Fluids and electrolytes

Overload and deficit, sodium, potassium, calcium, magnesium and phosphate

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1 AT A GLANCE

The scale and the intake record catch most fluid problems. Sodium mostly affects the brain, potassium mostly affects the heart, and both can turn dangerous fast.

Too much or too little fluid

Check	Overload	Deficit
Causes	Heart failure, kidney failure, cirrhosis, pregnancy	Vomiting, diarrhea, sweating, fever, bleeding, diuretics, not drinking enough
★ **BP, pulse**	High BP; bounding pulses	Low BP; fast, weak, thready pulse
Lungs, neck veins	Crackles (often first in the lower back of the lungs); distended neck veins	Clear; flat neck veins
Skin, mouth	Tight, swollen, shiny	Tenting; dry, sticky mouth
Urine	May fall	Low, dark, concentrated
★ **Weight**	**Up over 1 kg a day**	**Down over 1 kg a day**

Trap: Heavy edema can hide a deficit: the vessels can still be dry, with low pressure and a fast, thready pulse.

Sodium: about 136 to 145 mEq/L, by lab

	High sodium	Low sodium
Causes	Water loss (too little drinking, vomiting, diarrhea) or too much salt	Too much water or hypotonic IV fluid, diuretics; also heart failure, cirrhosis, kidney disease, SIADH, underactive thyroid, SSRIs
Cells	Shrink	Swell
★ **Signs (brain)**	Confusion, irritability, lethargy, seizures; severe thirst, sticky mouth	Headache, confusion, vomiting, cramps, seizures, coma
Treatment	Less salt, controlled free water (like dextrose 5% in water). Low-volume shock: **isotonic fluid first**	Isotonic saline if volume-depleted; restrict water if water excess. Severe symptoms: emergency **3 percent saline bolus protocol**

Watch: Check sodium serially, stay within the ordered correction limits, and watch mental status: seizures can follow.

Potassium: about 3.5 to 5.1 mEq/L

	High potassium	Low potassium
Causes	Kidney failure, acidosis, potassium-sparing diuretics, ACE inhibitors, supplements	Vomiting, diarrhea, potassium-wasting diuretics, insulin, poor diet; low magnesium
Signs	Irritability, cramps, diarrhea; **often silent** until it shows in the heart rhythm	Weakness, lethargy, thready pulse, arrhythmias; makes digoxin more toxic
★ **ECG**	**Peaked T** from about 5.5 mEq/L. Above about 6.5: flat P, long PR, **wide QRS**; can slide into sine wave and arrest	ST dip, flat or inverted T, **U waves**, long QT (torsades risk)
★ **Treatment**	Severe: **IV calcium gluconate first** to protect the heart; insulin with dextrose; binder, loop diuretic or dialysis. Mild: cut dietary potassium, review drugs like spironolactone	Food, oral or IV potassium, run slowly. Check the kidneys first, recheck after; check magnesium

Never IV push: IV push potassium can stop the heart. Give it diluted and slow: the label limits it to about 10 mEq an hour in most cases; faster needs continuous heart monitoring.

Calcium, magnesium and phosphate (use your lab's range)

Normal	Too high	Too low
Total calcium about 8.6 to 10.2 mg/dL. Ionized calcium is a separate test with its own range	Immobility, cancer, overactive parathyroid. Slows things: nausea, vomiting, constipation, thirst, more urine, weak muscles	Low parathyroid hormone (as after the glands are removed), low vitamin D, kidney disease, high phosphorus. Twitchy: tingling lips, hands and feet, cramps, tetany, **long QT**
Magnesium about 1.5 to 2.4 mg/dL	Kidney failure, too much replacement, magnesium laxatives or antacids. Slows: slow, weak pulse, lethargy, **weak reflexes**, cardiac arrest	Poor diet, loop diuretics, alcohol use disorder, long-term PPIs. Excitable: tremor, leg cramps, dysrhythmias, tetany
Phosphorus about 2.5 to 4.5 mg/dL in adults	Kidney disease, crush injuries, too many phosphate enemas. Usually silent; the low calcium it causes can show as tingling and cramps	Alcohol misuse, burns, diuretics, starvation, recovering DKA; **refeeding** can drop it fast. Severe: weakness, confusion, seizures

Not always opposite: Calcium and phosphate often move in opposite directions in parathyroid hormone patterns, but not always: low vitamin D can lower both.

Educational use only. Not a substitute for clinical judgment, your facility's policy or the provider's orders. Where practice varies, follow facility policy and state law. No patient information.

