FUNDAMENTALS OF NURSING · STUDY GUIDE

Exam 8 Study Guide

This guide covers chapters 15 and 16. Chapter 15 is fluids, electrolytes and acid base: where water lives and moves, how to tell deficit from excess, what each electrolyte does when it is too high or too low, how to read a blood gas in five steps, and how to give IV fluids and blood safely. Chapter 16 is nutrition: the fuels and their energy, needs across the lifespan, screening for malnutrition, keeping a patient with dysphagia safe, and feeding through a tube or a vein. Work every blood gas and every calculation yourself before reading the steps.

WHAT THIS GUIDE COVERS

- Chapter 15 · ICF and ECF, osmosis, diffusion, filtration and active transport, edema and third spacing, thirst, ADH, RAAS and natriuretic peptides, intake and output, deficit versus excess, orthostatic checks, daily weights, sodium, potassium, calcium and magnesium imbalances, buffers, lungs and kidneys, the four acid base imbalances, ROME and compensation, isotonic, hypotonic and hypertonic fluids, starting and maintaining IVs, infiltration, extravasation, phlebitis, flow rates and blood transfusion.
- Chapter 16 · carbohydrates, fiber, protein, fats, vitamins, minerals and water, 4 4 9 7 energy math, protein and fluid needs, dietary guideline limits, infancy, childhood, adolescence, pregnancy and older adults, cultural and religious food practices, food insecurity screening, MST and MNA-SF, weight loss thresholds, BMI, albumin and prealbumin limits, malnutrition signs, diet progression, dysphagia and IDDSI levels, aspiration precautions, tube types and placement, feeding and medication administration, refeeding syndrome and parenteral nutrition.

CHAPTER 15

Fluid, Electrolyte and Acid Base Balance

Read it in full: **Chapter 15 in the textbook**. Practice it in the lab: **Fluid Balance Bench** and **Blood Gas Interpreter**.

What to know

Water is about 60% of a lean adult man's weight, 70 to 80% of an infant's and about 45 to 50% of an older adult's; both extremes of age dehydrate fast. About two thirds is **intracellular** (potassium,

magnesium, phosphate) and one third **extracellular** (sodium, chloride, bicarbonate): interstitial about three quarters of the ECF, plasma about one quarter. Lab tests sample plasma.

Osmosis moves water toward higher solute concentration (serum osmolality about 275 to 295 mOsm/kg). **Diffusion** moves solutes down a gradient. **Filtration**: hydrostatic pressure pushes fluid out of capillaries; **oncotic pressure** from albumin pulls it back. **Active transport** uses energy (the sodium potassium pump moves 3 sodium out for 2 potassium in). Edema follows high hydrostatic pressure, low albumin, leaky capillaries or blocked lymph. **Third spacing** traps fluid where it cannot support circulation.

Regulation: thirst (blunted in older adults); **ADH** retains water and concentrates urine; the **renin angiotensin aldosterone system** constricts vessels and retains sodium and water while excreting potassium; **natriuretic peptides** (ANP, BNP) excrete sodium and water (BNP marks heart failure). Report adult urine output below about 30 mL/hour (0.5 mL/kg/hour). Intake includes liquids at room temperature, ice chips at **half** their volume, flushes, IV fluids and blood; output includes urine, emesis, liquid stool, suction and drains. Insensible loss is about 800 to 1,000 mL a day.

Fluid volume deficit: weight loss, rapid weak pulse, orthostatic hypotension, flat neck veins, dry mucosa, scant concentrated urine (specific gravity above about 1.030), high hematocrit and BUN (BUN to creatinine above 20:1), confusion in older adults. **Fluid volume excess**: weight gain, bounding pulse, hypertension, distended neck veins, crackles, dyspnea, pitting edema, low hematocrit and BUN. Turgor is unreliable in older adults. Orthostatic changes: systolic drop of 20, diastolic drop of 10 or pulse rise of 20.

Daily weight is the best bedside measure: 1 kg is about 1 L. Weigh at the same time (early morning after voiding, before breakfast), on the same scale, in the same clothing, and compare with yesterday. Many programs teach reporting a gain of more than 1 kg (2 to 3 lb) in a day or about 2 kg (5 lb) in a week. Deficit care: oral or isotonic IV fluids, fall precautions, oral care. Excess care: fluid and sodium restriction spread over the day, diuretics with potassium checks, semi Fowler's, skin protection.

Sodium 135 to 145 mEq/L; problems are water problems and show in the **brain**. Hyponatremia (sodium loss or water gain, SIADH): headache, confusion, seizures; correct slowly (commonly no more than about 8 to 10 mEq/L in 24 hours) to avoid osmotic demyelination. Hypernatremia (water loss, poor access to water, diabetes insipidus): thirst, sticky mucosa, agitation; replace water gradually to avoid cerebral edema.

Potassium 3.5 to 5.0 mEq/L; problems show in the **heart and muscles**. Hypokalemia (diuretics, vomiting, suction, diarrhea, insulin, alkalosis): weakness, cramps, ileus, flat T waves and **U waves**, and raised digoxin toxicity risk. Give oral potassium with food and water; IV potassium is **never IV push or IM**, always diluted on a pump, commonly no faster than about 10 mEq/hour peripherally, after confirming urine output. Hyperkalemia (kidney failure, potassium sparing diuretics, ACE inhibitors, acidosis, tissue breakdown; rule out a hemolyzed sample): weakness, **tall peaked T waves**, wide QRS. Treat with monitoring, IV calcium gluconate, insulin with dextrose, binders, diuretics or dialysis.

