NCLEX-RN 2026 ▸ DAY 14 OF 14 ▸ PHARM MASTERY SERIES

Oncology, Immunology & *High-Risk Medications*

Chemotherapy safety, methotrexate, biologics, immunosuppressants, transplant medications, colony-stimulating factors, vesicants, antidotes & toxicity recognition — built for the 2026 NGN test plan with NCJMM clinical judgment integration.

22 FLASHCARDS | 5 SAFETY RULES | 5 DOSE CALC | 5 NGN ITEMS | 1 CASE STUDY | RED FLAG REVIEW

§ 01 Advanced Flashcards

22 CARDS · APPLICATION-LEVEL

Methotrexate (MTX)

HIGH-ALERT

ANTIMETABOLITE · FOLATE ANTAGONIST · DMARD

MECHANISM	Blocks dihydrofolate reductase → stops DNA synthesis in rapidly dividing cells.
INDICATION	Leukemia, lymphoma, breast/osteosarcoma, ectopic pregnancy, RA, psoriasis.
PRE-ASSESS	Pregnancy test (Category X — **teratogen**), CBC, LFTs, BUN/Cr, folate level, hydration status, NSAID/PPI/Bactrim use.
MONITORING	CBC weekly, ALT/AST, creatinine, MTX serum level for high-dose protocols, mucositis screen.
WORST AE	**Pancytopenia, hepatotoxicity, pulmonary fibrosis, nephrotoxicity, severe mucositis, tumor lysis.**
SIDE EFFECTS	Mouth sores, N/V, alopecia, photosensitivity, fatigue.
HOLD/NOTIFY	ANC < 1,500, platelets < 100k, AST/ALT > 3× upper limit, Cr ↑ >0.3 from baseline, severe stomatitis, pregnancy.
ANTIDOTE	**Leucovorin (folinic acid)** — "rescue" within hours of toxic levels.
TEACHING	Weekly dose for RA, never daily. Avoid alcohol, NSAIDs, Bactrim. Effective contraception 6 mo after stopping (male & female). Report mouth sores or cough.
NURSING ACTION	Alkalinize urine (pH > 7) and aggressive hydration for high-dose IV MTX.

Q: *A client with RA reports taking 7.5 mg of methotrexate daily for 2 weeks. The nurse's priority?*

A: Hold the dose, draw CBC/LFTs/Cr immediately, and notify the provider — MTX for RA is dosed **weekly**; daily dosing causes severe pancytopenia and hepatic toxicity. This is a sentinel medication-error scenario.

⚡ **NCLEX tip —** Confusion between "weekly" and "daily" is a sentinel event. On the test, MTX = once weekly unless it's a high-dose oncology protocol.

Cyclophosphamide

HIGH-ALERT

ALKYLATING AGENT · NITROGEN MUSTARD

MECHANISM	Cross-links DNA strands → cell death in dividing cells.
INDICATION	Lymphoma, leukemia, breast, ovarian, lupus nephritis, severe vasculitis.
PRE-ASSESS	CBC, renal/hepatic panel, urinalysis, hydration status, pregnancy, prior pelvic radiation.
MONITORING	Hematuria/UA every visit, CBC nadir at 7–14 days, BUN/Cr, electrolytes (SIADH risk).
WORST AE	**Hemorrhagic cystitis, secondary leukemia, infertility, SIADH, severe myelosuppression.**
HOLD/NOTIFY	Gross hematuria, dysuria, ANC < 1,000, hyponatremia, oliguria.
ANTIDOTE	**Mesna** + IV hydration ≥ 2 L/day to bind acrolein in bladder.
TEACHING	Void every 1–2 h, drink 2–3 L fluids/day, take in AM, report pink/red urine immediately, contraception during & 12 mo after.
NURSING ACTION	Administer mesna before, during & after dose. Strict I/O. Never give at bedtime.

Q: *Which lab/finding most urgently warrants intervention on day 2 of cyclophosphamide?*

A: Bloody urine and oliguria — signals **hemorrhagic cystitis** from acrolein. Stop drug, increase hydration, escalate to provider, prepare mesna and bladder irrigation.

⚡ **NCLEX tip —** Hint: "morning dose + lots of water" almost always = cyclophosphamide on NCLEX.

Doxorubicin

VESICANT

ANTHRACYCLINE · VESICANT CHEMO

MECHANISM	Intercalates DNA + topoisomerase II inhibition + free-radical damage to cardiac myocytes.
INDICATION	Breast cancer, lymphoma, sarcoma, leukemia.
PRE-ASSESS	**Baseline LVEF (echo or MUGA)**, cumulative lifetime dose (max ≈ 450–550 mg/m²), CBC, central line patency.
MONITORING	LVEF before each cycle if cumulative dose high, ECG, signs of CHF, IV site every 5–10 min.
WORST AE	**Cardiotoxicity / cardiomyopathy (dose-related, often irreversible), extravasation = tissue necrosis.**
SIDE EFFECTS	Red-orange urine (harmless, 1–2 days), alopecia, mucositis, N/V, myelosuppression.
HOLD/NOTIFY	LVEF drop > 10% or below 50%, new dyspnea/edema, S3, pain/burning at IV site.
ANTIDOTE	**Dexrazoxane** for extravasation; cold compress; STOP infusion immediately; aspirate residual drug.
TEACHING	Reassure red urine. Report leg swelling, weight gain, dyspnea, irregular heartbeat.

> **Q:** *During doxorubicin infusion via peripheral IV, the client reports burning at the site. Best action?*
>
> **A: Stop the infusion immediately**, leave the IV in place, attempt to aspirate residual drug, apply cold compress, mark margins, notify provider, prepare dexrazoxane. Removing the catheter first loses the access for antidote delivery.

⚡ **NCLEX tip —** Anthracyclines = "rubicin" suffix. Always think HEART before, during, and after.

