

NGN NCLEX 2026 • PHARMACOLOGY / NUTRITION • VOL. 47

Water-Soluble *Vitamins*

The B-complex family and Vitamin C — eight nutrients the body cannot store. Deficiencies appear fast; clinical clues are tested heavily on every NCLEX iteration.

SYSTEM • NUTRITION

FORMAT • NGN 2026

SCOPE • B1-B12 + C

DOMAIN • PHYSIO INTEGRITY

 **Source transparency:** This topic was not present in the uploaded reference notes. Content has been compiled from standard NGN NCLEX 2026 references: *Saunders Comprehensive Review for the NCLEX-RN (Silvestri, 9th ed.)*, *ATI RN Pharmacology Made Easy & Nutrition Review Modules*, *Lippincott Illustrated Reviews: Biochemistry (8th ed.)*, and the National Institutes of Health Office of Dietary Supplements vitamin fact sheets.



SECTION 01 • FOUNDATIONS

Definition & Overview

8

Total Vitamins

Eight B-complex vitamins (B1, B2, B3, B5, B6, B7, B9, B12) plus Vitamin C make up the water-soluble group.

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Storage Capacity

The body does **not store** water-soluble vitamins (with one exception — see below). Excess is excreted in urine.

B12

The Lone Exception

Vitamin B12 (cobalamin) *is* stored in the liver — sometimes for 3 to 5 years. Deficiency appears slowly.

Why it matters for NCLEX: Because they are not stored, water-soluble vitamins must be replenished daily through diet. Deficiencies develop more rapidly than fat-soluble deficiencies (A, D, E, K), but toxicity is generally less dangerous because excess is excreted in urine. The major exception is megadose supplementation, especially B6 and niacin, which can produce real toxicity syndromes.

2

SECTION 02 • MECHANISM

Absorption & Metabolism Pathway

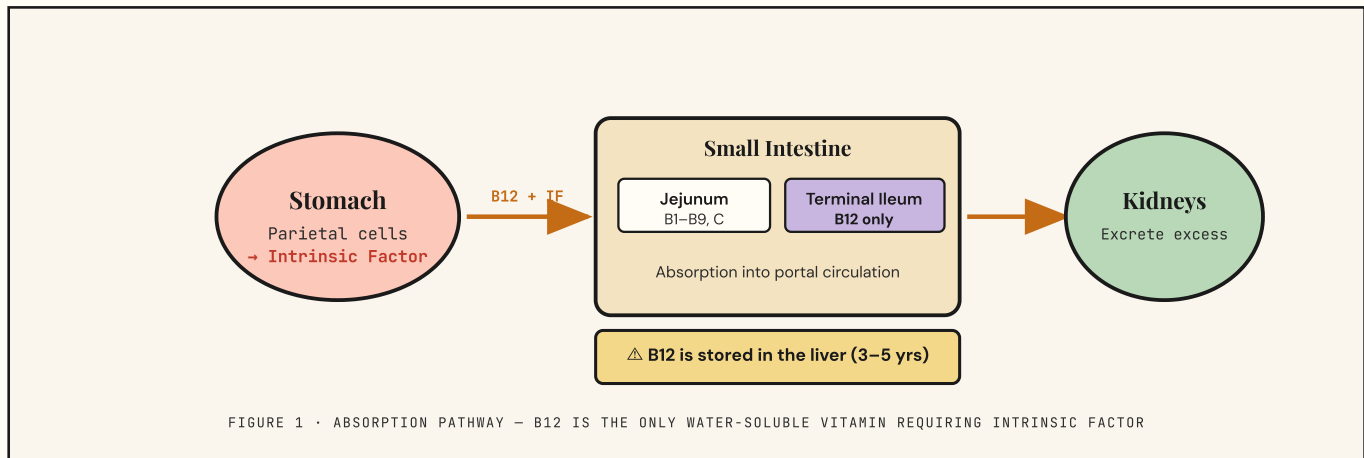
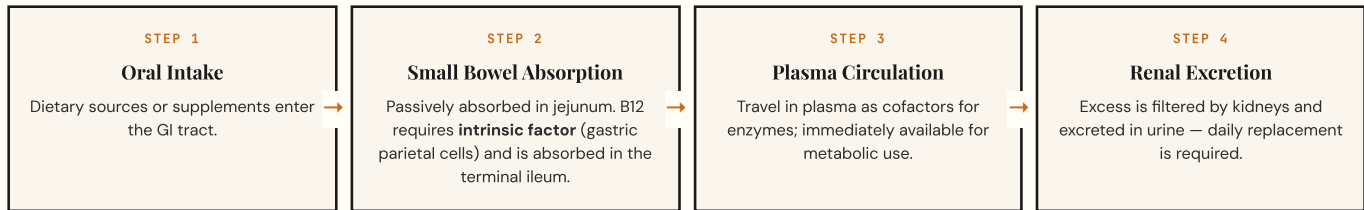