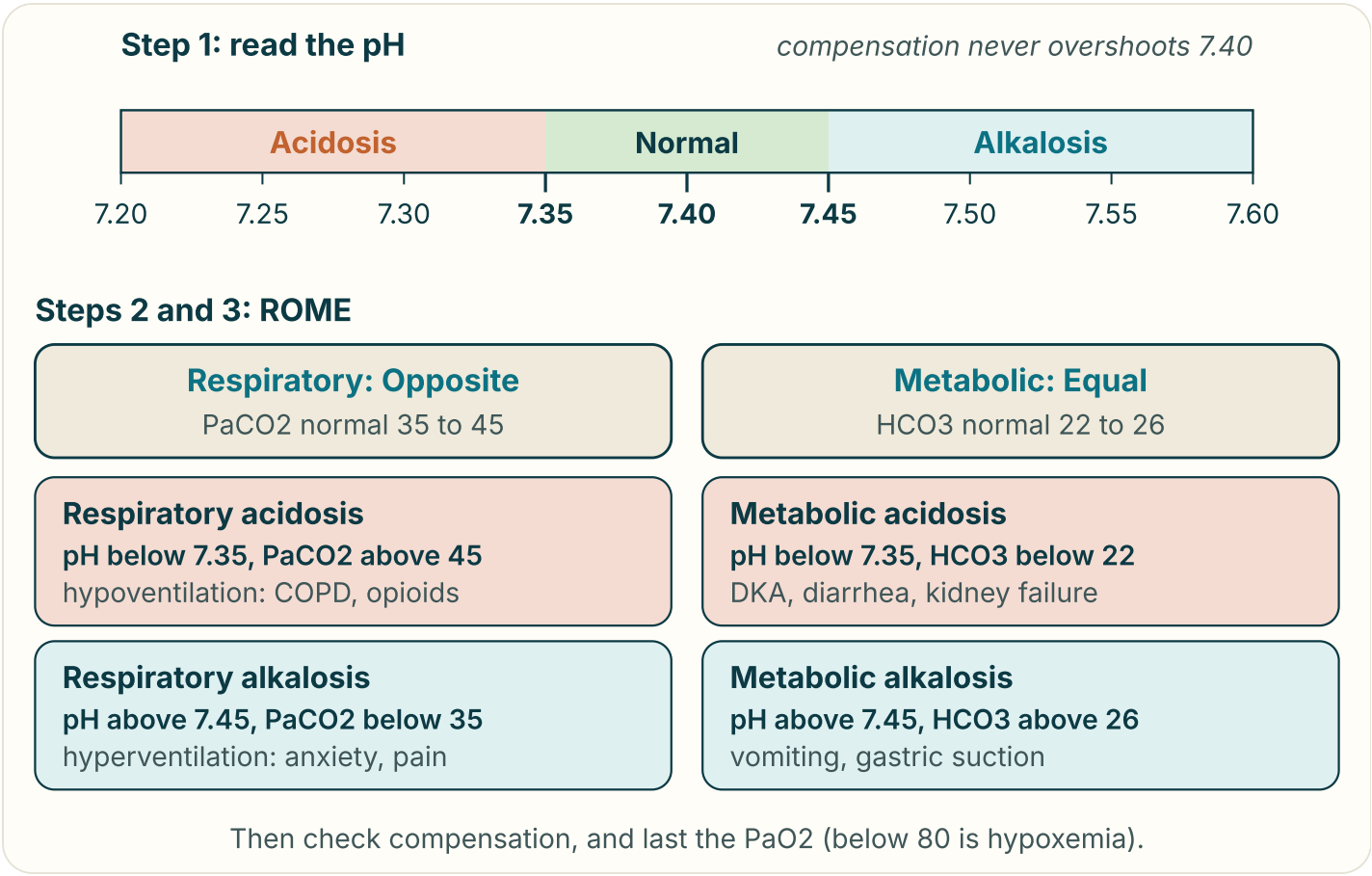
Calcium total about 9.0 to 10.5 mg/dL. Low calcium makes nerves excitable: tingling, cramps, tetany, **Trousseau** (carpal spasm with a BP cuff) and **Chvostek** (facial twitch when the facial nerve is tapped), laryngospasm, seizures, long QT; causes include thyroid or parathyroid surgery, kidney failure, low vitamin D, pancreatitis and massive transfusion. High calcium makes them sluggish: weakness, low reflexes, constipation, kidney stones, short QT; treat with saline, then loop diuretics, mobility and fluids. **Magnesium** about 1.5 to 2.5 mEq/L: low looks like low calcium (and keeps potassium from correcting); high causes flushing, hypotension, lost reflexes and respiratory depression, with calcium gluconate as the antidote.

pH 7.35 to 7.45. **Buffers** act in seconds, the **lungs** (CO_2, an acid) in minutes, the **kidneys** (HCO_3, a base) over hours to days. Compensation never overshoots past 7.40. Respiratory acidosis: pH low, $PaCO_2$ above 45 (hypoventilation: COPD, opioids, obstruction). Respiratory alkalosis: pH high, $PaCO_2$ below 35 (hyperventilation: anxiety, pain, early PE). Metabolic acidosis: pH low, HCO_3 below 22 (DKA, lactic acidosis, kidney failure, diarrhea), with Kussmaul breathing. Metabolic alkalosis: pH high, HCO_3 above 26 (vomiting, gastric suction, antacids, diuretics with low potassium). Acidosis tends to raise potassium; alkalosis lowers it.

