

FOUNDATIONAL NURSING · NUTRITION · PHARMACOLOGY

Fat-Soluble *Vitamins*

A · D · E · K — Absorption, Deficiency, Toxicity & Nursing Implications

NGN NCLEX 2026

HEALTH PROMOTION

PHARM THERAPIES

REDUCTION OF RISK

SOURCE TRANSPARENCY

Fat-soluble vitamins were not present in the uploaded reference notes for this study session. Content compiled from standard NCLEX 2026 references:

SAUNDERS COMPREHENSIVE REVIEW FOR THE NCLEX-RN (9TH ED.)

ATI RN NUTRITION FOR NURSING

LIPPINCOTT ILLUSTRATED REVIEWS: PHARMACOLOGY (8TH ED.)

LEHNE'S PHARMACOLOGY FOR NURSING CARE (11TH ED.)

, and current Institute of Medicine / NIH Office of Dietary Supplements DRI guidelines.

01

Definition & Overview

WHAT THEY ARE · WHY IT MATTERS

- **Fat-soluble vitamins** are organic nutrients that **dissolve in fat (lipids), not water**, and are absorbed alongside dietary fats through the small intestine.
- The four fat-soluble vitamins — **A, D, E, and K** — are **stored in the liver and adipose (fat) tissue** and excreted slowly, which means deficiency develops gradually and **toxicity is a real risk with over-supplementation**.
- Because they require fat and bile for absorption, **any condition that impairs fat digestion or absorption** (cystic fibrosis, biliary obstruction, chronic pancreatitis, IBD, celiac disease, bariatric surgery, cholestyramine use) puts patients at high risk for deficiency.

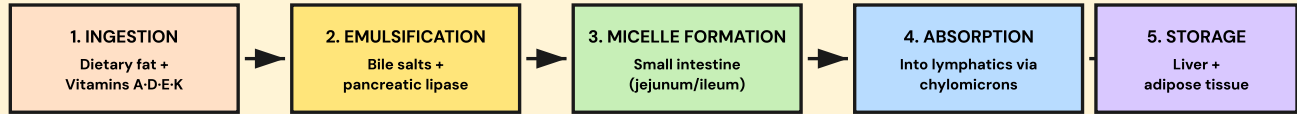
NCLEX Pearl: Water-soluble vitamins (B-complex, C) are *excreted in urine* — toxicity is rare. Fat-soluble vitamins are *stored* — toxicity is common with megadosing. This is the #1 conceptual distinction the boards test.

02

Pathophysiology of Absorption

HOW THEY GET IN • HOW THEY GET STORED

Fat-soluble vitamins follow the same absorption pathway as dietary fats. Disruption at *any* step causes deficiency.



⚠ WHERE ABSORPTION FAILS ⚠



Conceptual anchor: "Fat-soluble" really means "bile-soluble." If the gallbladder/pancreas/small bowel/liver is compromised, suspect ADEK deficiency — even if the diet looks adequate.

03

Signs & Symptoms

DEFICIENCY VS. TOXICITY FOR EACH VITAMIN

A Vitamin A (Retinol)

Functions: vision (especially night/low-light), epithelial integrity, immune function, reproduction, growth.

▼ Deficiency:

- **Night blindness** (earliest sign — nyctalopia)
- Xerophthalmia (dry eyes), **Bitot's spots** on conjunctiva
- Dry, scaly skin · poor wound healing
- Frequent infections (impaired immunity)
- Keratomalacia → corneal ulceration → **blindness**

▲ Toxicity (Hypervitaminosis A):

- Headache, blurred vision (↑ intracranial pressure)
- Dry, peeling skin · alopecia · cheilitis
- Bone & joint pain · hepatotoxicity
- **TERATOGENIC** — birth defects (CNS, craniofacial, cardiac)

D Vitamin D (Calciferol)

Functions: calcium & phosphorus absorption, bone mineralization, immune modulation, muscle function.

