

NGN NCLEX 2026

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Loop Diuretics

High-Ceiling Workhorses of Fluid Overload

Furosemide • Torsemide • Bumetanide • Ethacrynic Acid — mechanism, comparison, nursing care, and the NCLEX cues that separate safe practice from a sentinel event.

SYSTEM: RENAL/CARDIOVASCULAR

CLASS: LOOP DIURETICS

SITE OF ACTION: THICK ASCENDING LOOP OF HENLE

MECHANISM: NKCC2 INHIBITION

NGN SKILLS: RECOGNIZE CUES • TAKE ACTION • EVALUATE OUTCOMES

SOURCE TRANSPARENCY: This topic was not included in Student's uploaded personal study notes. Content drawn from standard NGN NCLEX 2026 references — Saunders Comprehensive Review (2026), ATI Pharmacology Made Easy, Lippincott Illustrated Reviews: Pharmacology, and current FDA labeling for each agent.

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Definition & Overview

WHAT THEY ARE • WHY THEY MATTER

- ▶ **The most potent diuretic class** — also called "high-ceiling" diuretics because increasing the dose continues to produce more diuresis (no plateau).
- ▶ Act on the **thick ascending limb of the Loop of Henle** — the site that normally reabsorbs ~25% of filtered sodium.
- ▶ First-line for **acute pulmonary edema**, decompensated heart failure, hepatic/renal edema, and edema unresponsive to thiazides.
- ▶ Effective even when GFR is reduced — making them the diuretic of choice in **chronic kidney disease**.

The Four Agents at a Glance

Furosemide (Lasix) — the prototype; most commonly prescribed.

Torsemide (Demadex) — longer half-life, more reliable PO absorption.

Bumetanide (Bumex) — most potent per mg (1 mg ≈ 40 mg Lasix).

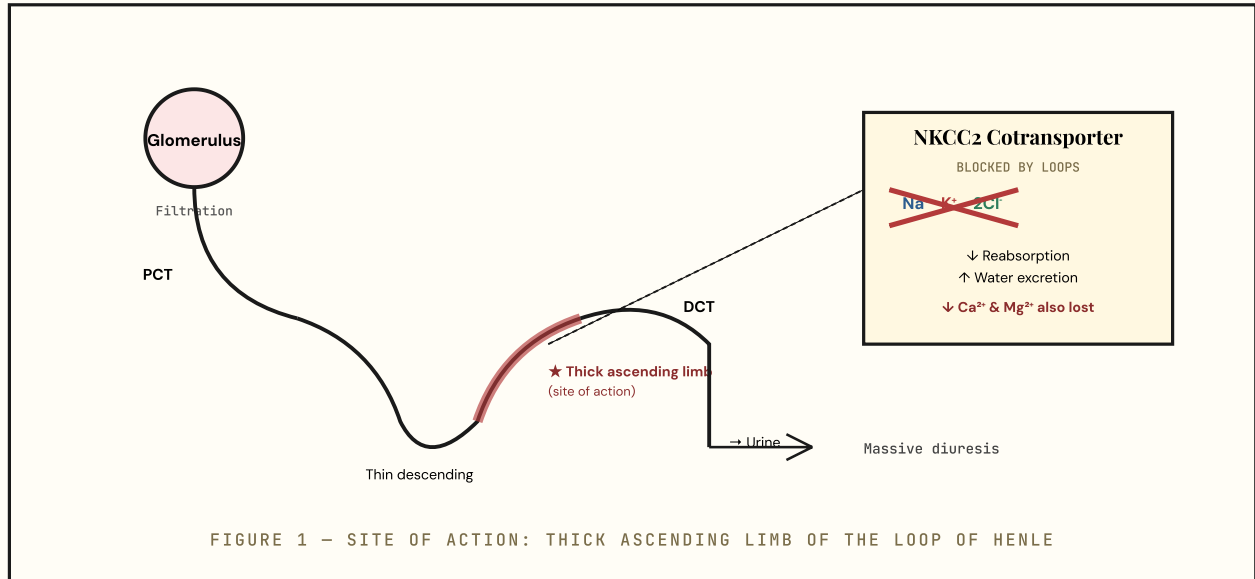
Ethacrynic Acid (Edecrin) — the *only* non-sulfa loop diuretic; reserved for sulfa-allergic patients.