Read a gas in five steps: pH; PaCO2 (moves **opposite** to pH when respiratory); HCO3 (moves the **same** way when metabolic) = **ROME**; compensation (other value normal: uncompensated; other value abnormal the opposite way with pH still abnormal: partially compensated; both abnormal with pH normal: fully compensated, and the side of 7.40 names the cause); then PaO2 (below 80 is hypoxemia).

IV fluids: **isotonic** (0.9% saline, lactated Ringer's) expand the ECF; normal saline is the only fluid with blood; LR holds potassium and lactate; D5W acts hypotonic once the dextrose is used. **Hypotonic** (0.45% saline) swells cells; avoid with raised ICP, stroke, head injury, burns and hypovolemia. **Hypertonic** (3% saline, D10W, D5 0.45% NaCl, D5 0.9% NaCl, D5LR) pulls water into vessels; risk of overload. Start IVs distally on the nondominant arm, avoid the fistula or mastectomy side, smallest catheter that works, chlorhexidine dried completely, two attempts per clinician. **Infiltration**: cool, swollen, pale; stop and remove. **Extravasation**: vesicant, follow protocol. **Phlebitis**: red, warm, cordlike vein; remove and apply warmth. Fluid overload: slow, sit up, notify. Air embolism: clamp, left side head down, oxygen.

Blood: consent, type and crossmatch, a good IV (often 18 to 20 gauge), Y set primed with **0.9% saline only**, baseline vital signs, two person bedside check, start within about 30 minutes of pickup, go slowly and **stay for the first 15 minutes**, finish within **4 hours**. One unit of packed cells raises hemoglobin about 1 g/dL. For any reaction (acute hemolytic: fever, chills, back pain, hypotension, dark urine; allergic; febrile; circulatory overload): **stop** the transfusion, disconnect at the hub, keep the vein open with new tubing and saline, stay, notify the provider and blood bank, return the bag and tubing.



pH first, then ROME. In respiratory problems pH and PaCO2 move in opposite directions; in metabolic problems pH and HCO3 move the same way.

LOCK THESE IN

- Two thirds ICF, one third ECF; plasma is the smallest compartment.
- Ice chips count as half; report urine below about 30 mL/h.
- Daily weight: 1 kg is about 1 L; same time, scale and clothing.
- Deficit concentrates (high Hct, BUN); excess dilutes (low Hct, BUN).
- Na 135 to 145 (brain); K 3.5 to 5.0 (heart); Ca about 9 to 10.5; Mg about 1.5 to 2.5.
- Potassium never IV push. Peaked T in high K; U wave in low K.
- ROME: respiratory opposite, metabolic equal; compensation never overshoots.
- Blood: saline only, stay 15 minutes, done in 4 hours, stop at the first reaction sign.

Key terms and comparisons: electrolyte imbalances

Imbalance	Common causes	Key signs and care
Hyponatremia (below 135)	Diuretics, vomiting, water gain, SIADH	Headache, confusion, seizures; restrict water or replace sodium; correct slowly
Hypernatremia (above 145)	Water loss, no access to water, diabetes insipidus	Thirst, sticky mucosa, agitation; replace water gradually
Hypokalemia (below 3.5)	Loop and thiazide diuretics, vomiting, suction, insulin	Weakness, cramps, U waves, digoxin toxicity; IV K on pump only
Hyperkalemia (above 5.0)	Kidney failure, spironolactone, ACE inhibitors, acidosis	Peaked T, wide QRS; calcium gluconate, insulin and dextrose, binders
Hypocalcemia	Thyroid or parathyroid surgery, kidney failure, pancreatitis	Tetany, Trousseau, Chvostek, long QT; seizure and airway readiness
Hypercalcemia	Hyperparathyroidism, cancer, immobility	Weakness, stones, constipation, short QT; saline, then loop diuretic
Hypermagnesemia	Kidney failure, antacids, IV magnesium	Lost reflexes, respiratory depression; calcium gluconate

Priority rules: acid base patterns and IV fluids

Pattern or fluid	Rule
Respiratory acidosis	pH below 7.35, PaCO2 above 45: hypoventilation
Respiratory alkalosis	pH above 7.45, PaCO2 below 35: hyperventilation
Metabolic acidosis	pH below 7.35, HCO3 below 22: DKA, diarrhea, kidney failure
Metabolic alkalosis	pH above 7.45, HCO3 above 26: vomiting, suction
Isotonic	0.9% saline, LR: expand ECF; saline with blood
Hypotonic	0.45% saline: swell cells; avoid in raised ICP
Hypertonic	3% saline, D5 0.45% NaCl, D10W: pull water into vessels
Flow rate	mL/h = mL / h; gtt/min = mL x DF / min

Worked cases

WORKED CASE 1 · TOTALING INTAKE AND OUTPUT

Over 8 hours Mr. Quist, 64, receives 1,000 mL IV fluid, 200 mL of ice chips, 240 mL of juice and 90 mL of tube flushes. Urine output is 300 mL and his NG tube drained 350 mL.

STEP 1 · COUNT ICE CHIPS AT HALF

200 mL / 2 = 100 mL.

STEP 2 · TOTAL INTAKE

1,000 + 100 + 240 + 90 = **1,430 mL**.

STEP 3 · TOTAL MEASURED OUTPUT

300 + 350 = **650 mL**.