FIGURE 1 • ABSORPTION PATHWAY — B12 IS THE ONLY WATER-SOLUBLE VITAMIN REQUIRING INTRINSIC FACTOR

3

SECTION 03 • CLINICAL MANIFESTATIONS

Deficiencies — Signs, Symptoms & Red Flags

Thiamine (B1)

B1

DEFICIENCY SYNDROMES

- ▶ **Beriberi** — dry (neuro) or wet (cardiac)
- ▶ **Wernicke-Korsakoff** **ALCOHOL**

KEY CUES

- ▶ Confusion, ataxia, ophthalmoplegia
- ▶ Peripheral neuropathy, edema
- ▶ Tachycardia, heart failure (wet)

Riboflavin (B2)

B2

DEFICIENCY

- ▶ **Ariboflavinosis**

KEY CUES

- ▶ Cheilosis (cracked lip corners)
- ▶ Glossitis (red, swollen tongue)
- ▶ Photophobia, corneal vascularization
- ▶ Seborrheic dermatitis

Niacin (B3)

B3

DEFICIENCY SYNDROME

- ▶ **Pellagra** — the 3 D's **CLASSIC**

THE 3 D'S OF PELLAGRA

- ▶ **Dermatitis** (sun-exposed areas)
- ▶ **Diarrhea**
- ▶ **Dementia** → 4th D = Death if untreated

Pantothenic Acid (B5)

B5

DEFICIENCY

- ▶ Extremely **rare** — found widely in foods

KEY CUES (IF SEEN)

- ▶ "Burning feet" syndrome
- ▶ Fatigue, irritability, GI upset
- ▶ Component of Coenzyme A

Pyridoxine (B6)

B6

DEFICIENCY

- ▶ Microcytic anemia, peripheral neuropathy
- ▶ Seizures (infants)
- ▶ Common with **INH (isoniazid)** use **TB**

▲ TOXICITY (MEGADOSE)

- ▶ Sensory neuropathy — paradoxical
- ▶ Tingling, gait disturbance

Biotin (B7)

B7

DEFICIENCY

- ▶ Very rare in normal diet
- ▶ Risk: raw egg whites (avidin binds biotin)

KEY CUES

- ▶ Alopecia (hair loss)
- ▶ Dermatitis around eyes, nose, mouth
- ▶ Neurologic symptoms

Folate / Folic Acid (B9)

B9

DEFICIENCY

- ▶ **Megaloblastic anemia** (large RBCs)
- ▶ **Neural tube defects** in fetus **OB**

PREGNANCY DOSING

- ▶ **400 mcg/day** all women of childbearing age
- ▶ **600 mcg/day** during pregnancy
- ▶ Start *before* conception

Cobalamin (B12)

B12

DEFICIENCY CAUSES

- ▶ **Pernicious anemia** — no intrinsic factor **CLASSIC**
- ▶ Strict vegan diet (animal sources only)
- ▶ Gastric bypass, ileal resection

KEY CUES

- ▶ Megaloblastic anemia
- ▶ **Neuro symptoms** — paresthesias, ataxia, dementia
- ▶ Beefy red, smooth tongue
- ▶ Treatment: **monthly IM injections**

Ascorbic Acid (Vit C)

C

DEFICIENCY SYNDROME

- ▶ **Scurvy** — collagen synthesis fails **CLASSIC**

KEY CUES — THE 4 B'S

- ▶ **Bleeding** gums, bruising
- ▶ **Broken** teeth, loose teeth
- ▶ **Bone** pain
- ▶ **Bad** wound healing
- ▶ Toxicity: kidney stones (Ca-oxalate)

4

SECTION 04 • NURSING ACTION

Priority Interventions (ABC + Safety)

A

AIRWAY / ASSESSMENT

Assess for **neurologic** deficits (B12, B1, B6), **cardiac** compromise (B1 wet beriberi → heart failure), and **bleeding** risk (Vit C scurvy). Obtain dietary history — especially alcohol use, vegan diet, pregnancy status, and chronic GI disease.