Fluids and electrolytes

1 AT A GLANCE, CONTINUED

Measuring fluid status

- Daily weights: same scale, same time of day, similar clothing. **1 kg in 24 h is about 1 liter**: report it.
- ★ Urine is about 1,500 mL a day. Adults: report under about **0.5 mL/kg/h**, or a falling trend. 30 mL/h matches that only at 60 kg.
- Urine specific gravity, typically 1.005 to 1.030 by your lab, rises when urine is concentrated. Hematocrit and BUN rise when the blood is concentrated.

Follow policy: Report low BP by ordered parameters or policy (a systolic under 100 mmHg is one example), weighing baseline and symptoms.

Care

- Overload: head of bed up, diuretics as ordered, fluid and sodium limits (ice chips count in the limit). Watch the lungs.
- Deficit: treat the cause, IV fluids as ordered, preferred fluids every 1 to 2 hours, oral rehydration for losses. Check orthostatics.
- Moderate coffee or tea still counts; limit excess caffeine, alcohol, and prune juice with loose stools.

2 PRIORITY AND SAFETY CALLS

Treatment can swing a client from one problem to the other: **reassess before every intervention**, and listen to the lungs during IV fluids.

New crackles and breathlessness during IV fluids: slow the infusion per protocol, raise the head of the bed, notify the provider.

Report signs of shock at once: fast pulse and breathing, falling pressure, cold, clammy skin, confusion.

A widening QRS with high potassium is an **emergency**.

★ Hemolyzed high potassium: report it, assess the client, expect an urgent repeat. A normal ECG doesn't rule out danger; don't delay indicated treatment.

Insulin for high potassium goes with dextrose; check glucose often, sometimes hourly.

Newly confused on a diuretic or an SSRI: check the sodium.

After parathyroid surgery: ask about tingling, and report twitching or spasm at once.

★ Magnesium sulfate: lost knee reflexes or slow breathing mean toxicity. **Stop the infusion**, get help, and give IV calcium gluconate per protocol.

4 SELF-QUIZ

1. A weight change of 1 kg in 24 hours is about 1 _____ of fluid.
2. For adults, report urine under about _____ mL/kg/h.
3. Normal sodium is about 136 to _____ mEq/L.
4. Potassium is never given by IV _____.
5. Peaked T waves can appear from a potassium of about _____ mEq/L.
6. A facial twitch when you tap over the facial nerve is _____'s sign.
7. Lost knee reflexes on magnesium sulfate: _____ the infusion.

ANSWER KEY 1. liter · 2. 0.5 · 3. 145 · 4. push · 5. 5.5 · 6. Chvostek · 7. stop

3 EXAM ANCHORS

1. Overnight gain over 1 kg in heart failure: assess the lungs and breathing, and report it.
2. Trap: assuming edema means full vessels, or weighing on a different scale.
3. First drug for dangerous high potassium with ECG changes: IV calcium gluconate, then insulin with dextrose.
4. High potassium: peaked T waves, wide QRS. Low potassium: flat T waves, U waves.
5. Tingling plus a positive Chvostek's sign after parathyroid surgery: low calcium.
6. Trousseau's sign: hand spasm with a BP cuff inflated above systolic for 3 minutes.
7. Traps: magnesium antacids in kidney failure, and missing a low magnesium when potassium or calcium won't come up.

5 SOURCES

1. Open RN, Nursing Fundamentals 2e, 15.4 Electrolytes. wtcs.pressbooks.pub/nursingfundamentals/chapter/15-4-el…
2. Open RN, Nursing Fundamentals 2e, 15.2 Basic Fluid and Electrolyte Concepts. wtcs.pressbooks.pub/nursingfundamentals/chapter/15-2-ba…
3. Open RN, Nursing Fundamentals 2e, 15.6 Applying the Nursing Process. wtcs.pressbooks.pub/nursingfundamentals/chapter/15-6-ap…
4. KDIGO consensus on potassium disorders (PubMed Central). pmc.ncbi.nlm.nih.gov/articles/PMC7448835
5. Society for Endocrinology emergency guidance: severe symptomatic hyponatremia (PubMed Central). pmc.ncbi.nlm.nih.gov/articles/PMC5314809
6. Endotext, mineral homeostasis (NCBI Bookshelf). ncbi.nlm.nih.gov/books/NBK279023
7. DailyMed, Potassium Chloride for Injection Concentrate label. dailymed.nlm.nih.gov/dailymed/drugInfo.cfm
8. AHRQ PSNet WebM&M, A Fatal Twist in Pseudohyperkalemia (2024). psnet.ahrq.gov/web-mm/fatal-twist-pseudohyperkalemia

Built from RN PocketPal course lessons: Fluid balance: deficit and overload (c07-l01); Sodium and potassium (c07-l02); Calcium, magnesium and phosphate (c07-l03). Every line on this sheet comes from those lesson scripts.

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