Vincristine

IV-ONLY · FATAL IT

VINCA ALKALOID · VESICANT

MECHANISM	Disrupts microtubules → cell-cycle arrest in mitosis.
INDICATION	ALL, lymphoma, Wilms tumor, neuroblastoma.
PRE-ASSESS	Baseline neuro exam (DTRs, gait, fine motor), bowel pattern, CBC, LFTs.
MONITORING	DTR loss, foot drop, paresthesias, ileus, jaw pain.
WORST AE	**Severe peripheral neuropathy, paralytic ileus. *Intrathecal administration = FATAL*** (ALWAYS IV; mini-bag, never syringe).
HOLD/NOTIFY	Loss of DTRs, severe constipation/ileus, motor weakness, jaw or bone pain.
ANTIDOTE	For extravasation: **hyaluronidase** + warm compress (opposite of doxorubicin!).
TEACHING	Stool softener + laxative routinely. Report tingling, falls, jaw pain.
NURSING ACTION	Verify "FOR IV USE ONLY — FATAL IF GIVEN INTRATHECALLY" label. Use mini-bag of 50 mL — NEVER syringe.

> **Q:** *Which order for vincristine requires the nurse to clarify before administration?*
>
> **A:** An order for vincristine **"intrathecal 1.4 mg/m²"** — IT administration is universally fatal. Sentinel event. Verify route, document clarification, escalate per chain of command.

⚡ **NCLEX tip —** Mnemonic: Vincristine = Vesicant + Very neurotoxic + Very fatal IT. Warm + Hyaluronidase. Doxorubicin = Cold + Dexrazoxane.

Cisplatin

HIGH-ALERT

PLATINUM ALKYLATING-LIKE

MECHANISM	Forms DNA crosslinks → cell death.
INDICATION	Testicular, ovarian, bladder, head & neck, lung cancers.
PRE-ASSESS	BUN/Cr, GFR, Mg, K, audiogram, hydration status, antiemetic plan.
MONITORING	Daily I/O, daily weights, BUN/Cr, electrolytes, hearing screen.
WORST AE	**Nephrotoxicity, ototoxicity, peripheral neuropathy, severe N/V, hypomagnesemia.**
HOLD/NOTIFY	Cr ↑ > 0.3, urine output < 30 mL/h, tinnitus/hearing loss, Mg < 1.5.
ANTIDOTE	Amifostine (cytoprotectant) + aggressive saline pre/post hydration.
TEACHING	Drink ≥ 2 L/day, report ringing in ears, numbness, decreased urine.

Q: *Best premedication regimen?*

A: Aggressive IV hydration with NS + mannitol/furosemide protocol, **ondansetron + dexamethasone + aprepitant** for the high-emetic-risk class.

⚡ **NCLEX tip —** "-platin" drugs = ears + kidneys. Always check baseline hearing.

Paclitaxel

ANAPHYLAXIS RISK

TAXANE · MITOTIC SPINDLE INHIBITOR

MECHANISM	Stabilizes microtubules → blocks mitosis.
INDICATION	Breast, ovarian, lung, Kaposi sarcoma.
PRE-ASSESS	History of allergy to **Cremophor EL** or castor oil, neuropathy, CBC, BP, premed regimen given.
MONITORING	VS every 15 min × first hour, infusion-reaction signs, ANC nadir.
WORST AE	**Hypersensitivity reaction (bronchospasm, hypotension) within first 10 min, neuropathy, bone marrow suppression.**
HOLD/NOTIFY	Flushing, chest tightness, dyspnea, hives, hypotension during infusion.
ANTIDOTE	Stop infusion + epinephrine, diphenhydramine, hydrocortisone, oxygen.
TEACHING	Premeds (dexamethasone, H1/H2 blockers) must be taken on schedule. Report numbness/tingling.

Q: *Premedication 12 h and 6 h before paclitaxel is missed. The nurse should:*

A: Hold the infusion and contact the provider — premedications prevent severe hypersensitivity from the Cremophor EL diluent.

⚡ **NCLEX tip —** Anything ending in "-taxel" → premedicate or risk anaphylaxis.

5-Fluorouracil (5-FU)

HIGH-ALERT

PYRIMIDINE ANTIMETABOLITE

MECHANISM	Blocks thymidylate synthase → DNA disruption.
INDICATION	Colorectal, breast, gastric, pancreatic, head & neck.
PRE-ASSESS	DPD deficiency screening when available, CBC, mucositis exam, cardiac history.
MONITORING	Mucositis, hand-foot syndrome, diarrhea severity, ANC nadir.
WORST AE	**Severe diarrhea, mucositis, myelosuppression, coronary vasospasm/MI, hand-foot syndrome.**
HOLD/NOTIFY	Grade 3+ diarrhea, severe mouth pain, chest pain, ANC < 1,000.
ANTIDOTE	**Uridine triacetate** within 96 hr for overdose/severe toxicity.
TEACHING	Bland diet, no alcohol, sunscreen, ice chips during bolus to reduce mucositis, report > 4 stools above baseline.

Q: *A client on continuous-infusion 5-FU develops new chest pain. Action?*

A: Stop the infusion, obtain 12-lead ECG, troponin, give nitrate per protocol — 5-FU causes **coronary vasospasm**.

⚡ **NCLEX tip —** "5-FU + chest pain" is a tested pearl — don't dismiss as anxiety.

