

• NCLEX-RN 2026 • PHARMACOLOGY SERIES • DOSSIER N° 042

Immunosuppressive Drugs — Organ Transplant

Calcineurin inhibitors · Antiproliferatives · mTOR inhibitors · Corticosteroids · Monoclonal antibodies

SYSTEM · IMMUNE / MULTI-ORGAN
CLASS · IMMUNOSUPPRESSANTS
RISK TIER · HIGH-ALERT
FOCUS · REJECTION VS INFECTION

BLACK BOX WARNINGS

NCJMM ALIGNED

2026 TEST PLAN

01 · DRUG OVERVIEW

WHY WE GIVE IT

Suppress the immune system to prevent organ rejection.

KEY INDICATIONS

- ▶ **Prevent rejection** after solid organ transplant — kidney, liver, heart, lung, pancreas, intestine
- ▶ **Treat acute rejection** episodes (high-dose corticosteroids, ATG, basiliximab)
- ▶ **Graft-versus-host disease (GVHD)** prevention in bone marrow / stem cell transplant
- ▶ Off-label autoimmune disease: lupus nephritis, severe RA, IBD, psoriasis

GOAL OF THERAPY

- ▶ Lifelong, multi-drug regimen — usually **3-drug combo**: calcineurin inhibitor + antiproliferative + steroid
- ▶ Lowest effective dose to prevent rejection while minimizing infection & toxicity

CLASS AT A GLANCE

5 MAJOR DRUG FAMILIES

Know the prototypes.

Calcineurin Inhibitors

Cyclosporine · Tacrolimus

Antiproliferatives

Mycophenolate · Azathioprine

mTOR Inhibitors

Sirolimus · Everolimus

Corticosteroids

Prednisone · Methylpred.

Monoclonal / Polyclonal Antibodies

Basiliximab (Simulect) · Antithymocyte globulin (ATG / Thymoglobulin) · Muromonab-CD3 — used for **induction** at transplant or to reverse **acute rejection**

02 · MECHANISM OF ACTION

SIMPLIFIED PHYSIOLOGY

Each class shuts down a different step in T-cell activation.

CALCINEURIN INHIBITORS (CYCLOSPORINE, TACROLIMUS)

- Bind **calcineurin** in T-cells
- Block **IL-2 transcription**
- ↓ T-cell proliferation & activation
- ⇒ ↓ **rejection** — but ↑ infection & nephrotoxicity

ANTIPROLIFERATIVES (MYCOPHENOLATE, AZATHIOPRINE)

- Inhibit **purine (DNA) synthesis** in lymphocytes
- B- & T-cells can't replicate
- ⇒ **Bone marrow suppression** — pancytopenia risk

MTOR INHIBITORS (SIROLIMUS, EVEROLIMUS)

- Block **mTOR kinase** downstream of IL-2
- Arrest T-cell cycle in G1
- ⇒ Less nephrotoxic than CNIs but ↑ **hyperlipidemia & poor wound healing**

CORTICOSTEROIDS · MONOCLONAL ANTIBODIES

- **Steroids**: broad anti-inflammatory; ↓ cytokines & lymphocyte trafficking
- **Basiliximab**: blocks IL-2 receptor (CD25) on T-cells
- **ATG**: antibodies destroy circulating T-lymphocytes
- ⇒ Used at **induction** or for **acute rejection rescue**

03 · THERAPEUTIC EFFECTS

04 · SIDE EFFECTS & ADVERSE REACTIONS

03 • THERAPEUTIC EFFECTS

"IS IT WORKING?"

Signs the graft is happy.

- ✓ **No signs of rejection** — the #1 goal
- ✓ **Stable graft function:**
 - Kidney: stable creatinine, BUN, urine output
 - Liver: normal LFTs, bilirubin, INR
 - Heart: normal EF, no biopsy infiltrates
 - Lung: stable FEV₁, no dyspnea
- ✓ **Drug trough levels in target range**
- ✓ Patient feels well, no fever, weight stable
- ✓ Negative biopsy / no donor-specific antibodies

04 • SIDE EFFECTS & ADVERSE REACTIONS

COMMON vs SERIOUS

What harms — and what kills.

