

HEMATOPOIETIC AGENTS

Class: Hematopoietic Growth Factors / Bone Marrow Stimulants

System: Hematologic • NCLEX-RN 2026 Test Plan • NGN / NCJMM Aligned

1. DRUG OVERVIEW

WHY WE GIVE IT (Key Indications)

- ESAs (Erythropoiesis-Stimulating Agents) → Anemia of CKD, chemo-induced anemia, zidovudine/HIV anemia, reduce transfusions in surgery
- Myeloid Growth Factors (G-CSF / GM-CSF) → Chemo-induced neutropenia, post-bone marrow transplant, stem cell mobilization
- Thrombopoietin Receptor Agonists → Immune thrombocytopenia (ITP), aplastic anemia, HCV-induced thrombocytopenia

HIGH-YIELD CLINICAL USE

- Replace **deficient blood cell lines** when bone marrow is suppressed, diseased, or chronically underproducing
- ↓ Need for blood/platelet transfusions → ↓ transfusion reactions, iron overload, alloimmunization
- Support patients through chemotherapy cycles safely

2. MECHANISM OF ACTION (SIMPLIFIED)

ERYTHROPOIESIS-STIMULATING AGENTS (ESAs)

- Mimic endogenous erythropoietin → bind receptors on **erythroid progenitor cells** in bone marrow → ↑ RBC production → ↑ O₂ carrying capacity → ↑ Hgb/Hct

MYELOID (COLONY-STIMULATING) GROWTH FACTORS

- G-CSF (filgrastim) → stimulates **granulocyte (neutrophil) production** → ↑ ANC → ↓ infection risk
- GM-CSF (sargramostim) → stimulates **granulocytes + macrophages** → broader myeloid recovery

THROMBOPOIETIN RECEPTOR AGONISTS

- Bind TPO receptor on megakaryocytes → ↑ **platelet production** → ↓ bleeding risk

 **BOTTOM LINE:** These drugs TELL the bone marrow to make more RBCs, WBCs, or platelets.

3. THERAPEUTIC EFFECTS

ESAs — Look For:

- ↑ Hgb (target 10–11 g/dL — NOT normal!)
- ↑ Hct, ↑ reticulocyte count within 1–2 weeks
- ↓ Fatigue, ↑ energy, ↑ activity tolerance
- ↓ Transfusion requirement

CSFs (Filgrastim / Pegfilgrastim) — Look For:

- ↑ **ANC > 1,500 cells/mm³ (recovered)**
- WBC recovery 3–5 days after chemo nadir
- ↓ Febrile neutropenia episodes
- Afebrile, no signs of infection

TPO Agonists — Look For:

- ↑ **Platelets > 50,000/mm³** (safe for surgery/procedures)
- ↓ Bruising, petechiae, bleeding

4. SIDE EFFECTS & ADVERSE REACTIONS

ESAs (Epoetin / Darbepoetin)	CSFs (Filgrastim / Pegfilgrastim)	TPO Agonists (Romi / Elt)
COMMON: • HTN (very common!) • Headache • Flu-like symptoms • Injection site pain • Nausea, arthralgia	COMMON: • Bone pain (classic!) • Fever, chills • Headache, fatigue • Injection site reaction • Rash	COMMON: • Headache • Fatigue • Arthralgia / myalgia • Nausea, dizziness • URI symptoms
🚨 SERIOUS / BLACK BOX: • ↑ MI, stroke, VTE, DVT, PE • ↑ Tumor progression / shortened survival in cancer • Severe HTN → seizures • Pure Red Cell Aplasia (anti-EPO antibodies) → STOP permanently	🚨 SERIOUS: • SPLenic RUPTURE (LUQ/L shoulder pain!) • ARDS / pulmonary infiltrates • Capillary leak syndrome • Severe sickle cell crisis • Allergic reaction (E. coli protein)	🚨 SERIOUS: • Thrombosis (arterial & venous) • Hepatotoxicity (eltrombopag) • Bone marrow fibrosis (long-term) • Rebound thrombocytopenia after D/C • Cataracts (eltrombopag)