Tamoxifen

LONG-TERM THERAPY

SERM (SELECTIVE ESTROGEN RECEPTOR MODULATOR)

MECHANISM	Blocks estrogen at breast tissue; agonist at endometrium, bone, liver.
INDICATION	ER+ breast cancer treatment/prevention; gynecomastia.
PRE-ASSESS	Baseline pelvic exam, lipid panel, LFTs, DVT history, pregnancy test.
MONITORING	Yearly gyn exam, signs of VTE/stroke, vision.
WORST AE	**Endometrial cancer, DVT/PE, stroke, cataracts, hepatotoxicity.**
SIDE EFFECTS	Hot flashes, menstrual irregularity, weight gain, mood changes.
HOLD/NOTIFY	Abnormal vaginal bleeding, leg pain/swelling, vision change, sudden HA.
TEACHING	Take 5–10 yrs. Use non-hormonal contraception. Report any vaginal bleeding immediately. Avoid St. John's wort.

Q: *Which symptom most urgently requires evaluation?*

A: Postmenopausal vaginal bleeding — concerning for **endometrial cancer**. Calf swelling/pain also urgent (DVT). Hot flashes alone do not warrant emergent evaluation.

⚡ **NCLEX tip —** "-fen" = SERM. Think clot + uterus.

Leucovorin (Folinic acid)

ANTIDOTE

RESCUE AGENT · REDUCED FOLATE

MECHANISM	Bypasses methotrexate's block on folate metabolism, "rescuing" healthy cells.
INDICATION	High-dose MTX rescue, MTX overdose, 5-FU potentiation in colorectal cancer.
PRE-ASSESS	MTX serum level, urine pH (> 7), Cr trend, time of last MTX dose.
MONITORING	MTX level q24h until < 0.05 µmol/L, CBC, renal panel.
WORST AE	Rare hypersensitivity. Wrong-time error = MTX kills healthy cells.
HOLD/NOTIFY	Confirm timing — leucovorin must be given on schedule until MTX cleared.
TEACHING	Take EXACTLY at scheduled times — alarm reminders. Do not substitute folic acid OTC.
NURSING ACTION	Never confuse leucovorin (rescue) with folic acid (vitamin). Different drugs.

> **Q:** *A high-dose MTX patient has a delayed leucovorin dose by 4 hours. The nurse anticipates which lab change?*
>
> **A:** Drop in WBC + neutrophils, rising AST/ALT, rising Cr — **MTX continues to suppress healthy cells** when rescue is delayed.

⚡ **NCLEX tip —** Leucovorin "rescues" healthy cells; folic acid "feeds" tumor cells. Different roles.

Mesna

ANTIDOTE

UROPROTECTANT · SULFHYDRYL DONOR

MECHANISM	Binds acrolein in urine before it can damage bladder mucosa.
INDICATION	Prevention of hemorrhagic cystitis from cyclophosphamide / ifosfamide.
PRE-ASSESS	Hydration, baseline UA, allergy to thiol drugs.
MONITORING	Hourly urine output, dipstick for blood, dysuria.
SIDE EFFECTS	Headache, fatigue, false-positive ketones on dipstick.
HOLD/NOTIFY	Gross hematuria despite mesna → escalate; do not stop cyclophosphamide independently.
TEACHING	Drink 2–3 L water/day, void hourly, report pink urine.
NURSING ACTION	Doses typically scheduled **0 min, 4 h, and 8 h** after ifosfamide/cyclophosphamide.

> **Q:** *Which finding indicates mesna is effective?*
>
> **A:** Clear yellow urine without blood and absence of dysuria — protects bladder mucosa from acrolein.

⚡ **NCLEX tip —** "Mesna for the Madder bladder" — pair it mentally with cyclophosphamide and ifosfamide.

Filgrastim (G-CSF)

BONE PAIN RISK

HEMATOPOIETIC GROWTH FACTOR

MECHANISM	Stimulates neutrophil production in bone marrow.
INDICATION	Chemotherapy-induced neutropenia prevention; stem-cell mobilization.
PRE-ASSESS	CBC w/ diff, allergy to E. coli–derived proteins, splenic exam, sickle cell history.
MONITORING	ANC, WBC (target > 10,000), spleen tenderness, dyspnea (ARDS rare).
WORST AE	**Splenic rupture (rare, but fatal), ARDS, sickle cell crisis.**
SIDE EFFECTS	Bone pain (sternum, pelvis, long bones), low-grade fever.
HOLD/NOTIFY	LUQ or shoulder pain, dyspnea, WBC > 100,000 (in non-mobilization use).
TEACHING	Subcut self-injection rotation. Bone pain = drug working; treat with acetaminophen or loratadine. Refrigerate; warm to room temp before use.

Q: *A client on filgrastim reports LUQ pain radiating to the left shoulder. The nurse?*

A: Hold the drug, vital signs, alert provider — concern for **splenic rupture** (Kehr sign). Surgical emergency.

⚡ **NCLEX tip —** "-grastim" = Granulocytes. "-poetin" = RBCs. Don't mix them up.

Epoetin alfa

HTN / CLOT RISK

ESA · ERYTHROPOIESIS-STIMULATING AGENT

MECHANISM	Recombinant EPO → ↑ RBC production in marrow.
INDICATION	Anemia in CKD, chemo, HIV/zidovudine, surgery.
PRE-ASSESS	BP, Hgb (target 10–11 g/dL, never > 12), iron studies, history of stroke/MI.
MONITORING	Hgb weekly until stable, BP each visit, iron saturation > 20%.
WORST AE	**Hypertensive crisis, thrombosis (DVT/PE/MI/CVA), tumor progression risk.**
HOLD/NOTIFY	Hgb > 11–12 g/dL, BP > 160/100, sudden headache, chest pain, leg swelling.
TEACHING	Black-box: don't exceed Hgb target. Iron supplementation usually required. Report HA, vision changes.
NURSING ACTION	Don't shake vial. Subcut or IV. Use lowest dose to avoid transfusion.

Q: *Hgb 12.4 g/dL after 3 weeks of epoetin. Action?*

A: Hold dose, notify provider. Hgb > 11 increases thrombotic events; target is 10–11.