COMMON (CLASS-WIDE)

- ▶ GI upset — N/V, diarrhea, abdominal pain
- ▶ HTN, headache, tremor
- ▶ Hyperglycemia (esp. **tacrolimus, steroids**)
- ▶ Hyperlipidemia (esp. **sirolimus, cyclosporine**)
- ▶ Hirsutism + gum hyperplasia → **cyclosporine**
- ▶ Alopecia + tremor + hyperglycemia → **tacrolimus**
- ▶ Cushingoid features → **steroids**

SERIOUS 🚨 / LIFE-THREATENING

- ✗ **Infection** — opportunistic: CMV, BK virus, PJP, candida, aspergillus
- ✗ **Nephrotoxicity** — cyclosporine, tacrolimus (↑ creatinine)
- ✗ **Bone marrow suppression** — mycophenolate, azathioprine (pancytopenia)
- ✗ **Malignancy** — skin cancers, post-transplant lymphoproliferative disorder (PTLD)
- ✗ **Neurotoxicity** — seizures, tremor, encephalopathy (CNIs)
- ✗ **Hepatotoxicity** (azathioprine, cyclosporine)
- ✗ **Anaphylaxis / cytokine release** with ATG, basiliximab, muromonab
- ✗ **Teratogenicity** — mycophenolate (REMS, pregnancy test required)

⚠ HIGH ALERT

Black Box Warnings: ↑ **infection & malignancy** risk with all immunosuppressants · **Mycophenolate:** pregnancy loss + congenital malformations · **Azathioprine:** lymphoma · Use only by clinicians experienced in transplant care.

05 • PRIORITY NURSING CONSIDERATIONS

ASSESS • MONITOR • HOLD • NOTIFY

The most NCLEX-tested actions.

ASSESS

- ▶ VS every shift — **fever is the #1 red flag** (any temp ≥100.4°F / 38°C → notify)
- ▶ Signs of **rejection**: pain/tenderness over graft, ↓ urine output, weight gain, ↑ Cr or LFTs, dyspnea (lung), ↓ EF (heart)
- ▶ Signs of **infection**: fever, sore throat, cough, dysuria, redness, fatigue, oral thrush, mouth ulcers
- ▶ Skin every visit — new lesions, non-healing wounds (skin cancer screening)

MONITOR

- ▶ **Drug trough levels** — cyclosporine, tacrolimus, sirolimus (drawn just **before next dose**)
- ▶ BUN / creatinine, GFR — nephrotoxicity
- ▶ CBC w/ diff — neutropenia, thrombocytopenia
- ▶ LFTs, glucose, lipid panel, K⁺, Mg²⁺
- ▶ BP — HTN is common, especially with CNIs & steroids

HOLD & NOTIFY PROVIDER IF...

- ✗ Signs of **active infection** or **sepsis**

06 • LABS & DIAGNOSTICS

CRITICAL VALUES

Numbers that change what you do.

LAB	GOAL / NORM	ACTION IF ABNORMAL
Tacrolimus trough	5–15 ng/mL	↑ → toxicity (Cr, neuro); ↓ → rejection
Cyclosporine trough	100–400 ng/mL (assay-dep.)	↑ → nephrotox; ↓ → rejection
Sirolimus trough	4–12 ng/mL	↑ → ↑ lipids, BMS
Creatinine	0.6–1.2 mg/dL	↑ 25% → suspect rejection or CNI toxicity
WBC / ANC	WBC 4–11k · ANC ≥1,500	↓ → hold antiproliferative
Platelets	150–400k	<100k → bleeding precautions
Glucose	70–110 fasting	↑ → new-onset DM (PTDM)

- ✗ **WBC < 3,000** or ANC < 1,500 (mycophenolate, azathioprine)
- ✗ Platelets < 100,000
- ✗ ↑ creatinine >25% baseline (CNIs)
- ✗ Trough level **above** therapeutic range → toxicity
- ✗ Trough **below** range → rejection risk

CONTRAINDICATIONS & DRUG INTERACTIONS

- ▶ **Live vaccines contraindicated** — MMR, varicella, yellow fever, intranasal flu, rotavirus, BCG, oral polio
- ▶ **Grapefruit juice** — ↑ cyclosporine, tacrolimus, sirolimus levels (CYP3A4)
- ▶ **NSAIDs + CNIs** — additive nephrotoxicity
- ▶ **Azathioprine + allopurinol** = severe bone marrow suppression (lethal interaction — reduce dose 75%)
- ▶ **Statins + cyclosporine** — ↑ rhabdomyolysis risk
- ▶ St. John's wort → ↓ levels → rejection
- ▶ Macrolides, azoles, CCBs → ↑ levels → toxicity

K⁺ / Mg²⁺	K 3.5–5 · Mg 1.8–2.6	CNIs → ↑ K ⁺ , ↓ Mg ²⁺
Lipid panel	LDL <100	Sirolimus → ↑ ↑ lipids
CMV PCR · BK virus	Undetectable	↑ titer → reduce immunosuppression

07 · ADMINISTRATION & SAFETY

ROUTES · TIMING · HIGH-ALERT

How not to harm the graft.