5. PRIORITY NURSING CONSIDERATIONS

→ ASSESS

- Baseline BP (ESAs can cause severe HTN — #1 cause of holding)
- Baseline Hgb, Hct, ANC, platelets, iron studies

- History of CV disease, stroke, VTE, cancer type
- LUQ / left shoulder pain (splenic rupture — filgrastim)
- Signs of infection despite therapy (fever, chills, cough)

→ MONITOR

- BP every visit (ESAs) — report SBP ≥ 160 or sudden $\uparrow$
- CBC with differential — weekly initially, then with each dose
- Reticulocyte count (ESAs), ANC (CSFs), platelet count (TPO)
- Iron studies: ferritin and TSAT (transferrin saturation) BEFORE starting ESAs
- Chest pain, SOB, calf swelling, sudden headache, vision changes → VTE/MI/stroke

→ HOLD when...

- **ESA: Hgb > 11 g/dL** (non-dialysis CKD) or $> 11-12$ g/dL (dialysis) — exceeding target $\uparrow$ CV events & mortality
- **ESA: Hgb $\uparrow > 1$ g/dL in 2 weeks** → reduce dose 25%
- ESA: Uncontrolled HTN or pure red cell aplasia (anti-EPO antibodies)
- **Filgrastim: ANC $> 10,000$** (over-response)
- Any hematopoietic agent: active thrombosis event

→ NOTIFY HCP for...

- Chest pain, SOB, leg pain/swelling, facial droop, slurred speech
- LUQ or left shoulder pain (Kehr sign — splenic rupture)
- BP $> 160/100$ or sudden severe headache/seizure
- Rash, urticaria, dyspnea (hypersensitivity)
- ANC falling despite therapy (therapy failure)

CONTRAINDICATIONS

- Uncontrolled HTN (ESAs)
- Hypersensitivity to mammalian cell-derived products or albumin
- Pure red cell aplasia with anti-EPO antibodies
- Filgrastim: known hypersensitivity to E. coli-derived proteins

KEY DRUG INTERACTIONS

- **Filgrastim + chemo within 24 hrs** → bone marrow cells destroyed — separate by 24 hrs before & after
- **Eltrombopag + antacids/dairy/polyvalent cations (Ca, Mg, Fe, Al)** → chelation; separate by 4 hrs
- ESAs + other thrombogenic drugs (estrogens, anti-cancer) → $\uparrow$ VTE risk



6. LABS & DIAGNOSTICS

LAB	NORMAL	 CRITICAL	MEANING
Hgb	12–16 F / 14–18 M g/dL	> 11 = HOLD ESA	Target 10–11 only; higher $\uparrow$ MI/stroke
Hct	36–46 F / 41–53 M %	$\uparrow > 3\%$ in 2 wks = $\downarrow$ dose	Rapid rise = thrombotic risk

Reticulocytes	0.5–1.5%	↑ confirms ESA working	No rise after 8 wks = therapy failure
Ferritin	20–250 ng/mL	< 100 = iron-deplete	ESAs FAIL without iron
TSAT (Fe sat)	20–50%	< 20% = iron-deplete	Replete iron BEFORE ESA
ANC	2,500–6,000 /mm ³	< 500 = neutropenic emergency	Protective isolation, neutropenic precautions
Platelets	150,000–400,000	< 20,000 = bleed risk	TPO goal ≥ 50,000
BP	< 130/80	> 160/100 = HOLD ESA	ESA-induced HTN
LFTs (ALT/AST)	< 40 U/L	> 3× ULN (eltrombopag)	Hepatotoxicity — notify HCP

7. ADMINISTRATION & SAFETY

ROUTE & TIMING

- **Epoetin alfa (Epogen/Procrit):** SC or IV; dialysis pts → IV into dialysis line
- **Darbepoetin alfa (Aranesp):** SC or IV; longer half-life → weekly or every 2 weeks
- **Filgrastim (Neupogen):** SC daily OR IV infusion; START ≥24 hrs AFTER chemo, continue until ANC recovers
- **Pegfilgrastim (Neulasta):** SC once per chemo cycle, ≥24 hrs after chemo; OnPro on-body injector releases 27 hrs later
- **Sargramostim (Leukine):** SC or IV; start 2–4 hrs after BMT infusion
- **Romiplostim (Nplate):** SC once weekly; weight-based
- **Eltrombopag (Promacta):** PO; empty stomach; separate from antacids/dairy/Fe/Ca by ≥4 hrs