⚡ **NCLEX tip —** "-poetin" raises RBC. Higher isn't better — it clots.

Ondansetron

COMMONLY TESTED

5-HT3 ANTAGONIST · ANTIEMETIC

MECHANISM	Blocks serotonin receptors in CTZ & gut.
INDICATION	Chemo-induced N/V, post-op, hyperemesis.
PRE-ASSESS	Baseline ECG (QT), electrolytes (K, Mg), liver function, medication list (SSRIs, methadone).
MONITORING	QTc, serotonin syndrome signs, bowel pattern.
WORST AE	**QT prolongation → torsades de pointes, serotonin syndrome, severe constipation.**
HOLD/NOTIFY	QTc > 500 ms, syncope, palpitations, K < 3.5, Mg < 1.7.
TEACHING	Use ODT for severe N/V. Headache common. Hydrate. Avoid combining with multiple serotonergic drugs.

Q: *A client on chemo + sertraline now receives ondansetron and reports tremor, agitation, diaphoresis. Suspect?*

A: Serotonin syndrome. Stop serotonergic drugs, monitor temp/VS, supportive care, consider cyproheptadine.

⚡ **NCLEX tip —** "-setron" = 5HT3 blockers = QT prolongation. Check K/Mg first.

Allopurinol

TLS PREVENTION

XANTHINE OXIDASE INHIBITOR

MECHANISM	Blocks conversion of hypoxanthine → uric acid.
INDICATION	Tumor lysis syndrome prophylaxis, chronic gout.
PRE-ASSESS	Renal function, allergy hx, HLA-B*5801 status in high-risk ethnicities, hydration.
MONITORING	Uric acid, BUN/Cr, K, Ca, phosphorus, LFTs, skin exam.
WORST AE	**Stevens-Johnson syndrome / TEN, DRESS, hepatotoxicity, bone marrow suppression.**
HOLD/NOTIFY	Any rash — high suspicion of SJS/TEN, fever, mucosal lesions.
TEACHING	Drink 2–3 L water/day. Stop and report rash. Avoid azathioprine/6-MP combo.
NURSING ACTION	Start 1–2 days before chemo. Adjust dose for CKD.

Q: *A leukemia patient starts induction chemo. Pre-chemo labs show uric acid 9.4. Anticipated order?*

A: Allopurinol or rasburicase + aggressive hydration + frequent electrolyte monitoring — **prevent tumor lysis syndrome**.

⚡ **NCLEX tip —** Rash on allopurinol = STOP, never just give Benadryl.

Rasburicase

RECOMBINANT URATE OXIDASE

G6PD CONTRAINDICATION

MECHANISM	Converts uric acid → allantoin (water-soluble, excreted).
INDICATION	Treatment/prevention of severe hyperuricemia in tumor lysis syndrome.
PRE-ASSESS	**G6PD screen** (contraindicated → hemolytic anemia & methemoglobinemia), pregnancy, allergy.
MONITORING	Uric acid drawn into **pre-chilled tubes** on ice (or false-low), K, Ca, phosphorus, hemoglobin.
WORST AE	**Hemolytic anemia (G6PD def), methemoglobinemia, anaphylaxis.**
HOLD/NOTIFY	Cyanosis, brown urine, fall in Hgb, hypoxia not responding to O_2.
ANTIDOTE	Methylene blue for methemoglobinemia (avoid in G6PD).

Q: *SpO_2 unchanged at 85% on 100% O_2 after rasburicase. Suspect?*

A: Methemoglobinemia — O_2 saturation appears low despite oxygen because methemoglobin can't bind O_2. Verify with co-oximetry; consider methylene blue (not if G6PD def).

⚡ **NCLEX tip —** "Rasburicase + G6PD" is a classic NCLEX trap.

Rituximab

ANTI-CD20 MONOCLONAL ANTIBODY

INFUSION REACTION

MECHANISM	Targets CD20 on B-lymphocytes → cell lysis.
INDICATION	Non-Hodgkin lymphoma, CLL, RA, MS, lupus nephritis.
PRE-ASSESS	**Hepatitis B screen** (reactivation risk), VS, premeds (acetaminophen + diphenhydramine ± steroid).
MONITORING	VS every 15 min × first hour, IgG, JC virus (PML risk), CBC.
WORST AE	**Severe infusion reaction, tumor lysis (1st dose), HBV reactivation, PML.**
HOLD/NOTIFY	Hypotension, dyspnea, throat tightness, rigors — slow or stop, give meds, may resume at 50% rate.
TEACHING	No live vaccines. Report fever, cough, new neuro symptoms (PML). Premed compliance critical.

Q: *During the first rituximab infusion, the client has rigors and hypotension. Action?*

A: Stop the infusion, support BP with fluids, administer diphenhydramine ± steroid, notify provider. Restart at 50% of rate once symptoms resolved.

⚡ **NCLEX tip —** "-mab" = monoclonal antibody. First dose is the riskiest.

Trastuzumab

ANTI-HER2 MONOCLONAL ANTIBODY

CARDIOTOXIC

MECHANISM	Binds HER2 receptor on cancer cells → growth arrest + immune destruction.
INDICATION	HER2+ breast cancer, gastric cancer.
PRE-ASSESS	**LVEF baseline + every 3 months**, no concurrent anthracycline if possible, pregnancy test.
MONITORING	LVEF, signs of CHF, infusion reactions, pulmonary function.
WORST AE	**Cardiomyopathy (often reversible vs doxorubicin), pulmonary toxicity, infusion reaction.**
HOLD/NOTIFY	LVEF drop > 10% from baseline or below 50%, new dyspnea, S3, edema.
TEACHING	Avoid pregnancy 7 mo after stopping. Report cough, leg swelling, fatigue with exertion.

