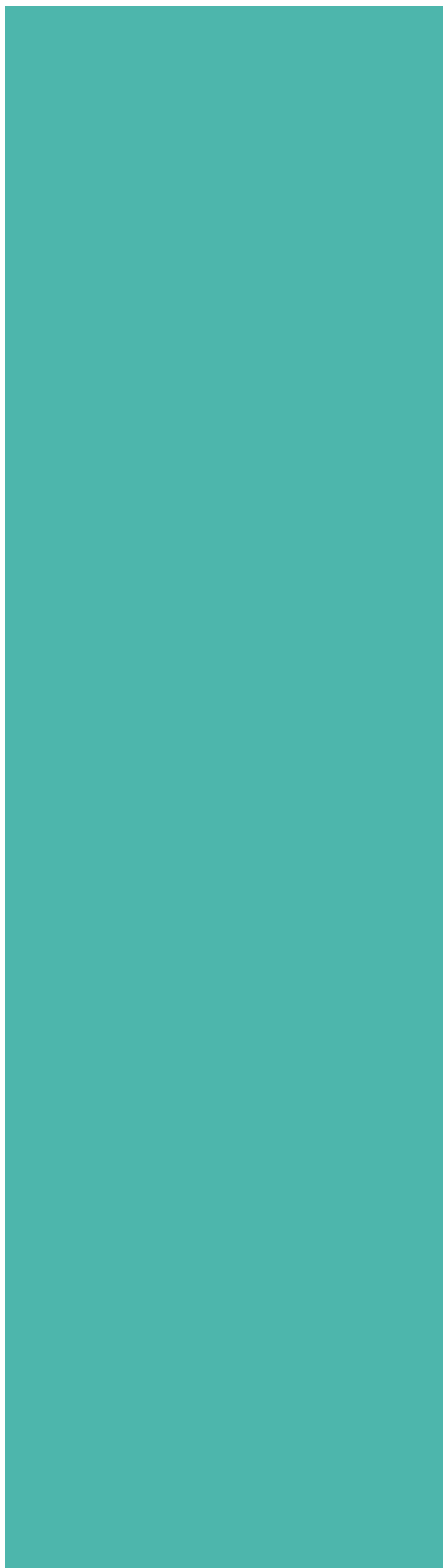
## 3% NaCl

- In patients with severe symptoms of hyponatremia (eg, seizures, obtundation, coma, respiratory arrest) we treat with a 50-100 mL bolus of 3 percent saline

## Correcting too rapidly

- A goal rate of correction of approximately 6-8 mEq/L per day is reasonable.
- Osmotic Demyelination Syndrome: The majority of ODS cases occur in patients whose sodium concentrations at presentation are  $\leq 120$  mEq

# Cases



### Fluid, Electrolyte, and Acid-Base Disorders Question 21

A 22-year-old woman is evaluated in the emergency department because of severe dizziness, weakness, nausea, and vomiting of 1 week's duration. She has noted fatigue and moderate weight loss over the preceding 2 months. She has a history of hypothyroidism and takes levothyroxine, 100 µg/d.

On physical examination, the patient is 168 cm (66 in) tall and weighs 53 kg (116 lb). Blood pressure is 90/60 mm Hg supine and 80/50 mm Hg standing, and pulse rate is 84/min supine and 96/min standing. The skin is well tanned, and there is markedly increased pigmentation of the gums and palmar creases.

Hematocrit	40%
Serum creatinine	1.2 mg/dL
Blood uric acid	39 mg/dL
Serum sodium	124 meq/L
Serum potassium	6.8 meq/L
Plasma glucose	61 mg/dL

**What is the most likely underlying cause of the hyponatremia?**

- (A) Acute adrenal hemorrhage
- (B) Autoimmune adrenalitis (Addison's disease)
- (C) Fulminant meningococemia
- (D) Pituitary apoplexy
- (E) Tuberculosis

### Approaching questions

1. Read question first
2. Symptoms
3. Vitals
4. Physical exam findings
5. Pertinent lab findings

**Item 32**

A 23-year-old man with HIV infection is evaluated in the office during a follow-up examination. He was hospitalized 1 week ago with *Pneumocystis jirovecii* (formerly *Pneumocystis carinii*) pneumonia, which is being treated with trimethoprim-sulfamethoxazole and prednisone. During his hospitalization, he was diagnosed with hyponatremia. He feels well, and his condition has significantly improved since his discharge 3 days ago.

On physical examination, temperature is 36.6 °C (97.8 °F), heart rate is 84/min, respiration rate is 12/min, and blood pressure is 110/60 mm Hg without orthostatic changes. He appears thin and in no apparent distress. Cardiac examination is normal. The lungs are clear. There is no peripheral edema. Neurologic examination, including mental status, is normal.