B

BREATHING / BLEEDING

Monitor for dyspnea and crackles in B1 wet beriberi. Watch for **spontaneous bleeding** from gums/skin (Vit C). For B12 deficiency with severe anemia, assess oxygen saturation and respiratory effort — chronic anemia stresses the heart and lungs.

C

CIRCULATION / COGNITION

Check pulses, BP, and capillary refill. Assess **level of consciousness**, orientation, and gait — neuro changes signal B12 or B1 deficiency. **Fall precautions** for any client with ataxia or peripheral neuropathy.

Nursing Action Sequence — Suspected Deficiency

1. **Assess** diet, alcohol use, medications (INH, metformin, PPIs, oral contraceptives), GI surgery history, pregnancy status.
2. **Draw labs** — CBC with peripheral smear, MCV, serum B12/folate, methylmalonic acid, homocysteine, Schilling test (if available).
3. **Administer** prescribed replacement: oral, IM, or IV; B12 deficiency from pernicious anemia *requires IM injection* — oral will not work.
4. **Implement safety** — fall precautions for neuropathy/ataxia; bleeding precautions for scurvy; seizure precautions for severe B6 deficiency.
5. **Educate** on dietary sources, supplement timing, and signs of toxicity (especially B6 and niacin).
6. **Evaluate** response: improved energy, normal CBC, resolved neuro symptoms, restored skin integrity.

5

SECTION 05 • PHARMACOLOGY

Drug Reference Table

VITAMIN	INDICATION	ROUTE / DOSE	ADVERSE EFFECTS	NURSING PRIORITIES
Thiamine (B1) Vitamin replacement	Beriberi, Wernicke-Korsakoff (alcohol use), chronic alcoholism	PO, IM, IV 50–100 mg/day	Usually well-tolerated; rare anaphylaxis with IV push	Give BEFORE glucose in malnourished alcoholic clients — glucose without thiamine precipitates Wernicke encephalopathy
Niacin (B3) Vitamin / antilipidemic	Pellagra; also used at higher doses to lower LDL & triglycerides , raise HDL	PO Variable; titrate up slowly	Flushing (vasodilation), pruritus, GI upset, hepatotoxicity, hyperglycemia, hyperuricemia (gout)	Pretreat with aspirin 325 mg 30 min before dose to reduce flushing; monitor LFTs, glucose, uric acid; take with food
Pyridoxine (B6) Vitamin replacement	Deficiency; given with INH (isoniazid) , hydralazine, cycloserine to prevent peripheral neuropathy	PO 10–50 mg/day with INH	Generally safe; megadoses (>200 mg/day) cause sensory neuropathy — paradoxical	Counsel that more is not better ; do not exceed prescribed dose; reverses INH-induced neuropathy
Folic Acid (B9) Vitamin	Megaloblastic anemia; prevention of neural tube defects in pregnancy; given with methotrexate	PO 400 mcg/day (women); 600 mcg pregnant; 1 mg deficiency	Rare; allergic reaction; can mask B12 deficiency (corrects anemia but neuro deficits progress)	Always check B12 level before treating with folate alone ; emphasize preconception start; food sources — leafy greens, fortified grains
Cyanocobalamin (B12) Vitamin	Pernicious anemia, vegan deficiency, ileal disease, gastric bypass	IM for pernicious anemia (lifelong); nasal spray or PO if absorption intact	Hypokalemia (with treatment), injection site pain, rare allergic reaction	Pernicious anemia = IM route only ; monitor K+ early in therapy (cells take up K+ as they regenerate); teach lifelong commitment
Ascorbic Acid (Vit C) Vitamin / antioxidant	Scurvy, wound healing, enhances iron absorption	PO, IV 90 mg/day (M), 75 mg/day (F)	GI upset, diarrhea, kidney stones (calcium oxalate) at megadose, false negatives on stool guaiac	Take with iron supplements to ↑ absorption; encourage fluids; teach citrus, peppers, strawberries; hold before guaiac testing if possible

6

SECTION 06 • EXAM STRATEGY

NCLEX Test Traps ⚠️

WRONG ANSWER

"Treat pernicious anemia with oral B12 tablets"

Pernicious anemia is an *absorption* problem — the client lacks intrinsic factor. Oral B12 cannot be absorbed without it.

