

PHARMACOLOGY · RESPIRATORY · NCLEX-RN 2026

Long-Acting β_2 Agonists

salmeterol · formoterol · vilanterol · indacaterol · olodaterol · arformoterol

● CLASS: LABA (BRONCHODILATOR) ● SYSTEM: RESPIRATORY ● USE: MAINTENANCE — NOT RESCUE ● ⚠ BLACK BOX WARNING

BLACK BOX

LABA MONOTHERAPY IN ASTHMA → INCREASED RISK OF ASTHMA-RELATED DEATH

In **asthma**, a LABA must **NEVER** be used alone — it must always be combined with an **inhaled corticosteroid (ICS)**. Monotherapy is acceptable *only* in **COPD**. This is the single most tested LABA fact on the NCLEX.

01

DRUG OVERVIEW

WHY WE GIVE IT

INDICATIONS

- ▶ **Asthma maintenance** — long-term control, ALWAYS combined with ICS
- ▶ **COPD maintenance** — emphysema, chronic bronchitis (monotherapy OK here)
- ▶ **Exercise-induced bronchospasm** prevention (formoterol, salmeterol)
- ▶ **Combination products** with ICS or LAMA for step-up therapy

HIGH-YIELD CLINICAL USE

- ▶ Scheduled **twice-daily** (salmeterol, formoterol) or **once-daily** (vilanterol, indacaterol, olodaterol)
- ▶ Onset: 5–20 min · Duration: **12–24 hours**
- ▶ **NOT for acute bronchospasm** — patient must keep a SABA (albuterol) for rescue
- ▶ Step 3+ in GINA asthma stepwise care; first-line maintenance in symptomatic COPD

02

MECHANISM OF ACTION

HOW IT CHANGES PHYSIOLOGY

LABA binds β_2 receptors on bronchial smooth muscle → activates **adenylyl cyclase** → ↑ intracellular **cAMP** → smooth muscle **relaxation** → **bronchodilation lasting 12-24 hours**

Lipophilic side-chain anchors drug in the membrane → sustained receptor stimulation → **prolonged effect vs. SABA**



KEY PHARMACOLOGY POINT

β_2 **selectivity is dose-dependent**. At higher doses, β_1 activation occurs → tachycardia, tremor, hypokalemia. This is the source of nearly every LABA adverse effect.

03

THERAPEUTIC EFFECTS

WHAT TELLS YOU IT'S WORKING

SYMPTOM IMPROVEMENT

- ▶ **Fewer nighttime awakenings** from cough/wheeze
- ▶ **Reduced rescue SABA use** (gold-standard control marker)
- ▶ Improved exercise tolerance, less dyspnea on exertion
- ▶ Decreased frequency of asthma/COPD exacerbations

OBJECTIVE MARKERS

- ▶ ↑ **FEV₁** on spirometry (pre-/post-bronchodilator)
- ▶ ↑ **peak expiratory flow rate (PEFR)** readings
- ▶ Lung sounds: clearer breath sounds, ↓ wheezing
- ▶ SpO₂ ≥ 95% (or patient's baseline goal in COPD)

04

SIDE EFFECTS & ADVERSE REACTIONS

WHAT YOU'LL SEE — COMMON TO DEADLY

COMMON (B-STIMULATION)

Tremor (fine hand)	Tachycardia	Palpitations	Headache
Nervousness	Throat irritation	Muscle cramps	Insomnia

SERIOUS

Paradoxical bronchospasm	Severe hypokalemia	QT prolongation
Arrhythmias	Hyperglycemia	Asthma death (monotherapy)

SEVERITY HIERARCHY — SEQUENCE BY ACUTE RISK

IMMEDIATE	PARADOXICAL BRONCHOSPASM — STOP DRUG, GIVE SABA
HOURS	TACHYARRHYTHMIA / QT PROLONGATION / HYPOKALEMIA
DAYS	HYPERGLYCEMIA, TREMOR, SLEEP DISTURBANCE
LONG-TERM	TOLERANCE / LOSS OF BRONCHOPROTECTION



PARADOXICAL BRONCHOSPASM

If wheezing/SOB **worsens immediately after** a LABA dose → this is paradoxical bronchospasm. **STOP the LABA**, administer SABA (albuterol), and notify the provider. This is the #1 acute LABA emergency.