Q: *A client on trastuzumab + doxorubicin has new fatigue, JVD, S3. Concern?*

A: Cardiotoxicity. Both drugs are cardiotoxic — synergistic risk. Stop, echo, cardiology referral.

⚡ **NCLEX tip —** "Trastuzumab" → HER2 → Heart at risk.

Bevacizumab

VEGF INHIBITOR · ANTI-ANGIOGENIC MAB

BLEEDING · PERFORATION

MECHANISM	Binds VEGF → blocks new tumor blood vessel formation.
INDICATION	Colorectal, lung, glioblastoma, renal cell, ovarian, cervical cancer.
PRE-ASSESS	BP, surgery within 28 days (delay), bleeding history, urine protein, wound status.
MONITORING	BP every visit, proteinuria (dipstick), bleeding signs, abdominal exam.
WORST AE	**GI perforation, hemorrhage, hypertensive crisis, impaired wound healing, thrombosis.**
HOLD/NOTIFY	BP > 160/100, hematemesis/melena, severe abdominal pain, proteinuria > 2g/24h.
TEACHING	No surgery 28 days before/after dose. Report bloody stools, vomiting blood, severe pain.

Q: *Client on bevacizumab reports sudden severe abdominal pain + rigid abdomen. Action?*

A: Activate rapid response — concern for **GI perforation**. NPO, large-bore IV, surgical consult, antibiotics.

⚡ **NCLEX tip —** VEGF inhibitor = "Bleeding, BP, Bowels."

Cyclosporine

NARROW THERAPEUTIC INDEX

CALCINEURIN INHIBITOR · IMMUNOSUPPRESSANT

MECHANISM	Inhibits calcineurin → ↓ T-cell IL-2 production.
INDICATION	Organ transplant rejection prevention, severe psoriasis, RA, GVHD.
PRE-ASSESS	BP, BUN/Cr, K, Mg, LFTs, infection screen, drug levels, grapefruit avoidance.
MONITORING	Trough levels, Cr trend, BP, K (↑), Mg (↓), glucose, lipid panel.
WORST AE	**Nephrotoxicity, hypertension, hyperkalemia, infection, malignancy (especially skin/lymphoma).**
HOLD/NOTIFY	Cr rising > 30% from baseline, K > 5.5, BP uncontrolled, new infection.
TEACHING	NO grapefruit/juice (CYP3A4), gum hyperplasia (oral hygiene), hirsutism, daily sunscreen, no live vaccines, mix oral solution in glass not Styrofoam.

Q: *Best follow-up teaching question?*

A: "What do you eat with breakfast?" — grapefruit increases cyclosporine levels and risks toxicity.

⚡ **NCLEX tip —** All calcineurin inhibitors hit the kidney and potassium. Grapefruit = poison.

Tacrolimus

NARROW THERAPEUTIC INDEX

CALCINEURIN INHIBITOR (MORE POTENT)

MECHANISM	Same family as cyclosporine — calcineurin blockade.
INDICATION	Solid-organ transplant rejection prevention.
PRE-ASSESS	BUN/Cr, glucose, K, Mg, BP, neuro baseline.
MONITORING	12-hr trough levels, glucose (more diabetogenic than cyclosporine), Cr, K, Mg, neuro exam.
WORST AE	**New-onset diabetes after transplant (NODAT), nephrotoxicity, neurotoxicity (tremor, seizures), PRES.**
HOLD/NOTIFY	Tremor, vision changes, severe HA, glucose > 200, Cr ↑, fever, K > 5.5.
TEACHING	Same time q12h, no grapefruit, glucose monitoring, no live vaccines, daily sunscreen, infection precautions.

Q: *A kidney transplant patient on tacrolimus develops tremor + visual blurring + HA. Suspect?*

A: PRES (posterior reversible encephalopathy syndrome) or supratherapeutic level. Hold dose, check trough, MRI brain, contact transplant team.

⚡ **NCLEX tip —** Cyclosporine causes gum & hair growth; tacrolimus causes diabetes & tremor.

Mycophenolate Mofetil

TERATOGEN · REMS

ANTI-PROLIFERATIVE IMMUNOSUPPRESSANT

MECHANISM	Inhibits inosine monophosphate dehydrogenase → ↓ B/T-cell proliferation.
INDICATION	Transplant rejection prevention, lupus nephritis, autoimmune disease.
PRE-ASSESS	**Pregnancy test (REMS program)**, CBC, LFTs, GI baseline, contraception counseling.
MONITORING	CBC weekly initially, LFTs, signs of infection, pregnancy q month.
WORST AE	**Severe birth defects/miscarriage, lymphoma/skin cancer, severe infection, GI bleeding, PML.**
HOLD/NOTIFY	Positive pregnancy test, ANC < 1,300, melena, severe diarrhea.
TEACHING	Two forms of contraception during & 6 wks after. No live vaccines, no breast-feeding. Take on empty stomach. Sunscreen.

Q: *Which teaching point is most important?*

A: "Use two reliable forms of contraception during and 6 weeks after stopping mycophenolate — even with a partner who has had vasectomy." REMS-mandated teaching.

⚡ **NCLEX tip —** "Mycophenolate = May-not-conceive." Pregnancy testing q month is a REMS requirement.

TNF-α Inhibitors

INFECTION RISK

ETANERCEPT · ADALIMUMAB · INFLIXIMAB

MECHANISM	Bind tumor necrosis factor → block inflammatory cascade.
INDICATION	RA, psoriatic arthritis, ankylosing spondylitis, IBD, plaque psoriasis.
PRE-ASSESS	**Baseline TB skin test or IGRA**, hepatitis B/C screen, HF history (avoid if NYHA III/IV), MS history.
MONITORING	Infection signs, CBC, LFTs, skin exam (lymphoma/skin cancer), TB monitoring.
WORST AE	**Reactivation of latent TB, serious infection (sepsis, fungal), lymphoma, demyelination, CHF worsening.**
HOLD/NOTIFY	Fever, cough > 2 wks, weight loss, new neuro symptoms, worsening dyspnea.
TEACHING	No live vaccines. Avoid sick contacts. Rotate injection sites. Store refrigerated; never freeze. Bring to room temp before use.