— TEST-READY ANSWER —

CORRECT

"Administer monthly IM injections for life"

IM bypasses the gut entirely. This is a lifelong requirement.

WRONG ANSWER

"Give glucose to the malnourished alcoholic immediately"

Glucose without thiamine precipitates **Wernicke encephalopathy** — confusion, ataxia, ophthalmoplegia.

— TEST-READY ANSWER —

CORRECT

"Give thiamine BEFORE or WITH glucose"

Thiamine is the cofactor needed to metabolize the glucose load safely.

WRONG ANSWER

"Niacin flushing means stop the medication"

Flushing is a common, expected side effect from prostaglandin-mediated vasodilation — not an allergy.

— TEST-READY ANSWER —

CORRECT

"Pretreat with aspirin 30 min before dose"

Aspirin blocks the prostaglandin pathway responsible for flushing.

WRONG ANSWER

"Folate alone is enough for macrocytic anemia"

Folate corrects the *blood* picture in B12 deficiency but lets the **neurologic damage progress silently**.

— TEST-READY ANSWER —

CORRECT

"Check B12 level before treating with folate"

Always distinguish B12 vs. folate deficiency — they look identical on CBC.

WRONG ANSWER

"Start folic acid when pregnancy is confirmed"

Neural tube closure happens by week 4 — often before a woman knows she is pregnant.

— TEST-READY ANSWER —

CORRECT

"Start folic acid BEFORE conception"

All women of childbearing age should take 400 mcg/day.

WRONG ANSWER

"More B6 will heal neuropathy faster"

Megadose B6 (>200 mg/day) *causes* sensory neuropathy — the same symptom it is supposed to treat.

— TEST-READY ANSWER —

CORRECT

"Take only the prescribed amount"

Vitamins can be toxic — water-soluble does not mean "safe at any dose."

7

SECTION 07 • TEACHING

Patient & Family Education

1

Daily Replenishment

"Your body doesn't store these vitamins (except B12). Eat sources every day or take a daily multivitamin if recommended."

3

Pregnancy Planning

"If you're trying to get pregnant — or could become pregnant — take 400 mcg of folic acid every day. This prevents serious birth defects."

5

Alcohol Use

"Alcohol blocks absorption of thiamine, folate, and B12. If you drink heavily, talk to your provider about supplementation."

7

Pernicious Anemia

"You will need a B12 shot every month for the rest of your life. Pills won't work because your stomach can't absorb them."

2

More Is Not Better

"High-dose B6 can damage nerves. High-dose niacin can damage your liver. High-dose Vitamin C can cause kidney stones. Stick to the prescribed dose."

4

Vegan / Vegetarian Diet

"B12 is only found in animal products. If you don't eat meat, dairy, or eggs, you must take a B12 supplement or eat fortified foods."

6

Iron + Vitamin C Pairing

"Take your iron supplement with orange juice or a Vitamin C tablet — this dramatically improves absorption."

8

Niacin Flushing Tip

"Take an aspirin 30 minutes before your niacin dose, and take it with food. The flushing usually fades after a few weeks."

8

SECTION 08 • MEMORY TOOLS

Mnemonics & Pattern Recognition

3 D's

Pellagra (Niacin / B₃ Deficiency)

- D** —Dermatitis (sun-exposed skin)
- D** —Diarrhea
- D** —Dementia
- D** —Death (the silent 4th D, if untreated)

"B-WET"

Wet Beriberi (B₁ / Thiamine — Cardiac)

- B** —Beriberi (wet form)
- W** —Weakness in heart muscle
- E** —Edema (peripheral)
- T** —Tachycardia, dyspnea

"COAT"

Wernicke Encephalopathy (B₁)

- C** —Confusion
- O** —Ophthalmoplegia
- A** —Ataxia
- T** —Thiamine deficiency (give BEFORE glucose)

"PINK"

Pernicious Anemia Picture (B₁₂)

- P** —Paresthesias (hands & feet)
- I** —Intrinsic factor missing
- N** —Neuro changes — irreversible if delayed
- K** —"K"obalamin → IM monthly for life

4 B's

Scurvy (Vitamin C)