05

PRIORITY NURSING CONSIDERATIONS

ASSESS • MONITOR • HOLD • NOTIFY

ASSESS & MONITOR

- ▶ **Assess** baseline lung sounds, RR, SpO₂, peak flow before & after dose
- ▶ **Monitor** HR, BP, rhythm — especially in cardiac patients
- ▶ **Monitor** serum K⁺, glucose; ECG in high-risk patients
- ▶ **Verify** the patient also has a SABA rescue inhaler available
- ▶ **Confirm** patient with asthma is on concurrent ICS
- ▶ **Notify** provider for ↑ rescue inhaler use → poor control

CONTRAINDICATIONS & CAUTIONS

- ▶ Acute asthma attack or status asthmaticus (NEVER use)
- ▶ LABA monotherapy in **asthma** (black box)
- ▶ Hypersensitivity to milk proteins (some DPI formulations)
- ▶ Caution: cardiac arrhythmia, HTN, hyperthyroidism, DM, seizure disorder, pheochromocytoma
- ▶ **Drug interactions:** non-selective β-blockers (antagonize), MAOIs/TCAs (↑ CV effects), diuretics (↑ hypokalemia), QT-prolonging drugs

HOLD

WHEN TO HOLD THE DRUG

- ▶ **HR > 100–110 bpm** at rest, or new arrhythmia
- ▶ **K⁺ < 3.5 mEq/L** until corrected
- ▶ Active **chest pain** or new ECG changes
- ▶ Acute exacerbation needing rescue therapy — **SABA, not LABA**
- ▶ Suspected paradoxical bronchospasm post-dose

06

LABS & DIAGNOSTICS

WHAT TO TRACK — AND WHY

LAB	NORMAL	CONCERN WITH LABA	WHAT IT MEANS
Potassium (K⁺)	3.5–5.0 mEq/L	< 3.5	β ₂ shifts K ⁺ intracellularly → arrhythmia risk; worse with diuretics
Glucose	70–110 mg/dL fasting	> 180 random	β ₂ stimulates glycogenolysis → hyperglycemia; watch in diabetics
Magnesium	1.6–2.6 mg/dL	< 1.6	Low Mg potentiates hypokalemia & QT prolongation
ECG / QTc	QTc < 450 ms (M) / 460 (F)	QTc > 500 ms	Risk of torsades; check before adding QT-prolonging drugs
FEV₁ / PEFR	Patient-specific baseline	< 80% personal best	Worsening control → escalate therapy, do NOT increase LABA

07

ADMINISTRATION & SAFETY

ROUTE • TIMING • TECHNIQUE

ROUTE & TIMING

- ▶ **Inhaled only** — DPI, MDI, or nebulized solution (formoterol, arformoterol)
- ▶ **BID** (q12h): salmeterol, formoterol, arformoterol
- ▶ **Once daily**: indacaterol, olodaterol, vilanterol
- ▶ Take at the **same time each day** — even when asymptomatic
- ▶ If using with ICS in same inhaler: **rinse mouth & spit** after each dose (prevents thrush)



HIGH-ALERT REMINDER

If two inhalers are prescribed (e.g., LABA + albuterol PRN), confirm the patient knows **which is rescue vs. maintenance**. Mistaking the LABA for rescue during an attack has caused fatal outcomes.

INHALER TECHNIQUE (DPI)

- ▶ Load dose, exhale fully **away from device** (don't blow into a DPI — moisture clumps powder)
- ▶ Seal lips, inhale **quickly and deeply**
- ▶ Hold breath ~10 seconds, exhale slowly
- ▶ No spacer needed for DPI; spacer required for MDI
- ▶ Track doses; never share inhalers

08

PATIENT EDUCATION

WHAT THE PATIENT MUST KNOW

DAILY USE TEACHING

- ▶ "This is a **controller**, not a rescue inhaler. Take it on schedule even when you feel fine."
- ▶ "Always carry your **albuterol** for sudden symptoms."
- ▶ "Never double up if you miss a dose — take the next one on time."
- ▶ "**Don't stop suddenly** — this can worsen asthma/COPD."
- ▶ "Rinse and spit after combo (LABA+ICS) inhalers to prevent thrush and hoarseness."

WHEN TO SEEK HELP

- ▶ Wheezing or SOB **right after** using the inhaler → 911 / ER (paradoxical bronchospasm)
- ▶ Using rescue inhaler **more than 2 days/week**
- ▶ Peak flow drops below personal yellow/red zone
- ▶ Heart racing, chest pain, palpitations, or tremor that doesn't improve
- ▶ Awakening at night with breathing difficulty

09

NCLEX TEST TRAPS ▲

WHERE STUDENTS LOSE POINTS

TRAP 01

"Patient is having an acute asthma attack — which inhaler?"