## Laboratory studies:

Glucose	122 mg/dL
Blood urea nitrogen	12 mg/dL
Creatinine	0.7 mg/dL
Sodium	111 mcq/L
Potassium	3.6 mcq/L
Chloride	96 mcq/L
Bicarbonate	22 mcq/L
Serum osmolality	246 mosm/kg H <sub>2</sub> O
Urine sodium	117 mcq/L
Urine osmolality	453 mosm/kg H <sub>2</sub> O

**Which of the following is the most likely cause of this patient's hyponatremia?**

- (A) Adrenal insufficiency
- (B) Pseudohyponatremia
- (C) Psychogenic polydipsia
- (D) Syndrome of inappropriate antidiuretic hormone secretion
- (E) Volume depletion

**Approaching questions**

1. Read question first
2. Symptoms
3. Vitals
4. Physical exam findings
5. Pertinent lab findings



**Item 29**

A 55-year-old man with coronary artery disease is evaluated in the office 2 weeks after having had a myocardial infarction. On hospital discharge, his medications were aspirin, sustained-release metoprolol, isosorbide mononitrate, lisinopril, furosemide, and atorvastatin. Echocardiogram at that time showed inferior and posterior wall akinesis and a left ventricular ejection fraction of 40%.

On examination today, heart rate is 60/min and blood pressure is 130/70 mm Hg. Jugular venous pressure is normal and the lungs are clear. Cardiac rhythm is regular, with normal S<sub>1</sub> and S<sub>2</sub> and no murmurs or extra heart sounds. Laboratory results from yesterday are potassium 5.7 meq/L, serum creatinine 1.0 mg/dL, and LDL cholesterol 65 mg/dL.

**Which of the following medications should be stopped in this patient?**

- (A) Atorvastatin
- (B) Aspirin
- (C) Furosemide
- (D) Lisinopril
- (E) Metoprolol

**Item 31**

A 61-year-old woman is hospitalized for a 5-day history of nausea and vomiting and decreased oral intake and a 2-day history of postural lightheadedness. Her creatinine level is 7 mg/dL (creatinine level 1 month ago was 1 mg/dL). She has a history of hypertension and type 2 diabetes mellitus. Medications are aspirin, glipizide, enalapril, and chlorthalidone.

On physical examination, heart rate is 98/min and blood pressure is 85/60 mm Hg. Skin turgor is decreased. Cardiac and pulmonary examinations are normal. There is no peripheral edema. On neurologic examination, she is alert and oriented and there are no focal neurologic signs.

Laboratory studies:

Blood urea nitrogen	85 mg/dL
Creatinine	8 mg/dL
Sodium	120 meq/L
Potassium	3.7 meq/L
Chloride	86 meq/L
Bicarbonate	26 meq/L
Urinalysis	Several hyaline casts/hpf
Urine sodium	4 meq/L

**Which of the following is the next best step in this patient's management?**

- (A) Dialysis
- (B) Fluid restriction
- (C) Intravenous normal (0.9%) saline
- (D) Intravenous 3% sodium chloride

**Item 30**

A 73-year-old woman is brought to the emergency department after falling at home. Her family states that she has been very confused and disoriented over the past 2 days and that she began therapy with a new medication 4 days ago. She has type 2 diabetes mellitus, hypertension, and glaucoma. A bag containing the patient's medications includes glyburide, metformin, hydrochlorothiazide, acetazolamide, and enalapril.

On physical examination, temperature is 37 °C (98.6 °F), heart rate is 68/min, respiration rate is 12/min, and blood pressure is 115/65 mm Hg. She is confused and unable to

answer questions appropriately. Cardiac examination is normal. The lungs are clear. There is no edema.

Laboratory studies:

Blood urea nitrogen	17 mg/dL
Creatinine	1.1 mg/dL
Sodium	107 meq/L
Potassium	2.9 meq/L
Chloride	76 meq/L
Bicarbonate	24 meq/L

**Therapy with which of the following drugs was most likely recently started in this patient?**

- (A) Acetazolamide
- (B) Enalapril
- (C) Glyburide
- (D) Hydrochlorothiazide
- (E) Metformin

60-year-old male presents to the clinic to review labs. He has a history of hypertension, diabetes, and lung cancer for which he is undergoing treatment. He voices no complaints at this time. He underwent a colonoscopy two years ago that did not identify any lesions or polyps. He is up to date with his eye exams. His only medications are metformin and lisinopril. His physical exam does not reveal any jugular venous distention (JVD), lower extremity edema, or other abnormality. Other results include:

- Sitting blood pressure 124/82mmHg
- Standing blood pressure 120/80mmHg
- HgbA1c is 6.4%
- CBC – unremarkable
- Lipid panel shows an LDL 58mg/dL
- CMP is normal except for a sodium level of 123mg/dL
- Serum osmolarity 250mOsm/L

He says his appetite has been great and denies any weight loss. He also denies vomiting or diarrhea. Which of the following is the best solution for his hyponatremia at this time?

- A. Furosemide
- B. 3% normal saline
- C. 0.9% normal saline
- D. Fluid restriction and possibly demecocycline
- E. 5% dextrose in water (D5W solution)

A 24 year old woman presents to the ER via ambulance. History provided by her friends shows she was at a party when she became more and more confused over the course of the evening, symptoms which initially were attributed to alcohol consumption.

On arrival to the ER patient is noted to be obtunded. Blood pressure is 86/60 with a heart rate of 80 and a normal temperature. Patient responded to painful stimuli by withdrawing.

Her initial labs showed a sodium for 116, creatinine of 2.1 and a potassium of 3.1. Her hemoglobin was normal and she had an elevated lactate.

Which of the following is the most appropriate next step:

- a) Administer isotonic saline
  - b) Insert a central IV
  - c) Administer 3% hypertonic saline
  - d) Administer antibiotics
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