Q: *Before starting infliximab for RA, what is essential?*

A: Screen for latent TB and hepatitis B — TNF inhibitors reactivate dormant infections. Vaccinate (non-live) prior. Confirm no active HF or demyelinating disease.

⚡ **NCLEX tip —** "-mab" or "-cept" for autoimmune disease → think TB screen + no live vaccines.

§ 02 Must-Not-Miss Safety Rules

5 RULES · SAFETY PRIORITY

Top 5 Sentinel-Event Safeguards

01 **Methotrexate is dosed WEEKLY for non-oncology indications.** A daily order = sentinel event. Always verify frequency, confirm with pharmacy & provider, hold until clarified. Same with oral chemo — never "as needed."

02 **Vincristine is IV only — intrathecal administration is universally fatal.** Must be prepared in a mini-bag (≥ 50 mL), never a syringe; label "FOR IV USE ONLY — FATAL IF GIVEN BY OTHER ROUTES."

03 **Treat any chemotherapy spill or splash as hazardous.** Wear chemo-rated PPE (double gloves, gown, eye protection, N95 if aerosol), use chemo spill kit, do not dispose in regular trash. Pregnant or breastfeeding nurses should not handle hazardous drugs per USP <800>.

04 **Vesicant extravasation = STOP, don't pull.** Halt infusion, leave catheter, aspirate residual drug, then give antidote: *cold + dexrazoxane for anthracyclines (doxorubicin); warm + hyaluronidase for vinca alkaloids (vincristine).*

05 **Live vaccines are contraindicated with all immunosuppressants and biologics.** No MMR, varicella, intranasal flu, oral typhoid, rotavirus, yellow fever for clients on chemo, high-dose steroids (≥ 20 mg prednisone × 14d), TNF inhibitors, rituximab, transplant meds, or within 3 months of stopping.

§ 03 Dose Calculations & Safety Math

5 PROBLEMS · APPLICATION

1 · BSA chemo dose

Doxorubicin is ordered 60 mg/m² IV. The client is 165 cm tall and weighs 70 kg (BSA = 1.77 m²).

Calculate the dose. Round to whole number.

▸▸ REVEAL WORK

2 · Filgrastim subcut dose

Filgrastim 5 mcg/kg/day subcut is ordered. Client weighs 154 lb. Vial concentration is 480 mcg/mL.

How many mL per dose?

▸▸ REVEAL WORK

3 · Weekly methotrexate

A client with RA is ordered methotrexate 0.3 mg/kg PO weekly. Weight = 68 kg. Tablets are 2.5 mg.

How many tablets per weekly dose?

▸▸ REVEAL WORK

4 · Mesna with cyclophosphamide

Cyclophosphamide 1,200 mg IV is ordered. Protocol calls for mesna 20% of the cyclophosphamide dose at 0, 4, and 8 hours.

What is each mesna dose?

▸▸ REVEAL WORK

5 · Rituximab infusion rate

First-dose rituximab 375 mg/m² in 500 mL NS. BSA 1.85 m². Initial rate 50 mg/hr; if tolerated, ↑ by 50 mg/hr q30 min to max 400 mg/hr.

After 30 min uneventful, what is the next infusion rate in mL/hr if the solution = 700 mg / 500 mL?

▸▸ REVEAL WORK

§ 04 NGN-Style Questions

5 ITEMS · MIXED FORMATS

SATA · NCJMM: ANALYZE CUES

Tumor Lysis Syndrome Labs

A 24-year-old with Burkitt lymphoma is 8 hours into induction chemotherapy. The nurse reviews the labs below. **Select all findings that indicate tumor lysis syndrome:**

- ☑ Potassium 6.4 mEq/L
- ☑ Phosphorus 7.5 mg/dL
- ☐ Sodium 138 mEq/L
- ☑ Calcium 7.0 mg/dL
- ☑ Uric acid 11.2 mg/dL
- ☑ Creatinine 2.1 mg/dL (baseline 0.9)
- ☐ Hemoglobin 11.0 g/dL

▸▸ REVEAL RATIONALE

MATRIX GRID · NCJMM: GENERATE SOLUTIONS

Chemotherapy Handling & Precautions

For each action, indicate whether it is **indicated** or **contraindicated** when caring for a client receiving IV cyclophosphamide and oral capecitabine.

ACTION	INDICATED	CONTRAINDICATED
Wear double chemo-rated gloves & gown during administration	✓	
Crush capecitabine tablets to mix in applesauce		✓
Dispose of urine and emesis in yellow chemo waste container × 48 h	✓	
Allow pregnant family members to provide bedside care		✓
Flush the toilet twice with the lid down after voiding × 48 h	✓	
Hand hygiene with soap & water (not alcohol-only gel) after care	✓	

▸▸ REVEAL RATIONALE

BOW-TIE · NCJMM: PRIORITIZE HYPOTHESIS

Methotrexate Overdose Scenario

A 36-year-old with RA reports taking methotrexate 7.5 mg **daily for 10 days**. Presents with mouth ulcers, melena, fever 101.4°F.