STEP 4 · CHECK HOURLY URINE

300 / 8 = **37.5 mL/hour**, above the 30 mL/hour floor.

WATCH

Large NG losses remove fluid, sodium, potassium, chloride and acid, setting up hypokalemia and metabolic alkalosis.

WORKED CASE 2 · READING THREE BLOOD GASES

Interpret: (A) pH 7.30, PaCO2 55, HCO3 24. (B) pH 7.48, PaCO2 40, HCO3 33. (C) pH 7.36, PaCO2 30, HCO3 17.

STEP 1 · GAS A

pH low is acidosis. PaCO2 high moves opposite: respiratory. HCO3 normal: **uncompensated respiratory acidosis** (think opioid oversedation).

STEP 2 · GAS B

pH high is alkalosis. PaCO2 normal. HCO3 high moves the same way: metabolic. PaCO2 normal: **uncompensated metabolic alkalosis** (think vomiting or suction).

STEP 3 · GAS C

pH normal but on the acid side of 7.40. HCO3 low explains acidosis: metabolic. PaCO2 low is the lungs compensating, and pH is normal: **fully compensated metabolic acidosis**.

RULE

When both values are abnormal and pH is normal, the side of 7.40 names the primary problem.

WORKED CASE 3 · LOW POTASSIUM AND DIGOXIN

Mr. Kaminski, 74, takes furosemide and digoxin. He has nausea, leg cramps and yellow halos. Potassium is 2.9 mEq/L and new PVCs appear on the monitor.

STEP 1 · CONNECT THE CUES

A loop diuretic lowered potassium; low potassium increases digoxin sensitivity and toxicity.

STEP 2 · ACT

Hold the digoxin, start continuous cardiac monitoring, notify the provider, expect a digoxin level.

STEP 3 · REPLACE SAFELY

IV potassium diluted on a pump at a safe rate after confirming urine output.

RULE

IV push potassium can stop the heart.

WORKED CASE 4 · A TRANSFUSION REACTION

Ten minutes into a unit of packed cells, Mr. Asare, 58, has chills and low back pain. Temperature rose from 37.0 to 38.6 C and BP fell from 132/78 to 96/58.

STEP 1 · RECOGNIZE

Early fever, chills, back pain and hypotension suggest an acute hemolytic reaction.

STEP 2 · STOP

Stop the transfusion and disconnect the blood tubing at the hub.

STEP 3 · KEEP THE VEIN OPEN

New tubing with 0.9% saline; do not flush the blood in the line into him.

STEP 4 · STAY AND REPORT

Monitor vital signs and urine output, notify the provider and blood bank, return the bag and tubing.

RULE

Slowing the rate or giving acetaminophen and continuing lets more incompatible blood in.

TRAPS PEOPLE FALL INTO

- **Counting ice chips at full volume.** Ice chips count as about half.
- **Relying on skin turgor in an older adult.** Turgor is unreliable with age. Use weight, orthostatics, urine and labs.
- **Weighing on different scales at different times.** Same scale, same time, same clothing.
- **Correcting sodium fast.** Rapid correction risks osmotic demyelination or cerebral edema.
- **Giving IV potassium before checking urine output.** The kidneys excrete potassium. No urine, no potassium.
- **Treating Kussmaul breathing with a sedative.** Deep fast breathing in DKA is compensation.
- **Calling D5W isotonic for volume.** It acts hypotonic once the dextrose is used.
- **Priming blood tubing with D5W or LR.** Dextrose hemolyzes cells and LR has calcium. Use 0.9% saline only.
- **Continuing a transfusion at a slower rate after a reaction.** Stop it at the first sign.

Chapter 15 self-test · ten items

1. Which compartment holds about two thirds of total body water?

A. Transcellular fluid

B. Intracellular fluid

C. Interstitial fluid

D. Intravascular plasma

B. Intracellular fluid About two thirds is inside cells. Interstitial and plasma make up the extracellular third.

2. A patient drank 300 mL of tea and ate 160 mL of ice chips. How much intake should be recorded?

A. 300 mL
B. 540 mL
C. 460 mL
D. 380 mL

D. 380 mL Ice chips count as about half: 300 + 80 = 380 mL.

3. A patient with heart failure is assessed after two days of IV fluids. Which group of findings points to too much fluid?

A. Bounding pulse, crackles and distended neck veins
B. Orthostatic drop, thirst and a rising BUN
C. Weak pulse, flat neck veins and dark urine
D. Dry tongue, poor turgor and a high hematocrit

A. Bounding pulse, crackles and distended neck veins Excess shows bounding pulses, crackles and JVD. The others describe deficit.

4. A patient's weight rose from 70.2 kg to 71.7 kg overnight. About how much fluid was retained?

A. About 3.0 L
B. About 0.5 L
C. About 1.5 L
D. About 0.15 L

C. About 1.5 L 1 kg is about 1 L, so 1.5 kg is about 1.5 L.

5. A potassium of 6.4 mEq/L is reported. Which ECG change should the nurse expect?

A. Tall peaked T waves
B. Prominent U waves
C. Flattened T waves
D. A shortened QT

A. Tall peaked T waves High potassium peaks the T wave and later widens the QRS. U waves suggest low potassium.

6. After thyroid surgery, a patient has tingling around the mouth and carpal spasm when the BP cuff inflates. What is likely?