- ▶ **PO & IV** available for most agents; PO preferred long-term
- ▶ **Same time each day** — consistency keeps trough levels stable
- ▶ **Cyclosporine oral solution**: mix in glass cup with milk/orange juice (NOT grapefruit), use the calibrated syringe, don't rinse with water (loses dose)
- ▶ **Tacrolimus capsules**: do NOT crush extended-release; take consistently with/without food
- ▶ **Mycophenolate**: do NOT crush, chew, or open; teratogenic — wear gloves if handling broken pills
- ▶ **IV CNIs**: infuse over 2–6 hr, monitor for anaphylaxis (cremophor vehicle)
- ▶ **ATG / basiliximab**: pre-medicate with acetaminophen, diphenhydramine, ± steroid; monitor for cytokine release first dose
- ▶ **Steroids**: never stop abruptly → adrenal crisis; taper
- ▶ **HIGH-ALERT class** — independent double-check, dose individualized to weight + level

09 · NCLEX TEST TRAPS ⚠

WHAT STUDENTS GET WRONG

Priority & distinguishing distractors.

08 · PATIENT EDUCATION

"YOU MUST KNOW THIS"

The teaching that prevents readmission.

- ! **Take every dose, every day, on time — for life.** Missed doses = rejection.
- 🚫 **No live vaccines** — and avoid people who recently had them. Get inactivated flu shot yearly.
- 🍷 **No grapefruit / grapefruit juice** — raises drug levels into toxic range.
- 👤 **Avoid sick contacts & crowds** in early post-transplant period; wash hands; mask in clinic.
- ★ **Skin cancer prevention** — daily SPF 30+, hats, long sleeves, annual derm exam.
- 🍖 **No raw / undercooked meat, unpasteurized dairy, or unwashed produce** — listeria, salmonella risk.
- 🪥 **Soft toothbrush, regular dental care** (gum hyperplasia w/ cyclosporine).
- 🏠 **Call provider for:** fever ≥100.4°F, pain over graft, ↓ urine, new cough, mouth sores, bleeding/bruising, sudden weight gain.
- 👶 **Effective contraception** (mycophenolate REMS); discuss pregnancy planning with transplant team.
- 🌿 **No OTC / herbals** without checking — esp. **St. John's wort**, NSAIDs, antacids.

10 · MEMORY BOOSTERS

MNEMONICS & PATTERNS

Quick recall for exam day.

- ✗ **"Fever in a transplant patient"** is ALWAYS the priority — even minor temp elevation = sepsis until proven otherwise. Do *not* wait or give Tylenol first.
- ✗ **Rejection vs Infection** — both cause fever, malaise, ↑ WBC. Look for **graft-specific findings** (↓ urine, ↑ Cr, graft tenderness) for rejection.
- ✗ **Live vaccine** is the trap answer — MMR, varicella, intranasal flu, yellow fever are **contraindicated**. The IM flu shot is OK.
- ✗ **Grapefruit juice** is the food-drug interaction NCLEX loves — applies to cyclosporine, tacrolimus, sirolimus.
- ✗ **Trough = right BEFORE next dose**, not after. Peak is wrong for these drugs.
- ✗ **Azathioprine + allopurinol** — life-threatening pancytopenia. Memorize this pair.
- ✗ Don't confuse **cyclosporine** (gum hyperplasia, hirsutism) with **tacrolimus** (alopecia, hyperglycemia, neurotox).
- ✗ **Mycophenolate** + pregnancy = NEVER. Two forms of contraception, monthly pregnancy tests (REMS).
- ✗ **Steroids** never stopped abruptly — adrenal crisis. Taper.
- ✗ "Stop the medication if a cold develops" → **WRONG**. Patient calls provider; rejection is more dangerous than most infections.
- ✗ **Cyclosporine PO**: mix in **glass** (not styrofoam/plastic) — drug binds to plastic.

"I-M-M-U-N-E"

Top risks of immunosuppression

- I** Infection (#1)
- M** Malignancy (skin, PTLD)
- M** Marrow suppression
- U** Uremia / nephrotoxicity
- N** Neurotoxicity / new-onset DM
- E** Elevated BP & lipids

Suffix Patterns

- **imus** → mTOR / CNI family (*sirolimus*, *tacrolimus*, *everolimus*)
- **ximab** monoclonal antibody (*basiliximab*)
- **prine** antiproliferative purine analog (*azathioprine*)

"GHH" — Cyclosporine

- G** Gum hyperplasia
- H** Hirsutism
- H** HTN + Hyperkalemia

"Tacro = TAR"

- T** Tremor + Tight glucose (DM)
- A** Alopecia
- R** Renal toxicity

DRUG-BY-DRUG COMPARISON

MOST TESTED DRUGS IN THIS CLASS

Side-by-side: the differences NCLEX exploits.