SPECIAL INSTRUCTIONS

- **⚡ DO NOT SHAKE the vial** — denatures the protein and inactivates the drug. Roll gently between palms.
- Refrigerate (36–46°F / 2–8°C); do NOT freeze; protect from light
- Inspect for discoloration or particulates — discard if cloudy
- Rotate SC injection sites (abdomen, outer thigh, upper arm)
- Single-dose vials/syringes: do NOT re-enter or re-use

HIGH-ALERT PRECAUTIONS

- ESAs: Pre-dose BP & Hgb REQUIRED — withhold if out of range
- Prescribers must enroll in REMS programs for some ESAs in cancer patients
- Dose based on actual body weight
- Filgrastim/Pegfilgrastim contains natural rubber latex in some cap components — screen for latex allergy

8. PATIENT EDUCATION

WHAT PATIENTS MUST KNOW

- “This drug stimulates your bone marrow — it won't work overnight. Give it 2–6 weeks.”
- Take BP at home daily (ESAs) and keep a log
- **Eat iron-rich foods** (red meat, beans, spinach, fortified cereals) while on ESAs
- Don't skip CBC appointments — labs guide dosing
- Store in the refrigerator; bring to room temp 30 min before injecting; never shake the vial
- Rotate injection sites; record date/site



SEEK HELP IMMEDIATELY FOR...

- **Chest pain, SOB, sweating** → possible MI
- **Facial droop, arm weakness, slurred speech** → FAST = stroke
- **Calf swelling/pain, sudden SOB** → DVT/PE
- **Severe headache, vision changes, BP > 180/110** → hypertensive emergency
- **Left upper belly or left shoulder pain** → splenic rupture (filgrastim)
- **Fever ≥ 100.4°F (38°C), chills, sore throat** → neutropenic infection = EMERGENCY

SAFETY / LIFESTYLE TEACHING

- Avoid crowds, sick contacts, raw/undercooked foods if neutropenic
- No live vaccines during neutropenia
- Soft toothbrush, electric razor, no flossing if platelets < 50,000
- Stay hydrated; avoid NSAIDs if thrombocytopenic
- Discuss pregnancy — use effective contraception (eltrombopag is teratogenic)

9. NCLEX TEST TRAPS ⚠

⚠ TOP TRAPS STUDENTS FALL INTO

- **TRAP 1: “Higher Hgb is better.”** FALSE. Target is 10–11 g/dL — NOT normal. Exceeding ↑ MI, stroke, death.
- **TRAP 2: Giving filgrastim on the same day as chemo.** WRONG — must be ≥24 hrs AFTER chemo so new cells aren't destroyed.
- **TRAP 3: Starting ESA without checking iron.** Check ferritin/TSAT FIRST — no iron = no RBCs made, regardless of ESA.
- **TRAP 4: Treating bone pain as a red flag.** With filgrastim, bone pain = drug is WORKING (marrow expansion). Treat with acetaminophen/loratadine, do NOT stop drug.
- **TRAP 5: Missing splenic rupture.** LUQ or LEFT shoulder pain on filgrastim ≠ GI upset. It's a surgical emergency.
- **TRAP 6: Shaking the vial.** ESAs/CSFs are proteins — shaking denatures them. Roll gently only.
- **TRAP 7: Assuming fever is ruled out on CSFs.** Febrile neutropenia can still occur — fever + ANC < 500 = blood cultures + empiric antibiotics STAT.

- **TRAP 8: Confusing ESA hypersensitivity with pure red cell aplasia.** PRCA = sudden loss of response + ↓↓ reticulocytes = STOP permanently, do NOT switch ESAs.
- **TRAP 9: Giving eltrombopag with milk or iron supplements.** Polyvalent cations chelate drug. Separate by 4 hrs.
- **TRAP 10: Stopping TPO agonist abruptly.** Causes rebound thrombocytopenia worse than baseline — taper per order.