Mechanism of Action (Simplified)

WHERE THEY WORK • WHAT THEY BLOCK • WHAT GETS LOST

- ▶ Reach the renal tubule via secretion into the proximal tubule (NSAIDs blunt this — clinically relevant).
- ▶ Travel to the **thick ascending limb of the Loop of Henle**.
- ▶ Block the **$\text{Na}^+ - \text{K}^+ - 2\text{Cl}^-$ (NKCC2) cotransporter** on the luminal membrane.
- ▶ Sodium, potassium, and chloride remain in the tubule → osmotic gradient drags water out with them.
- ▶ Loss of the positive lumen voltage also impairs **calcium and magnesium** reabsorption → *loops lose calcium* (the opposite of thiazides).



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Indications

WHEN THE HCP REACHES FOR A LOOP DIURETIC



Acute / Emergency

- ▶ **Acute pulmonary edema** — first-line IV push
- ▶ Acute decompensated heart failure
- ▶ Severe **hypercalcemia** (with IV NS)
- ▶ Oliguria in acute kidney injury



Chronic Conditions

- ▶ Chronic heart failure (NYHA II–IV)
- ▶ Edema of **hepatic cirrhosis** with ascites
- ▶ Nephrotic syndrome / CKD edema
- ▶ Resistant hypertension



When Loops Are Preferred

- ▶ GFR < 30 mL/min (thiazides lose effect)
- ▶ Need for rapid, predictable fluid removal
- ▶ Concurrent calcium overload
- ▶ IV access available for rapid response

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The Four Agents — Side by Side

DOSES • ROUTES • ONSET • PEAK • DURATION

DRUG (BRAND)	TYPICAL ADULT DOSE	ROUTES	ONSET	PEAK	DURATION	KEY DISTINCTION
Furosemide (Lasix)	PO: 20–80 mg daily–BID IV/IM: 20–40 mg	PO, IV, IM	PO: 30–60 min IV: 5 min	PO: 1–2 hr IV: 30 min	PO: 6–8 hr IV: ~2 hr	The prototype. Contains sulfa . IV push no faster than 20 mg/min .
Torsemide (Demadex)	PO/IV: 10–20 mg daily (max 200 mg)	PO, IV	PO: ~1 hr IV: 10 min	1–2 hr	6–8 hr	Best PO bioavailability (~80–100%). Contains sulfa. Increasingly preferred in HF.
Bumetanide (Bumex)	PO/IV: 0.5–2 mg daily–BID (max 10 mg/day)	PO, IV, IM	PO: 30–60 min IV: minutes	1–2 hr	4–6 hr	★ 40× more potent than furosemide. 1 mg Bumex ≈ 40 mg Lasix. Contains sulfa.
Ethacrynic Acid (Edecrin)	PO: 50–200 mg daily IV: 50 mg	PO, IV	PO: 30 min IV: 5 min	~2 hr	6–8 hr	★ Only non-sulfa loop . Use when sulfa-allergic. Most ototoxic — reserved for special cases.

★ Equivalency to remember: **40 mg furosemide ≈ 20 mg torsemide ≈ 1 mg bumetanide ≈ 50 mg ethacrynic acid (PO)**.

Adverse Effects & Red Flags

WHAT TO WATCH FOR • WHAT TO REPORT

Common (Expected — but monitor)

- ▶ **ELECTROLYTES** **Hypokalemia** (most dangerous), hyponatremia, hypochloremia, hypomagnesemia
- ▶ **CALCIUM** **Hypocalcemia** (loops lose Ca; opposite of thiazides)
- ▶ **ACID-BASE** Hypochloremic **metabolic alkalosis**
- ▶ **VOLUME** Dehydration, orthostatic hypotension, dizziness
- ▶ **METABOLIC** Hyperuricemia (gout flare), hyperglycemia, hyperlipidemia
- ▶ **SKIN** Photosensitivity, rash

Serious / Life-Threatening 🚩

- ▶ **RED FLAG** **Ototoxicity** — tinnitus, hearing loss, vertigo. Risk ↑ with rapid IV push, high dose, renal failure, or concurrent **aminoglycosides**. *Often permanent.*
- ▶ **RED FLAG** **Profound hypokalemia** → cardiac dysrhythmias (especially in patients on digoxin → dig toxicity)
- ▶ **RED FLAG** **Severe hypovolemia / hypotension** → shock, AKI
- ▶ **RED FLAG** **Sulfa hypersensitivity** — anaphylaxis, Stevens-Johnson (furosemide, torsemide, bumetanide)
- ▶ **RED FLAG** **Nephrotoxicity** at high doses, especially with aminoglycosides
- ▶ **RED FLAG** Thrombocytopenia, agranulocytosis (rare)

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Priority Nursing Interventions

ABC FRAMEWORK • SAFETY • TAKE ACTION

A • Airway / Breathing

- ▶ Assess **lung sounds** before and 30–60 min after dose (target: clearing crackles)
- ▶ Monitor **SpO₂** and respiratory rate in pulmonary edema
- ▶ Position semi- or high-Fowler's for fluid overload