▼ Deficiency:

- **Children:** **Rickets** — bowed legs, widened wrists, frontal bossing, rachitic rosary
- **Adults:** **Osteomalacia** — bone pain, muscle weakness, fractures
- Osteoporosis (chronic insufficiency)
- Hypocalcemia → tetany, Chvostek/Trousseau signs
- Increased fall risk in elderly

▲ Toxicity:

- **Hypercalcemia** — "stones, bones, groans, psychiatric overtones"
- Kidney stones · nephrocalcinosis · AKI
- Anorexia, nausea, vomiting, constipation
- Soft tissue calcification (vasculature, kidneys)

E Vitamin E (Tocopherol)

Functions: potent antioxidant, protects cell membranes & RBCs from oxidative damage, supports immune function.

▼ Deficiency (rare in adults):

- **Hemolytic anemia** (especially in premature infants)
- Peripheral neuropathy · ataxia · loss of position/vibration sense
- Muscle weakness · myopathy
- Retinopathy
- Impaired immune response

▲ Toxicity:

- **Bleeding risk** — interferes with vitamin K
- Potentiates warfarin, antiplatelet agents
- Hemorrhagic stroke (with megadoses)
- Nausea, fatigue, headache

K Vitamin K (Phytonadione)

Functions: synthesis of clotting factors **II, VII, IX, X** (and proteins C & S) in the liver; bone protein osteocalcin.

▼ Deficiency:

- **Bleeding** — easy bruising, prolonged bleeding
- **Prolonged PT / elevated INR**
- Hematuria, melena, epistaxis, gum bleeding
- **Newborns:** **hemorrhagic disease of the newborn** (gut is sterile, no synthesis)
- Risk in: long-term abx (kill gut flora), warfarin therapy, malabsorption

▲ Toxicity (rare):

- Hemolytic anemia & jaundice in **infants** (kernicterus risk)
- Decreased effectiveness of warfarin

🚨 PRIORITY RED FLAGS

- **Vitamin A in pregnancy** → teratogenic. **Isotretinoin (Accutane) is Category X.** Two forms of contraception required; pregnancy test before each refill (iPLEDGE program).
- **Vitamin D toxicity** → hypercalcemia → cardiac dysrhythmias, kidney damage, altered mental status.
- **Vitamin E + Warfarin** → massive bleeding risk. Always ask about supplements.
- **Newborn without Vit K** → intracranial hemorrhage. Single IM dose at birth is non-negotiable.

04

Priority Nursing Interventions

ABC • SAFETY • NCLEX PRIORITIZATION

A Airway / Breathing / Circulation

- **Assess for bleeding** (Vit K deficiency or Vit E excess): check gums, stool, urine, IV sites, neuro status.
- **Monitor for hypercalcemia** (Vit D toxicity): cardiac rhythm — short QT, AV block, dysrhythmias.
- **Assess respiratory effort** in patients with severe hypercalcemia (muscle weakness can compromise breathing).
- **Check ICP signs** with Vit A toxicity: headache, papilledema, vomiting.

B Assessment Priorities

- Obtain **full diet & supplement history** — including OTC vitamins, herbals, and "natural" products.
- Identify **malabsorption risk factors**: CF, IBD, celiac, bariatric surgery, biliary disease, alcoholism.
- Review labs: **PT/INR** (K), **serum calcium & 25-OH vit D** (D), **serum retinol** (A), **CBC** (E hemolytic anemia).
- Assess **bone density** and fall risk in elderly with low Vit D.
- Evaluate visual function — **night vision testing** if Vit A deficiency suspected.

C Safety Interventions

- **Fall precautions** for Vit D-deficient elderly & for Vit E neuropathy/ataxia.
- **Bleeding precautions** with Vit K deficiency: soft toothbrush, electric razor, no IM injections without HCP order, avoid NSAIDs/aspirin.
- **Pregnancy screening** before starting isotretinoin or high-dose Vit A.
- For Vit D toxicity: **increase fluids**, restrict dietary calcium, monitor I&O, watch for renal failure.

D Administer / Educate

- **Give with fat-containing meal** for absorption (key teaching point).
- **Vitamin K (phytonadione)**: 0.5–1 mg IM at birth for all newborns (preferred site: vastus lateralis); also given for warfarin reversal — **SQ or PO route preferred**; IV only in emergencies due to anaphylaxis risk.
- **Vitamin D**: for CKD patients use *activated* form (calcitriol) — kidneys cannot convert inactive forms.
- **Document and report** all supplement use prior to procedures, surgery, or anticoagulation therapy.