ACTIONS TO TAKE
- Hold all MTX
- Administer leucovorin rescue
- Aggressive IV hydration + urinary alkalinization

MOST LIKELY
Methotrexate Toxicity / Pancytopenia

PARAMETERS TO MONITOR
- CBC + ANC
- AST/ALT & serum MTX level
- BUN/Cr & urine pH

▸▸ REVEAL RATIONALE

ORDERED RESPONSE · NCJMM: TAKE ACTION

Neutropenic Fever Sequence

A client receiving R-CHOP for non-Hodgkin lymphoma calls the cancer clinic. Day 10 post-chemo. Reports temperature 38.5°C (101.3°F), chills, fatigue. Last ANC was 0.4 × 10^9/L (400). **Place the following actions in the correct order of priority:**

1. 1️⃣ Instruct the client to come to the ED immediately, NOT outpatient clinic
2. 2️⃣ On arrival: place client in private room with neutropenic precautions; mask the client
3. 3️⃣ Obtain blood cultures × 2 (peripheral + line) BEFORE antibiotics, plus urine & site cultures
4. 4️⃣ Administer empiric broad-spectrum IV antibiotics within 60 minutes of arrival (e.g., cefepime or pip-tazo)
5. 5️⃣ Initiate IV fluids; assess for sepsis (HR, BP, MAP, lactate) and consider G-CSF/filgrastim per protocol

▶▸ REVEAL RATIONALE

CLOZE/DROP-DOWN · NCJMM: RECOGNIZE CUES + TAKE ACTION

Vesicant Extravasation

A 58-year-old client receiving doxorubicin via peripheral IV reports stinging at the site. The IV no longer has a brisk blood return; mild swelling and redness are noted.

The nurse should first **stop the infusion**, then **leave the catheter in place and aspirate residual drug**, mark the borders of the affected area, and apply a **cold** compress. The expected antidote for this vesicant is **dexrazoxane**. The arm should be **elevated**, and the provider notified immediately. If the same scenario occurred with vincristine, the compress would instead be **warm** and the antidote would be **hyaluronidase**.

▶▸ REVEAL RATIONALE

§ 05 Mini Case Study · NCJMM

UNFOLDING CASE · 6 STEPS

CASE 14-A

Day 1 of Induction Chemotherapy for High-Grade NHL

Scenario. J.R., a 28-year-old male, is admitted for cycle 1 of R-CHOP (rituximab, cyclophosphamide, doxorubicin, vincristine, prednisone) for diffuse large B-cell lymphoma. He has bulky mediastinal disease. Pre-treatment WBC 78,000, LDH 1,400 (high), uric acid 9.6. He receives allopurinol, IV NS at 250 mL/hr, dexamethasone, ondansetron, diphenhydramine, and acetaminophen. Rituximab is started slowly. Forty-five minutes into the infusion, he develops chills, BP 86/52, HR 124, dyspnea, and a temp of 39°C. Repeat labs: K 6.0, Phos 7.8, Ca 7.2, Cr 1.9 (baseline 0.9), uric acid 13.2.

STEP 1 · RECOGNIZE CUES

What stands out?

- Infusion-reaction signs: rigors, hypotension, dyspnea during 1st rituximab dose
- Tumor lysis pattern: ↑K, ↑Phos, ↓Ca, ↑uric acid, AKI (Cr almost tripled)
- Risk factors are textbook: high tumor burden, bulky disease, elevated LDH, B-cell lymphoma, 1st dose

STEP 2 · ANALYZE CUES

Connect the dots

- Concurrent infusion reaction + tumor lysis — both expected within hours of starting rituximab in high-burden NHL
- Hyperkalemia + hypocalcemia synergistically raise arrhythmia risk
- AKI is multifactorial: TLS uric acid + nephrocalcinosis from phosphate

STEP 3 · PRIORITIZE HYPOTHESES

What kills first?

- **Highest priority:** arrhythmia from K 6.0 and Ca 7.2 — cardiac monitoring NOW
- Next: airway compromise from rituximab reaction (dyspnea)
- Then: renal failure from worsening TLS

STEP 4 · GENERATE SOLUTIONS

Plan parallel actions

- STOP rituximab; maintain IV line and fluids
- Continuous cardiac monitor; STAT ECG
- IV calcium gluconate to stabilize myocardium; insulin + D50 or β-agonist to shift K
- Rasburicase IV (verify G6PD result); hold further phosphate intake
- Bolus NS, supplemental O_2, vasopressor if BP unresponsive
- Notify oncology + rapid response/ICU; consider hemodialysis

STEP 5 · TAKE ACTION

Execute & document

- Stop rituximab, switch to NS at 500 mL/hr (per protocol)
- Calcium gluconate 1 g IV slow push under monitoring
- Regular insulin 10 units IV + D50 25 g IV
- Rasburicase 0.2 mg/kg IV over 30 min (sample on ice)
- Resume rituximab at 50% rate ONLY if/when reaction fully resolved, per provider order

STEP 6 · EVALUATE OUTCOMES

Were interventions effective?

- Expected: K trending to < 5.0 in 1 h, Ca rising, uric acid drops within 4 h with rasburicase
- Cr should plateau or improve with hydration; urine output target > 100 mL/hr
- BP stabilizes, dyspnea resolves, no further chills
- If not — escalate: emergent dialysis, ICU transfer, do NOT re-challenge rituximab without senior consult

§ 06 Red Flag Review

STOP · HOLD · ESCALATE · ANTIDOTE

When to Stop, Hold, Call, Activate RRT, or Give Antidote

Each row maps a finding → action. Memorize these patterns.

Burning / blistering at chemo IV site
STOP infusion. Aspirate residual. Cold + dexrazoxane (anthracyclines). Warm + hyaluronidase (vinca/taxanes).

Daily methotrexate > intended weekly
HOLD all MTX. Give leucovorin rescue. Notify provider. Sentinel event report.

Rituximab/paclitaxel hypotension + rigors
STOP infusion. IV fluids, diphenhydramine, hydrocortisone, ± epinephrine. Resume at 50% only when resolved.

K > 6 + Ca < 8 + ↑Phos + ↑Uric acid
Tumor lysis syndrome — cardiac monitor, calcium gluconate, K-lowering protocol, rasburicase, escalate to ICU/dialysis.