C • Circulation

- ▶ Take **BP & HR before each dose** — hold and call HCP if SBP < 90 or per parameters
- ▶ Monitor for **orthostatic hypotension** — sit-stand BP
- ▶ Place on telemetry if K⁺ low or patient on digoxin
- ▶ Strict **I&O**; daily **weight** (same time, scale, clothing)

S • Safety / Labs

- ▶ Check **K⁺ before giving**; report < 3.5 mEq/L
- ▶ Monitor BUN, creatinine, Na⁺, Mg²⁺, Ca²⁺, uric acid, glucose
- ▶ Assess for tinnitus / hearing changes each shift
- ▶ **Fall precautions** — orthostasis + frequent toileting
- ▶ Verify **sulfa allergy** before furosemide/torsemide/bumetanide

⚠ IV Push — The Rate Rule

Furosemide: push no faster than **20 mg/min** (40 mg over at least 1–2 minutes).

Bumetanide: push over 1–2 minutes.

Ethacrynic acid: dilute and infuse over **20–30 minutes** — never bolus.

Rapid administration is the single biggest cause of **permanent ototoxicity**.

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NCLEX Test Traps

WHERE STUDENTS LOSE THE POINT

✗ WRONG REASONING

"All diuretics cause the same electrolyte changes — they all dump calcium."

✓ CORRECT REASONING

Loops LOSE calcium (used to treat hypercalcemia). **Thiazides RETAIN calcium** (can cause hypercalcemia). Opposite effects — high-yield test point.

✗ WRONG ACTION

"Patient in pulmonary edema — push Lasix 80 mg IV over 30 seconds to act fast."

✓ CORRECT ACTION

Push at **≤ 20 mg/min**. Rapid push causes **permanent ototoxicity**. Fast onset is already 5 minutes — slowing the push doesn't blunt the effect.

✗ WRONG PATIENT

"Patient has a sulfa allergy — give furosemide; it's the standard for HF."

✓ CORRECT CHOICE

Furosemide, torsemide, and bumetanide all contain sulfa. The **only safe loop** in true sulfa allergy is **ethacrynic acid (Edecrin)**.

✗ WRONG PRIORITY

"K⁺ is 3.1 and patient takes digoxin — give the scheduled Lasix dose, then call HCP."

✓ CORRECT PRIORITY

Hold the dose, notify HCP. Low K⁺ + digoxin = high risk of fatal dysrhythmia. Diuretic-induced hypokalemia is the classic cause of dig toxicity.

✗ WRONG TIMING

"Schedule daily Lasix at 2100 so the patient has even fluid loss overnight."

✓ CORRECT TIMING

Give in the **morning** (BID dosing: morning + early afternoon, never after 1700). Evening doses cause **nocturia** → sleep disruption + fall risk.

✗ WRONG COMBINATION

"Patient on gentamicin needs Lasix — no problem."

✓ CORRECT CONCERN

Loops + **aminoglycosides** dramatically increase risk of **ototoxicity AND nephrotoxicity**. Notify HCP; monitor hearing, BUN/creatinine, and trough levels closely.



Patient & Family Education

WHAT THEY NEED TO KNOW BEFORE DISCHARGE



Timing & Routine

- ▶ Take in the **morning**; if BID, second dose by early afternoon (no later than 1700).
- ▶ **Weigh yourself daily** — same time, same scale, same clothing. Record it.
- ▶ Report weight gain > **2 lb in 24 hr** or **5 lb in a week**.
- ▶ Stand up **slowly** from bed or chair to prevent dizziness.



Diet

- ▶ Eat **potassium-rich foods daily**: bananas, oranges/OJ, potatoes, spinach, tomatoes, avocado, raisins, beans, cantaloupe.
- ▶ Limit added **sodium** — read labels, avoid processed/canned foods.
- ▶ Stay hydrated but follow any fluid restriction (HF: typically 1.5–2 L/day).
- ▶ Avoid **alcohol** — worsens orthostasis and dehydration.



Call the Provider For

- ▶ **Ringings in the ears** or hearing changes
- ▶ Severe weakness, leg cramps, irregular heartbeat (low K⁺)
- ▶ Confusion, very dark urine, no urine output
- ▶ Rash, blistering, swelling of face/lips (sulfa reaction)
- ▶ Joint pain or red, swollen toe (gout flare)
- ▶ Sudden weight gain or worsening shortness of breath



Lifestyle & OTC

- ▶ Wear sunscreen, hat, protective clothing — drug causes **photosensitivity**.
- ▶ **Do not take NSAIDs** (ibuprofen, naproxen) — they reduce diuretic effect and harm kidneys.
- ▶ Tell every provider and dentist you are on a diuretic.
- ▶ Diabetics: monitor blood sugar more often — diuretic can raise glucose.