It is **NEVER the LABA**. Salmeterol/formoterol take 5–20 min to act and last 12 hr — useless for rescue. The answer is always **albuterol (SABA)**. (Exception trivia: formoterol + budesonide SMART therapy in adults — but on NCLEX, default to SABA.)

TRAP 02

"Asthma patient is prescribed salmeterol alone."

This is the **black box trap**. LABA monotherapy in asthma = increased death risk. The nurse must **question the order** — an ICS must be added.

TRAP 03

"Patient says 'I use my Advair when I can't breathe.'"

Indicates **need for further teaching**. Advair (fluticasone/salmeterol) is maintenance — patient is mistaking it for rescue. Reinforce SABA for acute symptoms.

TRAP 04

"Which side effect requires the nurse to act FIRST?"

Among tremor, headache, tachycardia, and worsening wheeze post-dose → **worsening wheeze** (paradoxical bronchospasm). Airway always wins on prioritization questions.

TRAP 05

"Patient on furosemide started on formoterol."

Both lower K⁺. Priority lab to monitor: **potassium**. Hypokalemia → arrhythmia → the deadliest interaction.

TRAP 06

"LABA vs. LAMA — what's the difference?"

LABA = **β₂ agonist** (-terol suffix). LAMA = **muscarinic antagonist** (-tropium suffix: tiotropium, umeclidinium). Both are long-acting bronchodilators but different receptors. LAMAs cause anticholinergic effects (dry mouth, urinary retention), not tachycardia.

10

MEMORY BOOSTERS

MNEMONICS & PATTERN RECOGNITION

LABA

- L** Long-acting — 12 to 24 hours
- A** Always with ICS in asthma
- B** Bronchodilator — NOT a rescue
- A** Avoid in acute attacks

'-TEROL' = β_2 Agonist

- ▶ Salmeterol, formoterol, vilanterol, indacaterol, olodaterol, albuterol
- ▶ If it ends in -terol → think β_2 → bronchodilator

β_2 Side-Effect Pattern: "SHAKY"

- S** Sugar up (hyperglycemia)
- H** Heart races (tachycardia)
- A** Arrhythmia / QT prolongation
- K** K⁺ down (hypokalemia)
- Y** You shake (tremor)

SABA vs LABA

- S** Short-acting = Stat (rescue) — albuterol, levalbuterol
- L** Long-acting = Long-haul (maintenance) — never for sudden symptoms



MOST TESTED DRUGS IN THIS CLASS

LABA COMPARISON GRID

DRUG	DURATION	DOSING	FORM	COMMON COMBO PRODUCTS	NCLEX PEARL
Salmeterol SEREVENT	12 hr	BID	DPI (Diskus)	Advair (+ fluticasone)	Slow onset (~20 min) — never for rescue. Black box prototype drug.
Formoterol FORADIL • PERFOROMIST	12 hr	BID	DPI • Nebulizer	Symbicort (+ budesonide), Dulera (+ mometasone)	Faster onset (~5 min) — used in SMART therapy adults.
Arformoterol BROVANA	12 hr	BID	Nebulizer only	—	COPD only — useful when DPI technique is poor.
Indacaterol ARCAPTA	24 hr	Once daily	DPI (Neohaler)	Utibron (+ glycopyrrolate)	COPD only — cough on first inhalation common.
Olodaterol STRIVERDI RESPIMAT	24 hr	Once daily	Soft-mist inhaler	Stiolto (+ tiotropium)	COPD only — Respimat device, slow inhalation.
Vilanterol COMBINATION ONLY	24 hr	Once daily	DPI (Ellipta)	Breo (+ fluticasone), Anoro (+ umeclidinium), Trelegy (triple)	Never sold alone. Trelegy = ICS + LAMA + LABA in one inhaler.

NCJMM • CLINICAL JUDGMENT SNAPSHOT

Think like the *NCLEX*.

The three questions you must answer before clicking the answer button.

RISK 01

What is the #1 priority risk?

Asthma-related death from LABA monotherapy. In acute use: **paradoxical bronchospasm** immediately post-dose.

HARM 02

What will harm the patient FIRST?

Mistaking the LABA for a rescue inhaler during an attack — the airway closes faster than the LABA can open it. **Always pair with a SABA.**

ACTION 03

What is the FIRST nursing action?

Assess **airway and breath sounds** first. If bronchospasm post-dose: **STOP the LABA, give SABA, notify provider.** If asthma patient on LABA alone: **question the order.**