A. Hyperkalemia
B. Hypocalcemia
C. Hypernatremia
D. Hypercalcemia

B. Hypocalcemia Trousseau sign and perioral tingling point to low calcium, often from parathyroid injury.

7. Interpret this gas: pH 7.29, PaCO2 30, HCO3 15.

A. Fully compensated metabolic acidosis now
B. Partially compensated respiratory alkalosis
C. Partially compensated metabolic acidosis
D. Uncompensated respiratory acidosis now

C. Partially compensated metabolic acidosis Low pH with low HCO3 is metabolic acidosis; low PaCO2 is compensation, and pH is still abnormal.

8. Which IV fluid should be avoided in a patient with a head injury?

A. 0.9% sodium chloride
B. Lactated Ringer's
C. 3% sodium chloride
D. 0.45% sodium chloride

D. 0.45% sodium chloride Hypotonic fluid moves water into cells and can worsen cerebral edema.

9. An IV site is cool, swollen and pale, and the infusion has slowed. What should the nurse do first?

A. Stop the infusion and remove the catheter
B. Apply a warm pack and keep it running
C. Raise the bag higher on the pole
D. Flush the catheter with saline briskly

A. Stop the infusion and remove the catheter These are signs of infiltration. Stop, remove, elevate and restart elsewhere.

10. Which solution is used to prime tubing for a blood transfusion?

A. Lactated Ringer's
B. 0.45% sodium chloride
C. 0.9% sodium chloride
D. 5% dextrose in water

C. 0.9% sodium chloride Only normal saline is compatible with blood products.

CHAPTER 16

Nutrition

Read it in full: **Chapter 16 in the textbook**. Practice it in the lab: **Nutrition Math Bench** and **Tube Feeding Safety Station**.

What to know

Macronutrients give energy: carbohydrate and protein about **4 kcal/g**, fat about **9 kcal/g**; alcohol gives about 7 kcal/g with no useful nutrients. Micronutrients (vitamins and minerals) give none. BMR is about 60 to 70% of daily energy; it rises with fever (about 7% per degree F, about 13% per degree C), infection, burns, surgery, trauma, pregnancy and growth.

Carbohydrate is the preferred fuel and is **protein sparing**. Soluble fiber lowers LDL and slows glucose; insoluble fiber adds bulk; adults need about 25 to 38 g a day, with more fluid. **Protein** builds tissue and holds fluid in vessels; complete proteins contain all nine essential amino acids. Adults need **0.8 g/kg/day**, rising to about 1.2 to 2.0 g/kg with pressure injuries, wounds, burns, surgery and critical illness. **Fats**: limit saturated fat; prefer unsaturated fats.

Fat soluble vitamins **A, D, E, K** are stored and can become toxic. Water soluble C and B vitamins are not stored (except B12). Key facts: vitamin K makes clotting factors, so keep intake consistent on warfarin (no need to avoid greens); vitamin C for collagen and iron absorption; thiamine before glucose in alcohol use disorder; folate 400 mcg before and in early pregnancy; B12 from animal or fortified foods, at risk in vegans and older adults. Minerals: iron (vitamin C helps; tea, calcium and antacids hinder), calcium with vitamin D, potassium (salt substitutes are risky in kidney disease), zinc for healing.

Water need is about **30 to 35 mL/kg/day** or about 1 mL per kcal. Older adults have blunted thirst, so offer fluids. Dietary guidelines: added sugars and saturated fat each under 10% of calories from age 2, sodium under 2,300 mg a day, alcohol up to 2 drinks a day for men and 1 for women who drink. The plate: half fruits and vegetables, a quarter grains (half whole), a quarter protein, plus dairy or a fortified alternative.

Infants: human milk as the sole food for about 6 months; breastfed infants need vitamin D 400 IU daily; mix formula exactly. Start solids at about 6 months with readiness signs. **No honey or cow's milk as the main drink before 12 months**; avoid choking foods and bottle propping. Toddlers: whole milk at 12 months, about 16 to 24 oz a day (more crowds out iron). Adolescents need 1,300 mg calcium. Pregnancy: no extra energy in the first trimester, about 340 more kcal in

the second and 450 in the third; folic acid 400 mcg; iron 27 mg; no alcohol; limit caffeine; avoid Listeria sources.

Older adults need fewer calories but the same or more nutrients: vitamin D 800 IU after 70, calcium 1,200 mg (women over 50, men over 70), B12 from fortified foods, protein often 1.0 to 1.2 g/kg to prevent **sarcopenia**. Ask about cultural and religious practices instead of assuming: kosher (no pork or shellfish, meat and dairy separate), halal (no pork or alcohol; ill people usually exempt from fasting; check medicines for alcohol or pork gelatin), many Hindus vegetarian. Vegans need B12. Screen for **food insecurity** with the two item screen and refer.

Screen every patient within 24 hours of admission (MST: score of 2 or more is at risk; MNA-SF for 65 and older). The strongest red flags are **unintentional weight loss** and **poor intake**. Significant loss: more than 5% in 1 month, 7.5% in 3 months or 10% in 6 months; percent = (usual minus current) / usual x 100. Assessment uses ABCD: anthropometric, biochemical, clinical, dietary. Record intake specifically ("ate 25% of breakfast"), not "ate poorly."

BMI = kg / m2 (18.5 to 24.9 healthy); it cannot separate muscle from fat. **Albumin** (3.5 to 5.0 g/dL, half life about 20 days) and **prealbumin** (about 15 to 36 mg/dL, half life 2 to 3 days) are negative acute phase reactants: inflammation lowers them regardless of intake. Prealbumin shows short term change faster. Signs of malnutrition: temporal and clavicle wasting, hand muscle loss, dull sparse hair, poor healing, cheilitis, glossitis, edema masking loss. Marasmus is energy deficiency with wasting; kwashiorkor is protein deficiency with edema and low albumin.