Priority action for new transfusion-style scenarios: If a patient on warfarin presents with active bleeding and INR > 9, anticipate **Vitamin K (phytonadione)** administration plus possible fresh frozen plasma / prothrombin complex concentrate (PCC) — Vit K alone takes 6–24 hours to work.

05

Pharmacology

FORMS • INDICATIONS • CONSIDERATIONS

VITAMIN	DRUG FORMS	INDICATION	KEY SIDE EFFECTS	NURSING CONSIDERATIONS
Vitamin A <i>Retinol</i>	Retinol, beta-carotene, retinyl palmitate, isotretinoin (Accutane) , tretinoin	Deficiency, severe cystic acne (isotretinoin), measles in deficient children, certain leukemias (tretinoin)	Headache, dry skin/lips, hepatotoxicity, hyperlipidemia, teratogenicity , depression/suicidal ideation (isotretinoin)	Pregnancy Category X (isotretinoin) — iPLEDGE program, 2 forms of contraception, monthly pregnancy tests. Monitor LFTs and lipids.
Vitamin D <i>Calciferol</i>	Ergocalciferol (D2), cholecalciferol (D3), calcitriol (activated), paricalcitol, doxercalciferol	Deficiency/rickets, osteomalacia, osteoporosis, hypoparathyroidism, CKD-related bone disease (use activated form)	Hypercalcemia (anorexia, N/V, polyuria, polydipsia, confusion), hyperphosphatemia, kidney stones, soft-tissue calcification	Monitor serum calcium, phosphorus, 25-OH vit D, creatinine. Take with food/fat. Avoid concurrent thiazides (↑Ca). Hold and call HCP if Ca > 10.5 mg/dL.
Vitamin E <i>Tocopherol</i>	Alpha-tocopherol, mixed tocopherols (capsules & topical)	Deficiency (rare), prophylaxis in premature infants, antioxidant supplementation (limited evidence)	Bleeding risk (especially > 400 IU/day), nausea, fatigue, headache; hemorrhagic stroke at very high doses	Hold ≥ 1 week before surgery. Caution with warfarin, aspirin, NSAIDs, antiplatelet drugs. Educate on bleeding precautions.
Vitamin K <i>Phytonadione</i>	Phytonadione (Mephyton, AquaMEPHYTON) — oral, SQ, IM, IV	Newborn prophylaxis, warfarin reversal/overdose, vitamin K deficiency bleeding, biliary obstruction, prolonged antibiotic therapy	IV route: anaphylaxis & cardiovascular collapse (rare but life-threatening); flushing, hypotension, hemolysis in G6PD deficiency, injection-site reactions	PO or SQ preferred ; IV ONLY if no alternative, give diluted & slow (max 1 mg/min). Newborn: 0.5–1 mg IM vastus lateralis within 1 hr of birth. Onset PO: 6–12 hrs; SQ: 1–2 hrs; IV: 1–2 hrs.

HIGH-ALERT DRUG INTERACTIONS

- Warfarin + Vitamin K** → decreased anticoagulant effect. Teach patients to keep **consistent** green leafy vegetable intake — not eliminate it.
- Warfarin + Vitamin E (high dose)** → increased bleeding.
- Cholestyramine / Orlistat / Mineral oil** → impaired absorption of *all* fat-soluble vitamins. Separate doses.
- Isotretinoin + Tetracyclines** → pseudotumor cerebri (severe ↑ICP).
- Thiazide diuretics + Vit D** → additive hypercalcemia.

06

NCLEX Test Traps

WHAT STUDENTS CONFUSE · WRONG VS. RIGHT

✗ WRONG

"Patient on warfarin should completely avoid all green leafy vegetables."

This is a classic distractor. Eliminating Vit K causes unpredictable INRs.

✓ RIGHT

"Maintain a consistent intake of vitamin K-containing foods."

Consistency is the goal so the warfarin dose can be titrated accurately.

✗ WRONG

"Take fat-soluble vitamins on an empty stomach with water for best absorption."

This is true for many drugs but the *opposite* for ADEK.

✓ RIGHT

"Take with a meal containing fat to optimize absorption."

Bile and dietary fat are required for micelle formation.

✗ WRONG

"All vitamins are safe in any dose because they are natural."