MOST-TESTED · CLASS COMPARISON

DRUG	CLASS	KEY MOA	SIGNATURE ADVERSE EFFECTS	TOP NURSING PEARL	TROUGH / LAB FOCUS
Cyclosporine SANDIMMUNE · NEORAL · GENGRAF	CNI	Blocks calcineurin → ↓ IL-2	Nephrotoxicity, HTN, gum hyperplasia , hirsutism , ↑ K ⁺ , hepatotox	Mix oral soln in glass w/ milk or OJ — never grapefruit	Trough 100–400 ng/mL · Cr · BP · K ⁺
Tacrolimus PROGRAF · ASTAGRAF XL · ENVARSUS	CNI	Blocks calcineurin (more potent than cyclo)	Nephrotox, neurotox (tremor, seizure), hyperglycemia / new-onset DM , alopecia, ↑ K ⁺	Same time daily; do NOT crush ER; brand-specific (not interchangeable)	Trough 5–15 ng/mL · Cr · glucose · Mg ²⁺
Mycophenolate mofetil CELLCEPT · MYFORTIC	Antiproliferative	Inhibits IMPDH → ↓ purine synthesis	GI (diarrhea), leukopenia , anemia, teratogenic (REMS) , infection	Pregnancy test before, monthly while on; do NOT crush; gloves if handling	CBC weekly × 1 mo, then monthly

DRUG	CLASS	KEY MOA	SIGNATURE ADVERSE EFFECTS	TOP NURSING PEARL	TROUGH / LAB FOCUS
Azathioprine IMURAN	Antiproliferative	Purine analog → ↓ DNA synthesis	Pancytopenia , hepatotox, pancreatitis, lymphoma (BBW)	NEVER with allopurinol (lethal BMS); reduce dose 75% if combined	CBC, LFTs · TPMT level baseline
Sirolimus RAPAMUNE	mTOR inhibitor	Blocks mTOR kinase → arrests T-cell cycle	Hypertlipidemia , poor wound healing , mouth ulcers, ↓ platelets, pneumonitis	Avoid in early post-op (wound dehiscence); fasting lipid panel	Trough 4–12 ng/mL · lipids · CBC
Prednisone / Methylprednisolone DELTAONE · SOLU-MEDROL	Corticosteroid	Broad anti-inflammatory; ↓ cytokines	Hyperglycemia, Cushingoid , osteoporosis, mood, infection, peptic ulcer, cataracts	Take with food; NEVER stop abruptly — taper; monitor glucose	Glucose · BP · DXA · K ⁺
Basiliximab SIMULECT	IL-2R mAb	Blocks CD25 (IL-2 receptor) on T-cells	Anaphylaxis, cytokine release syndrome , infection, GI, fever	Induction therapy IV at transplant + day 4; pre-medicate; monitor first hour	VS during & after infusion
Antithymocyte globulin THYMOGLOBULIN · ATGAM	Polyclonal Ab	Destroys circulating T-cells	Severe cytokine release , fever, chills, ↓ plt, anaphylaxis, serum sickness	Pre-medicate w/ APAP, diphenhydramine, methylpred; central line; slow infusion	CBC daily during therapy

NCJMM • CLINICAL JUDGMENT SNAPSHOT

Clinical Judgment Snapshot — Think Like the NCLEX

Q1 • #1 PRIORITY RISK

Infection. All immunosuppressants ↓ the body's ability to fight pathogens. Fever ≥100.4°F (38°C) is a transplant emergency — work-up & cultures BEFORE giving antipyretics. Sepsis is the leading cause of post-transplant death.

Q2 • WHAT HARMS FIRST?

Opportunistic infection — within days to weeks (CMV, PJP, candida, BK virus, bacterial pneumonia). Then comes **nephrotoxicity** (CNIs). **Malignancy** (skin cancer, PTLN) is a long-term risk. Acute **rejection** typically presents weeks–months out as fever + graft tenderness + ↓ function.

Q3 • FIRST NURSING ACTION

Patient post-kidney transplant, on tacrolimus, reports temp 101°F + flank pain over graft → **Assess graft (urine output, Cr, BP), obtain VS & cultures, NOTIFY transplant team STAT.** Do NOT hold tacrolimus or give acetaminophen first. Rule out rejection vs infection — both are emergencies.