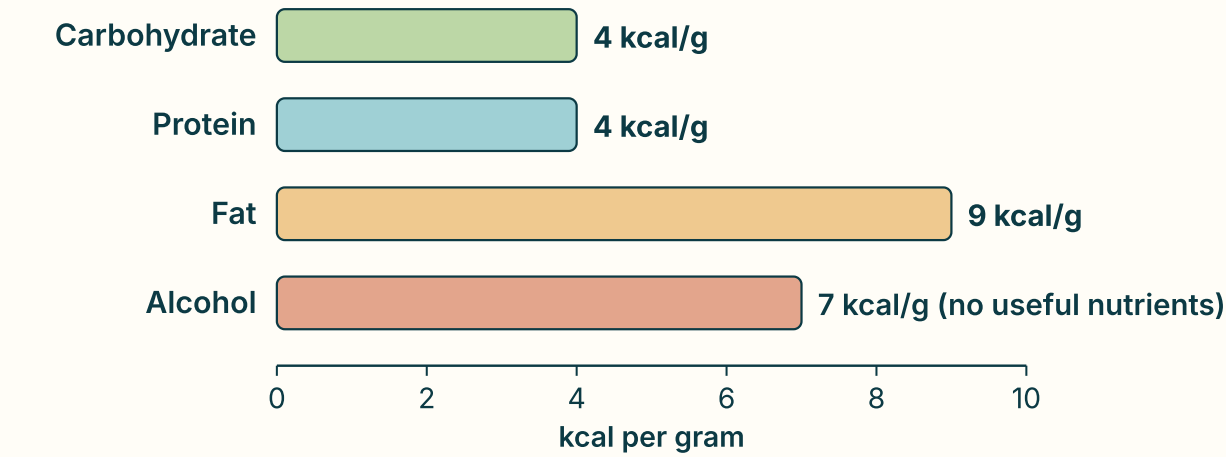
Advance diets from NPO and clear liquids only when bowel function returns and the patient is alert with a safe swallow. Clear liquids are see through at room temperature and inadequate long term. Consistent carbohydrate diets match insulin; sodium restricted diets are often 2 g. **Dysphagia** signs: coughing, wet voice, drooling, pocketing, multiple swallows; **silent aspiration** has no cough. Patients at risk need a passed **swallow screen** before any oral intake, including pills and water. IDDSI levels run drinks 0 to 4 and foods 3 to 7.

Aspiration precautions: check texture every meal and drink, upright 60 to 90 degrees for meals and 30 to 60 minutes after, alert and rested, small bites and sips, **chin tuck**, head turned to the weak side, food on the stronger side, no straws, check for pocketing, suction ready, oral care

before and after. Prepare the environment, sit at eye level, use the clock method for low vision and adaptive utensils for weakness. Feeding a patient with no swallowing risk can be delegated; a dysphagia plan that is unstable cannot.

"If the gut works, use it." Nasal tubes (NG, nasoduodenal) are short term (about 4 to 6 weeks or less); orogastric tubes are used when a nasal tube is contraindicated (basilar skull fracture); gastrostomy and jejunostomy tubes are long term; tubes past the pylorus need **continuous** feeding. NG length: **NEX** (nose, earlobe, xiphoid). An **x ray** confirms a newly placed blind tube before first use; then check the external mark and aspirate pH (gastric 5 or below). The **whoosh test** is unreliable. Keep the head of the bed **30 to 45 degrees**, pause the pump if the patient must lie flat, flush about 30 mL every 4 hours during continuous feeding, limit open system hang time to about 8 hours, change the set every 24 hours, use enteral only connectors and trace lines. Give medications one at a time with flushes; never crush extended release; unclog with warm water, not cola.

Refeeding syndrome follows restarting nutrition in a starved patient: insulin drives phosphate, potassium and magnesium into cells. The hallmark is **hypophosphatemia**, with low potassium and magnesium, fluid retention and thiamine depletion, causing heart failure, dysrhythmias and seizures. Prevent with baseline labs, slow starts, thiamine and daily electrolyte checks. **Parenteral nutrition** uses a central line (tip in the SVC), a dedicated lumen and filter, a pump, a new bag at least every 24 hours, glucose checks every 4 to 6 hours at first, and strict asepsis. If the bag runs out, hang **10% dextrose** at the same rate; never speed up to catch up. Fever and chills suggest a line infection.



Worked example: 30 g carbohydrate, 10 g protein and 8 g fat
= (30 × 4) + (10 × 4) + (8 × 9) = 120 + 40 + 72 = 232 kcal

Four, four, nine. Multiply grams by 4 for carbohydrate and protein and by 9 for fat, then add. Vitamins and minerals add no calories.

LOCK THESE IN

- 4, 4, 9, 7 kcal per gram: carbohydrate, protein, fat, alcohol.
- Protein 0.8 g/kg, rising to 1.2 to 2.0 g/kg with wounds and illness; fluid 30 to 35 mL/kg.
- A, D, E, K are fat soluble. On warfarin keep vitamin K steady.
- No honey or cow's milk before 12 months; folic acid 400 mcg before pregnancy.
- Unintentional weight loss and poor intake beat albumin as warning signs.
- Swallow screen before anything by mouth after stroke; chin tuck, no straws, upright.
- X ray before first use of a blind tube; whoosh test is unreliable; HOB 30 to 45 degrees.
- Refeeding: low phosphate. PN bag empty: hang 10% dextrose at the same rate.