- B** —Bleeding gums
- B** —Bruising
- B** —Bad wound healing
- B** —Bone pain & loose teeth

"NIACIN"

Pretreatment & Side Effects

- N** —Nausea / GI upset
- I** —Itching / pruritus
- A** —ASA 30 min before (prevents flush)
- C** —Cholesterol-lowering at high dose
- I** —Increased glucose / uric acid
- N** —Necrotic liver risk → monitor LFTs

Quick pattern key: If the question mentions *alcohol use* → think B₁ (thiamine). *Vegan diet or gastric surgery* → think B₁₂. *Pregnancy* → think folate (B₉). *INH/tuberculosis* → think B₆ (pyridoxine). *Bleeding gums & poor wound healing* → think Vitamin C. *The 3 D's* → niacin (B₃).

9

SECTION 09 • NGN CLINICAL JUDGMENT

NCJMM 6-Step Scenario

CLIENT SCENARIO

A 68-year-old female presents to the clinic with progressive fatigue, numbness and tingling in both hands and feet, and a "sore beefy red tongue." She had a partial gastrectomy 5 years ago for gastric cancer and has not seen a primary care provider since. She is a strict vegan. Her gait is unsteady. Vitals:

BP 108/64 HR 102 RR 20 SpO₂ 96% T 98.4°F

Labs: Hgb 8.2 g/dL · MCV 112 fL · Serum B12 < 100 pg/mL · Folate normal · Methylmalonic acid elevated.

STEP 1 • RECOGNIZE CUES

What data points matter?

- History: partial gastrectomy + vegan diet (no intrinsic factor + no dietary B12)
- Megaloblastic anemia (Hgb 8.2, MCV 112)
- Serum B12 critically low; MMA elevated
- Neuro symptoms: paresthesias, unsteady gait, glossitis
- Tachycardia (compensatory for anemia)

STEP 2 • ANALYZE CUES

What's the clinical picture?

Two converging causes of B12 deficiency: **loss of intrinsic factor** from gastric surgery (functional pernicious anemia) and **absent dietary intake** from veganism. The elevated methylmalonic acid confirms B12 deficiency rather than isolated folate deficiency — critical because the treatments differ. Neuro findings indicate the deficiency has progressed beyond the hematologic stage.

STEP 3 • PRIORITIZE HYPOTHESES

Most likely diagnosis?

- **#1 — B12 deficiency anemia** (combined etiology)
- #2 — rule out concurrent folate deficiency
- #3 — assess for iron deficiency (vegan diet)
- Differential: rule out other causes of macrocytic anemia (alcohol, hypothyroid)

STEP 4 • GENERATE SOLUTIONS

What interventions?

- Initiate **cyanocobalamin IM injections** (loading dose → monthly maintenance for life)
- Initiate **fall precautions** for ataxia/neuropathy
- Monitor **potassium** early in therapy (cells take up K⁺ as RBCs regenerate)
- Nutritional counseling — fortified foods, B12-containing alternatives
- Patient education on lifelong commitment

STEP 5 • TAKE ACTION

What does the nurse do now?

- Administer first cyanocobalamin 1000 mcg IM as ordered
- Implement fall precautions — bed in lowest position, call light within reach, non-skid footwear
- Draw baseline potassium and CBC for trending
- Educate client and family on injection schedule and home safety
- Document neuro baseline (Romberg, deep tendon reflexes, vibratory sense) for comparison

STEP 6 • EVALUATE OUTCOMES

What signals improvement?

- Reticulocyte count rises within 3–5 days (early marker)
- Hgb and MCV trend toward normal over 4–8 weeks
- Resolution of glossitis and tachycardia
- Improved energy and gait stability
- **Caution:** Neuro deficits may be partially or fully irreversible if treatment was delayed — this is a key teaching point about early recognition

WATER-SOLUBLE VITAMINS — NGN NCLEX 2026 REFERENCE

REFERENCES • Silvestri, L. (Saunders Comprehensive Review for NCLEX-RN, 9th ed.) • ATI RN Pharmacology Made Easy and Nutrition Review modules • Harvey, R. (Lippincott Illustrated Reviews: Biochemistry, 8th ed.) • NIH Office of Dietary Supplements — Vitamin Fact Sheets • This deliverable was generated for independent NCLEX 2026 preparation. Clinical decisions should be made in accordance with current institutional protocols and the most recent edition of standard references.