ANC < 500 + Temp ≥ 38°C
Neutropenic fever — cultures then broad-spectrum antibiotics within 60 min. RRT if hypotensive.

Vincristine ordered intrathecal
DO NOT GIVE. Verify route. Escalate. Fatal if administered.

LUQ/shoulder pain on filgrastim
Splenic rupture concern → hold drug, surgical consult, RRT.

Hgb > 11 on epoetin
Hold next dose — thrombosis & HTN crisis risk. Notify provider.

SpO_2 85% on 100% O_2 after rasburicase
Suspect methemoglobinemia — co-oximetry, hold rasburicase, methylene blue (avoid if G6PD def).

Any rash on allopurinol
STOP drug. Concern for SJS/TEN. Skin/mucosal exam, supportive care, dermatology consult.

Cyclosporine/tacrolimus tremor + headache + vision change
Hold dose. Check trough level. Rule out PRES — MRI brain, transplant service consult.

Bevacizumab + severe abdominal pain
GI perforation — NPO, surgical consult, antibiotics, RRT.

§ 07 Confusing Drugs Comparison

SIDE-BY-SIDE DECODING

FEATURE	DRUG A	VS	DRUG B
Cyclophosphamide	Alkylating chemo — hemorrhagic cystitis; antidote = mesna; needs hydration + AM dose	≠	Cyclosporine: calcineurin inhibitor for transplant — nephrotoxic + gum hyperplasia; no grapefruit
Doxorubicin	Anthracycline — cardiotoxicity, vesicant, COLD + dexrazoxane, red urine OK	≠	Vincristine: vinca alkaloid — neuropathy, vesicant, WARM + hyaluronidase, FATAL intrathecal
Filgrastim	G-CSF: ↑ neutrophils; bone pain = working; splenic rupture risk	≠	Epoetin alfa: ESA: ↑ RBC; cap Hgb at 11; HTN + clotting risk
MTX low-dose	Weekly for RA/psoriasis — daily dose = sentinel event; folate supplement OK	≠	MTX high-dose: oncology IV protocol — needs leucovorin rescue + urine alkalinization
Tacrolimus	Calcineurin inhibitor — more potent; causes diabetes, tremor, PRES; q12h trough	≠	Sirolimus: mTOR inhibitor — causes hyperlipidemia + poor wound healing; do NOT combine with calcineurin inhibitor due to additive nephrotoxicity
Allopurinol	Xanthine oxidase inhibitor — TLS prophylaxis & chronic gout; stop for rash	≠	Rasburicase: urate oxidase — treats severe hyperuricemia; contraindicated in G6PD
Vesicant	Causes blistering / necrosis on extravasation (doxorubicin, vincristine, mitomycin)	≠	Irritant: causes pain/inflammation but no necrosis (cisplatin low conc, etoposide)
Leucovorin	Reduced folate "rescue" for MTX toxicity — selective bypass	≠	Folic acid: vitamin supplement — can feed tumor cells, NOT used as MTX antidote

§ 08 **Day 14 Infographic Summary** ONE-PAGE RECAP

The Big Picture

ONCOLOGY · IMMUNOLOGY · HIGH-RISK MEDICATIONS

CLASS MNEMONIC
"-mab" mABs
Monoclonal antibodies — infusion reactions, premedicate (Tylenol + Benadryl ± steroid), screen for TB & HBV.

CLASS MNEMONIC
"-platin"
Platinum chemo — Nephro + Oto + Neuro toxic. Aggressive hydration + amifostine + check hearing.

CLASS MNEMONIC
"-rubicin"
Anthracyclines — Cardiotoxic (LVEF baseline + cum dose), vesicant (cold + dexrazoxane). Red urine OK.

CLASS MNEMONIC
"-poetin"
Erythropoiesis agents — Cap Hgb at 11; HTN + thrombosis; iron supplementation.

CLASS MNEMONIC
"-grastim"
G-CSF — bone pain (treat with APAP); rare splenic rupture (LUQ pain → STOP).

CLASS MNEMONIC
"-imus / -porin"
Calcineurin/mTOR inhibitors — nephrotoxic, NO grapefruit, no live vaccines, narrow TI.

TUMOR LYSIS
↑K ↑P ↑Uric ↓Ca
Prophylax with allopurinol + 3 L hydration. Treat with rasburicase (after G6PD screen).

SEPSIS TRIGGER
ANC < 500 + Fever
Neutropenic fever — cultures → antibiotics in < 60 min. Isolate. Reverse precautions.

! **USP <800> rule:** all hazardous drugs (chemo + many immunosuppressants) require chemo-rated PPE, vented spike or CSTD, segregated yellow waste, & soap-and-water hand wash. **Pregnant or breastfeeding nurses should not handle hazardous drugs.** Patient body fluids are hazardous × 48 h after IV chemo (longer for some oral agents).

DRUG / TOXICITY	ANTIDOTE / RESCUE	NOTE
Methotrexate	Leucovorin (folinic acid)	Time-critical, NOT folic acid
Cyclophosphamide / Ifosfamide (bladder)	Mesna + hydration	Pre, +4 h, +8 h
Doxorubicin extravasation	Dexrazoxane + cold compress	Stop, aspirate, leave IV in place
Vinca alkaloid extravasation	Hyaluronidase + warm compress	Opposite of doxorubicin
5-FU overdose (within 96 h)	Uridine triacetate	Limited window
Methemoglobinemia (rasburicase)	Methylene blue	Avoid if G6PD deficient
Cisplatin nephrotoxicity	Amifostine + aggressive saline hydration	Pre + post treatment
Acetaminophen (≥ 4 g/day with chemo)	N-acetylcysteine	Common adjunct issue
Severe rituximab reaction	Stop + epi + Benadryl + steroid	Resume at 50% rate