Key terms and comparisons: vitamins and lab markers

Item	Key fact	Nursing point
Vitamin A	Vision, epithelium	High doses in pregnancy cause birth defects
Vitamin D	Calcium absorption	Breastfed infants 400 IU; older adults 800 IU after 70
Vitamin K	Clotting factors II, VII, IX, X	Consistent intake on warfarin; given to newborns
Vitamin C	Collagen, iron absorption	Scurvy: bleeding gums, poor healing
Thiamine (B1)	Carbohydrate metabolism	Give before glucose in alcohol use disorder
Folate	DNA synthesis	400 mcg prevents neural tube defects
B12	Red cells and myelin	Animal or fortified foods; needs intrinsic factor
Albumin	3.5 to 5.0 g/dL, half life about 20 days	Falls with inflammation; slow to change
Prealbumin	About 15 to 36 mg/dL, half life 2 to 3 days	Shows short term trend; also falls with inflammation

Priority rules: energy math and feeding safety

Item	Rule
Energy	kcal = (carb g x 4) + (protein g x 4) + (fat g x 9)
Weight loss	% = (usual minus current) / usual x 100; over 5% in 1 month is significant
BMI	kg / m2; 18.5 to 24.9 healthy
Placement	X ray first; then external mark and pH 5 or below
Position	HOB 30 to 45 degrees during feeding; pause if flat
Flushes	About 30 mL every 4 h continuous; 15 mL or more before, between, after meds
Hang time	Open system about 8 h; set changed every 24 h
PN interrupted	10% dextrose at the same rate; never catch up

Worked cases

WORKED CASE 1 · ENERGY FROM A SNACK

A snack has 12 g fat, 30 g carbohydrate and 8 g protein. How many kcal does it supply?

STEP 1 · FAT

12 g x 9 = 108 kcal.

STEP 2 · CARBOHYDRATE

30 g x 4 = 120 kcal.

STEP 3 · PROTEIN

8 g x 4 = 32 kcal.

STEP 4 · TOTAL

108 + 120 + 32 = **260 kcal**.

NOTE

Fat supplies almost as much energy as the carbohydrate here despite weighing less than half as much.

WORKED CASE 2 · PROTEIN AND FLUID TARGETS

Mr. Abiola, 80 kg, has a stage 3 pressure injury and no fluid restriction. His team uses 1.5 g/kg of protein. A second patient, Ms. Kerr, weighs 60 kg.

STEP 1 · HIS PROTEIN

80 kg x 1.5 g/kg = **120 g** a day, compared with 64 g at the healthy adult 0.8 g/kg.

STEP 2 · HER FLUID RANGE

60 kg x 30 mL = 1,800 mL; 60 kg x 35 mL = 2,100 mL. About **1,800 to 2,100 mL** a day.

STEP 3 · ACT

Offer protein rich foods the patient likes, track a calorie count and request a dietitian.

RULE

Wounds raise protein needs; carbohydrate alone cannot build collagen.

WORKED CASE 3 · UNINTENTIONAL WEIGHT LOSS

Mrs. Varga, 78, usually weighs 62 kg and now weighs 55.8 kg, six months later. A second resident, 1.70 m tall and 52 kg, is screened on the same day.

STEP 1 · PERCENT LOSS FOR MRS. VARGA

(62 minus 55.8) / 62 x 100 = 6.2 / 62 x 100 = **10%** in 6 months.

STEP 2 · JUDGE IT

10% in 6 months meets the threshold for significant unintentional loss.

STEP 3 · BMI FOR THE SECOND RESIDENT

52 / (1.70 x 1.70) = 52 / 2.89 = **18.0**, below 18.5: underweight.

ACT

Report, request a dietitian, look for barriers (teeth, mood, money, swallowing). Do not wait for a low albumin.

WORKED CASE 4 · A FEEDING TUBE THAT MOVED

Mr. Lindgren, 47, has a small bore NG feeding tube confirmed by x ray with the mark at 60 cm at the nare, running at 60 mL/hour. After a coughing fit the mark reads 52 cm and his SpO2 fell from 96% to 91%.

STEP 1 · MEASURE THE CHANGE

60 minus 52 = **8 cm** of tube has come out.

STEP 2 · INTERPRET

The tip may now sit in the esophagus, where reflux and aspiration are likely.

STEP 3 · ACT

Stop the feeding, keep the head of the bed up, assess the airway and lungs, and notify the provider for imaging.

RULE

Do not push the tube back in or use a whoosh test to reassure. Never feed through a tube of doubtful position.

TRAPS PEOPLE FALL INTO

- **Telling a patient on warfarin to avoid greens.** The rule is consistent vitamin K intake, not avoidance.
- **Giving cow's milk or honey to an infant.** Both wait until 12 months.
- **Assuming food practices from religion or ethnicity.** Ask each patient.
- **Treating albumin as the best nutrition marker.** Inflammation lowers it. Weight loss and intake matter more.
- **Giving "just a sip" to test a stroke patient.** Keep NPO until a swallow screen is passed.
- **Using a straw for a patient with dysphagia.** Straws deliver a fast, uncontrolled bolus.
- **Relying on the whoosh test.** Air sounds can transmit from the lung. X ray first, then mark and pH.
- **Speeding up late PN to catch up.** This causes hyperglycemia and overload.
- **Blaming the formula first for diarrhea.** Check sorbitol medicines, antibiotics and C. difficile.