Fat-soluble vitamins accumulate and cause toxicity.

✓ RIGHT

"Fat-soluble vitamins (A, D, E, K) can build to toxic levels — take only as prescribed."

Toxicity is the boards' favorite ADEK question stem.

✗ WRONG

"Give the warfarin patient with INR 9 and active bleeding only IV vitamin K STAT."

IV vit K alone is slow (1–2 hrs) and risks anaphylaxis.

✓ RIGHT

"Hold warfarin, give IV vit K SLOWLY (diluted, max 1 mg/min) + FFP or PCC for rapid reversal."

Bleeding emergency requires immediate clotting factors.

✗ WRONG

"Give regular vitamin D (ergocalciferol/cholecalciferol) to the CKD patient with low Ca."

Damaged kidneys can't convert it to its active form.

✓ RIGHT

"Administer *activated* vitamin D (calcitriol) for CKD patients."

Calcitriol bypasses kidney activation — only form that works in CKD.

✗ WRONG

"A 27-year-old female on isotretinoin who has a positive pregnancy test should continue therapy."

Isotretinoin is a known teratogen.

✓ RIGHT

"Stop isotretinoin immediately and notify the prescriber and iPLEDGE program."

Severe craniofacial, CNS, and cardiac defects occur.

07

Patient & Family Education

TEACHING POINTS THAT SCORE

Diet & Food Sources

- **Vit A:** liver, fish oils, egg yolks, fortified dairy, dark leafy greens, carrots, sweet potatoes, cantaloupe
- **Vit D:** sunlight (15 min/day), fortified milk & cereals, fatty fish (salmon, tuna, mackerel), egg yolks
- **Vit E:** vegetable oils (sunflower, safflower), nuts (almonds), seeds, avocado, green leafy vegetables
- **Vit K:** kale, spinach, broccoli, brussels sprouts, cabbage, green tea (high amounts), produced by gut bacteria

Supplementation Safety

- Take vitamins **with a meal** containing fat.
- Never exceed prescribed dose — fat-soluble vitamins accumulate.
- Always **tell every provider** about ALL supplements, including herbals and OTC vitamins.
- Stop high-dose vit E **at least 1 week before surgery**.
- Store away from children — pediatric Vit A or D toxicity from overdose is a real ER presentation.

Special Populations

- **Newborns:** single Vit K IM injection within 1 hr of birth — explain to parents that breastmilk is low in Vit K and the gut is sterile.
- **Pregnancy:** avoid high-dose Vit A and isotretinoin. Beta-carotene (plant form) is safe.
- **Breastfed infants:** may need Vit D supplementation 400 IU/day (AAP recommendation).
- **Elderly:** Vit D + calcium for fall & fracture prevention.
- **Strict vegans:** at risk for Vit D deficiency; monitor levels.

When to Call the Provider

- Unexplained **bleeding** or bruising (Vit K issue or Vit E excess)
- Severe **headache, vomiting, blurred vision** (Vit A toxicity)
- **Polyuria, polydipsia, confusion** (Vit D toxicity → hypercalcemia)
- **Difficulty seeing at night** or in dim light (Vit A deficiency)
- New **numbness/tingling** or balance problems (possible Vit E deficiency)
- Possible/known **pregnancy** while on isotretinoin or high-dose Vit A

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Memory Boosters

MNEMONICS · PATTERN RECOGNITION

"ADEK" — The Fat-Soluble Four

A	Vision & skin — "Avision"
D	Bones — "Dem bones"
E	Antioxidant / RBCs — "Erythrocytes"
K	Clotting — "Koagulation"

Vit K Factors: "1972"

Factor X (10)
Factor IX (9)
Factor VII (7)
Factor II (2) — prothrombin

"1972" = factors 10, 9, 7, 2 — all vitamin K-dependent.

Vit D Toxicity: "Stones, Bones, Groans, Psychiatric Overtones"

- **Stones:** kidney stones, nephrocalcinosis
- **Bones:** bone pain (paradoxical)
- **Groans:** abdominal pain, N/V, constipation
- **Psychiatric:** confusion, lethargy, depression

"FAT" Patients Need ADEK

- Fat malabsorption (CF, pancreatitis)
- Abnormal bile flow (cholestasis, post-cholecystectomy)
- Total parenteral nutrition / bariatric surgery

Any "FAT" patient → screen all four ADEK levels.