Memory Boosters & Mnemonics

ANCHORS FOR THE TESTING CENTER

The "LOOP" Mnemonic for Side Effects

L

Lose K⁺

(and Ca²⁺, Mg²⁺, Na⁺)

O

Output ↑

High-ceiling diuresis

O

Ototoxicity

Rapid IV = ringing/deafness

P

Pressure drops

Hypotension, orthostasis



Quick Associations

- ▶ **"Loops Lose Calcium"** (thiazides retain it).
- ▶ **"Lasix LASTS only 6 hours"** — short PO duration; don't dose at night.
- ▶ **"Bumex is 40× stronger"** — 1 mg Bumex = 40 mg Lasix.
- ▶ **"Edecrin = Excludes sulfa"** — the safe choice in sulfa allergy.



The 6 H's of Loop Toxicity

- ▶ **Hypokalemia**
- ▶ **Hyponatremia**
- ▶ **Hypotension**
- ▶ **Hypocalcemia**
- ▶ **Hypomagnesemia**
- ▶ **Hearing loss (ototoxicity)**



NCJMM Clinical Judgment Walkthrough

NEXT GENERATION 6-STEP MODEL · BEDSIDE SCENARIO

SCENARIO: Mrs. K., 72, admitted with acute decompensated heart failure. She is short of breath at rest, has bilateral basilar crackles, +3 pitting edema in both legs, JVD to the angle of the jaw, and an O₂ sat of 88% on room air. Weight is up 8 lb from baseline. Home medication list includes **digoxin 0.125 mg PO daily**. Morning labs: K⁺ 3.2 mEq/L, Na⁺ 134, BUN 28, Cr 1.3, BNP 1,210. Allergies: "penicillin only." HCP orders: **Furosemide 40 mg IV push now**; O₂ 2 L NC; daily weights; strict I&O.

STEP 1 Recognize Cues

Pull the relevant data: dyspnea at rest, crackles, JVD, +3 edema, SpO₂ 88%, BNP 1,210 (very high), **K⁺ 3.2 (low)**, weight ↑ 8 lb, on digoxin, sulfa allergy **not specifically documented** (only "penicillin"). All consistent with fluid overload + electrolyte imbalance + dig-toxicity risk.

STEP 2 Analyze Cues

Acute decompensated HF → pulmonary congestion → hypoxia. Furosemide is the correct drug. **BUT** the existing hypokalemia is dangerous in a patient on digoxin (low K⁺ potentiates dig binding → dysrhythmias). Sulfa status needs explicit verification because furosemide contains a sulfonamide moiety. BUN/Cr ratio suggests pre-renal contribution — monitor renal function closely.

STEP 3 Prioritize Hypotheses

Using ABC + safety:

- 1 **Hypoxia / pulmonary edema** (Airway/Breathing — most urgent)
- 2 **Hypokalemia → dysrhythmia + digoxin toxicity** (Circulation — life-threatening)
- 3 **Potential sulfa hypersensitivity** (Safety — must verify before push)
- 4 **Fall risk** from diuresis + orthostasis (Safety)

STEP 4 Generate Solutions

Verify allergy detail with patient. Position semi-/high-Fowler's. Apply O₂. Place on telemetry. **Notify HCP of K⁺ 3.2 before push** — anticipate KCl replacement order. Hold digoxin pending HCP review. Push furosemide slowly (≤ 20 mg/min) once K⁺ plan in place. Initiate strict I&O, daily weight, fall precautions, bedside commode.

STEP 5 Take Action

Confirms no sulfa allergy → places patient on telemetry, semi-Fowler's, O₂ 2 L NC → notifies HCP of K⁺ 3.2; receives order for **KCl 20 mEq IV over 2 hr** and hold digoxin → administers furosemide 40 mg IV push over **2 minutes** → documents baseline lung sounds, BP, HR, rhythm → bedside commode within reach → reassessment plan written.

STEP 6 Evaluate Outcomes

Expected within 1–2 hr: **UOP $\geq$ 0.5 mL/kg/hr**, RR ↓, SpO₂ ↑ to $\geq$ 94%, crackles diminishing, BP stable, no new dysrhythmias on tele, no tinnitus or hearing change reported. By next AM: weight ↓ 2–3 lb, K⁺ rechecked and trending up, lung fields clearer, BNP downtrending. Document, communicate at handoff, adjust plan if response inadequate.

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