Chapter 16 self-test · ten items

1. A food has 5 g fat, 20 g carbohydrate and 10 g protein. How many kcal does it supply?

A. 140 kcal
B. 175 kcal
C. 165 kcal
D. 150 kcal

C. 165 kcal (5 x 9) + (20 x 4) + (10 x 4) = 45 + 80 + 40 = 165 kcal.

2. A patient on warfarin asks about leafy green vegetables. What is the best teaching?

A. Keep the amount you eat about the same each week
B. Avoid all leafy greens while on the drug
C. Eat as many as you like, they do not matter
D. Eat greens only on days you skip a dose

A. Keep the amount you eat about the same each week Consistent vitamin K intake keeps the warfarin dose matched to the diet.

3. Which food should be avoided for a 10 month old?

A. Mashed banana
B. Pureed carrots
C. Iron fortified cereal
D. Honey on toast

D. Honey on toast Honey before 12 months risks infant botulism.

4. A Muslim patient is admitted. What should the nurse do about meals?

A. Assume pork is fine if cooked well
B. Ask about food preferences and practices
C. Order a vegetarian tray for every meal
D. Tell the patient to fast as usual while ill

B. Ask about food preferences and practices Ask rather than assume, then accommodate, such as ordering a halal tray.

5. A patient's weight fell from 80 kg to 74 kg in 3 months. How much is that as a percent?

A. 7.5%
B. 8.1%
C. 6%
D. 10%

A. 7.5% (80 minus 74) / 80 x 100 = 6 / 80 x 100 = 7.5%, a significant loss in 3 months.

6. Why is albumin a weak marker of current nutrition in a patient with sepsis?

A. It rises quickly as soon as feeding begins
B. It changes within hours of a single meal
C. Inflammation lowers it whatever the intake
D. It is not made by the liver at all now

C. Inflammation lowers it whatever the intake Albumin is a negative acute phase reactant with a long half life.

7. A patient admitted with a stroke asks for water. No swallow screen is charted. What should the nurse do?

A. Give thickened water without a screen
B. Give a small sip to see if it is tolerated
C. Raise the head of the bed and give water
D. Keep the patient NPO until a screen is passed

D. Keep the patient NPO until a screen is passed Silent aspiration is common after stroke. Nothing by mouth until the screen is passed.

8. Which position is safest during continuous tube feeding?

A. Flat with the head turned to one side
B. Head of bed at 30 to 45 degrees
C. Prone with a pillow under the hips
D. Head of bed at 10 degrees

B. Head of bed at 30 to 45 degrees Elevation reduces reflux and aspiration.

9. Which method confirms placement of a newly inserted blind feeding tube before first use?

A. An x ray read by a qualified provider
B. Checking that the tape is secure
C. Listening for air over the stomach
D. Asking the patient to hum or speak

A. An x ray read by a qualified provider Radiographic confirmation is the only reliable method for a new blind tube.

10. A PN bag runs out and the new one has not arrived. What should the nurse hang?

A. 5% dextrose at double the rate
B. Normal saline at the same rate
C. Nothing until the new bag comes
D. 10% dextrose at the same rate

D. 10% dextrose at the same rate D10W prevents rebound hypoglycemia while the new bag is prepared.

Cram sheet

Chapters 15 and 16 on one page. Work one ABG and one energy problem before reading it.

Fluids, electrolytes and acid base

Item	Rule
Compartments	Two thirds ICF; one third ECF; plasma smallest
Hormones	ADH holds water; aldosterone holds Na and water, loses K; BNP excretes Na and water
I and O	Ice chips half; urine at least 30 mL/h
Deficit vs excess	Concentration vs dilution; weak vs bounding; flat vs distended veins
Weight	1 kg is about 1 L; same scale, time and clothing
Na and K	135 to 145 brain; 3.5 to 5.0 heart; K never IV push
Ca and Mg	Low: tetany, Trousseau, Chvostek; high: weak, low reflexes
ABG normals	pH 7.35 to 7.45; PaCO2 35 to 45; HCO3 22 to 26
ROME	Respiratory opposite; metabolic equal; no overcompensation
Causes	Vomiting metabolic alkalosis; diarrhea metabolic acidosis
IV fluids	Isotonic expand; hypotonic swell cells; hypertonic pull water in
Blood	Saline only; stay 15 min; done in 4 h; stop at reaction

Nutrition

Item	Rule
Energy	4, 4, 9, 7 kcal/g
Protein	0.8 g/kg; 1.2 to 2.0 g/kg with wounds
Fluid	30 to 35 mL/kg/day
Guidelines	Added sugar and saturated fat under 10%; sodium under 2,300 mg
Infants	No honey or cow's milk before 12 months; vitamin D 400 IU if breastfed
Pregnancy	Folic acid 400 mcg; iron 27 mg; +340 then +450 kcal
Screening	Within 24 h; weight loss and poor intake
Labs	Albumin and prealbumin fall with inflammation
Dysphagia	Swallow screen first; upright; chin tuck; no straws
Tube placement	X ray first; mark and pH 5 or below; no whoosh
Feeding	HOB 30 to 45; flush 30 mL every 4 h; one med at a time
Refeeding and PN	Low phosphate; PN empty means D10W at same rate

Dr. Garg Learning · CC BY-SA 4.0