Pattern recognition shortcut:

- *Bleeding* = think **K** (deficiency) or **E** (excess).
- *Bone problem* = think **D**.
- *Vision/skin/teratogenic* = think **A**.
- *Neuropathy/hemolytic anemia* = think **E**.

09

NCJMM Clinical Judgment Scenario

SIX-STEP NEXT GENERATION CASE

SCENARIO

Patient: A 3-year-old female with cystic fibrosis is brought to the pediatric clinic by her mother for a follow-up appointment. Mother reports the child "doesn't see well in the dark anymore," bruises easily, and has had three nosebleeds in the past two weeks. The child has been "skipping" her pancreatic enzyme replacement (Creon) because she "doesn't like the taste."

Vital signs: T 37.1°C · HR 118 · RR 28 · SpO₂ 95% on RA · BP 92/58. **Weight:** 5th percentile.

Labs: Hgb 9.8 g/dL · Plt 245,000 · **PT 22 sec (high)** · **INR 2.4** · Serum retinol low · 25-OH Vit D 12 ng/mL (low).

01

RECOGNIZE CUES

Identify the relevant findings:

- **Subjective:** night vision loss · easy bruising · recurrent epistaxis · skipping pancreatic enzymes
- **Objective:** weight in 5th percentile · prolonged PT/INR · low retinol · low 25-OH vit D · mild anemia
- **Background:** cystic fibrosis (pancreatic insufficiency → fat malabsorption)

02

ANALYZE CUES

Connect the data: Skipping Creon → no pancreatic lipase → cannot emulsify dietary fat → **fat-soluble vitamin malabsorption**.

- Night blindness ⇒ **Vitamin A deficiency**
- Easy bruising, epistaxis, prolonged PT/INR ⇒ **Vitamin K deficiency**
- Low 25-OH vit D + poor growth ⇒ **Vitamin D deficiency** (rickets risk)
- Mild anemia in CF child ⇒ possible **Vitamin E deficiency** (hemolytic component)

03

PRIORITIZE HYPOTHESES

Rank by safety risk:

1. **Vitamin K deficiency with active bleeding risk** — most acute (life-threatening hemorrhage potential). *Highest priority.*
2. **Vitamin A deficiency** — may progress to permanent corneal damage.
3. **Vitamin D deficiency** — risk of rickets and growth failure.
4. **Nonadherence to enzyme replacement** — the root cause driving all deficiencies.

04

GENERATE SOLUTIONS

- **Anticipate phytonadione (Vitamin K)** administration — PO or SQ route preferred for non-emergent correction.
- Initiate **ADEK supplementation** (CF-specific multivitamin such as AquADEKs or DEKAs) with each meal.
- Restart and ensure **pancreatic enzyme replacement therapy (PERT)** with every meal and snack containing fat — open capsule and mix with applesauce or other acidic non-protein food if needed for palatability.
- **Bleeding precautions:** soft toothbrush, no NSAIDs, fall precautions.
- Refer to CF nutrition team and family teaching on enzyme adherence.

05

TAKE ACTIONS

- Administer prescribed **Vitamin K** per HCP order (PO or SQ).
- Begin **ADEK** liquid or chewable multivitamin with breakfast (taken with fat-containing meal).
- Coach mother on giving Creon: **open capsule, sprinkle on applesauce, give immediately before meals/snacks — do NOT chew or crush beads.**
- Provide patient/family education on signs of bleeding, vision changes, and when to call the provider.
- Document teaching, vital signs, lab values, and family understanding.

06

EVALUATE OUTCOMES

Reassess in **2–4 weeks**. Expected outcomes:

- ☒ **PT/INR returning to normal range** within 1–2 weeks of supplementation
- ☒ **No new bleeding** or bruising episodes
- ☒ Improvement in **night vision** (Vit A repletion)
- ☒ **25-OH Vit D > 30 ng/mL** at recheck
- ☒ **Weight gain** trending toward growth curve
- ☒ **Family demonstrates correct Creon administration** and verbalizes understanding of fat-soluble vitamin needs

If no improvement → reassess adherence, consider higher dose, evaluate for additional GI pathology.