10. MEMORY BOOSTERS

MNEMONICS

- **“POIE-tin” = RBCs** (Epoetin, Darbepoetin raise O₂ carriers)
- **“GRA-stim” = Granulocytes** (Filgrastim, Pegfilgrastim fight infection)
- **“-plostim / -trombopag” = Platelets** (Romiplostim, Eltrombopag — think THROMBO-cytes)
- **ESA Black Box “HIP-T”:** Hypertension • Infarct (MI/stroke) • Progression of tumor • Thrombosis (VTE)
- **“Eleven is Heaven”** — Hgb > 11 g/dL on ESA = stop & reassess
- **“24-hour rule”** — CSFs given ≥24 hrs AFTER chemo
- **“Bone pain = bone GAIN”** — filgrastim working; treat, don't stop
- **“LUQ on filgrastim = SPLEEN screaming”** — rupture emergency

PATTERNS ACROSS THE CLASS

- All three categories = BONE MARROW STIMULANTS → takes 1–4 weeks to see effect
- All are PROTEINS → don't shake, refrigerate, most are injectable
- All share THROMBOSIS risk when they over-correct — goal is “enough, not normal”
- All require BASELINE labs before starting and SERIAL CBC to guide dose

QUICK RECALL

- Anemia of CKD? → Epoetin + iron
- Post-chemo low WBC? → Filgrastim/Pegfilgrastim
- ITP with low platelets? → Romiplostim or Eltrombopag
- Hgb climbing too fast? → HOLD and ↓ dose 25%



CLINICAL JUDGMENT SNAPSHOT (NGN / NCJMM)

#1 PRIORITY RISK

THROMBOTIC EVENTS (MI, stroke, DVT, PE) with ESAs •
SPLENIC RUPTURE with filgrastim • HEPATOTOXICITY with
eltrombopag

WHAT HARMS FIRST	Uncontrolled HTN → hypertensive encephalopathy/stroke • Over-correction of Hgb → clot burden • Missed febrile neutropenia → sepsis within hours
FIRST NURSING ACTION	1) Assess BP + Hgb BEFORE dose • 2) HOLD if Hgb > 11 or BP uncontrolled • 3) For LUQ pain on filgrastim → STOP drug, assess for shock, NOTIFY HCP STAT • 4) Fever + ANC < 500 → blood cultures x2 + empiric broad-spectrum antibiotics WITHIN 1 HOUR
NGN RECOGNIZE CUES	BP trending up • Hgb rising > 1 g/dL in 2 wks • Sudden LUQ/shoulder pain • Calf tenderness/unilateral edema • Temp ≥ 100.4 + neutropenia • ↓ reticulocytes + ↓ Hgb on ESA = PRCA suspicion
NGN TAKE ACTION	HOLD drug → notify HCP → reassess labs/vitals → neutropenic precautions if ANC < 500 → bleeding precautions if platelets < 50K → initiate STAT work-up for suspected thrombosis/rupture/sepsis

 MOST TESTED DRUGS IN THIS CLASS				
GENERIC	BRAND	CATEGORY	USE	KEY DIFFERENCE
Epoetin alfa	Epogen, Procrit	ESA	Anemia (CKD, chemo, HIV)	Short-acting; SC/IV 1–3x/wk
Darbepoetin alfa	Aranesp	ESA	Anemia (CKD, chemo)	LONG-acting; weekly or q2wk dosing
Filgrastim	Neupogen	G-CSF	Neutropenia from chemo	Short-acting; SC daily until ANC recovers
Pegfilgrastim	Neulasta	G-CSF (pegylated)	Neutropenia from chemo	LONG-acting; ONE dose per chemo cycle; OnPro injector
Sargramostim	Leukine	GM-CSF	Post-BMT, stem cell mobilization	Broader effect (granulocytes + macrophages); more flu-like Sx
Romiplostim	Nplate	TPO agonist	Chronic ITP	SC weekly; weight-based; peptibody mimics TPO
Eltrombopag	Promacta	TPO agonist	ITP, aplastic anemia, HCV thrombocytopenia	ORAL; empty stomach; avoid Ca/Fe/dairy x4 hrs; hepatotoxic

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