Annals of Medical and Health Research
An International Journal

OPEN ACCESS

Review Article

Safety and Efficacy of Asthma Medications: A Review

Valarmathy Joshua*[1], L. Samuel Joshua[1], Sherlyn Joshua[2], and Vinolyn Joshua[2]

[1]*Medicinal Chemistry Research Laboratory, Department of Pharmaceutical Chemistry, Sri Venkateswaraa Faculty of Pharmacy, Ettayapuram – 628902, Tamil Nadu, India*
[2]*UV Gullas College of Medicine, 6014 Mandaue City, Cebu, Philippines*

Corresponding author: **Valarmathy Joshua** | E-mail: **valarmathyjoshua@gmail.com**

Citation: Valarmathy Joshua, L. Samuel Joshua, Sherlyn Joshua, and Vinolyn Joshua (2026). Safety and Efficacy of Asthma Medications: A Review. *Annals of Medical and Health Research: An International Journal.* **DOI: https://doi.org/10.51470/ARMHR.2026.5.1.61**

Received 05 February 2026 | Revised 09 March 2026 | Accepted 03 April 2026 | Available Online 06 May 2026

Abstract

Asthma is a chronic inflammatory disorder of the airways characterized by bronchial hyperresponsiveness, reversible airflow obstruction, and recurrent episodes of wheezing, cough, chest tightness, and shortness of breath. The disease affects individuals of all age groups and may be triggered by allergens, respiratory infections, exercise, environmental pollutants, stress, and certain medications. Asthma pathophysiology involves airway inflammation, bronchoconstriction, mucus hypersecretion, and airway remodeling, leading to impaired airflow and breathing difficulties. Diagnosis is based on clinical history, physical examination, pulmonary function tests, and allergy assessment. The management of asthma includes long-term controller medications such as inhaled corticosteroids, long-acting beta-agonists, leukotriene modifiers, and biologic therapies, along with quick-relief medications such as short-acting beta-agonists and systemic corticosteroids. Allergy-directed therapies and biologic agents have significantly improved the treatment of severe asthma. Proper inhaler technique, adherence to therapy, trigger avoidance, and regular monitoring are essential for achieving effective asthma control and improving patient quality of life. The safety and efficacy of asthma medications depend on appropriate drug selection, dosage, patient compliance, and careful monitoring of adverse effects. This review summarizes the classification, mechanism of action, therapeutic uses, safety concerns, efficacy, and recent advances in asthma pharmacotherapy. Emerging biologic therapies and targeted treatment approaches have revolutionized the management of severe asthma and improved clinical outcomes in patients with uncontrolled disease.

Keywords: *Asthma; Airway inflammation; Bronchial hyperresponsiveness; Inhaled corticosteroids; Short-acting beta-agonists; Long-acting beta-agonists.*

1. Introduction

Asthma is a chronic inflammatory respiratory disease affecting millions of people worldwide. It is characterized by reversible airway obstruction, airway hyperresponsiveness, bronchial inflammation, and mucus hypersecretion. The disease manifests clinically with recurrent episodes of wheezing, coughing, chest tightness, and dyspnea [1-2]. Asthma can occur at any age and significantly affects the quality of life of patients when not properly controlled. The prevalence of asthma has increased globally because of environmental pollution, urbanization, smoking exposure, allergens, occupational hazards, and genetic predisposition. The disease burden is particularly high in children and elderly individuals. Asthma exacerbations contribute to repeated hospitalization, emergency medical visits, reduced work productivity, and increased healthcare costs [3]. Asthma pathogenesis involves chronic inflammation of the airways mediated by eosinophils, mast cells, T-helper-2 lymphocytes, cytokines, leukotrienes, and immunoglobulin E (IgE). Persistent inflammation causes bronchoconstriction, airway edema, mucus secretion, and airway remodeling, leading to impaired airflow and respiratory symptoms. Common triggers include allergens such as dust mites, pollen, animal dander, molds, respiratory tract infections, exercise, cold air, emotional stress, smoke exposure, and certain drugs, including aspirin and beta-blockers. Asthma may be classified as allergic asthma, non-allergic asthma, occupational asthma, exercise-induced asthma, nocturnal asthma, and severe asthma [4]. Diagnosis is based on clinical history, spirometry, peak expiratory flow rate, allergy testing, and pulmonary function assessment. Asthma management focuses on controlling symptoms, preventing exacerbations, maintaining normal lung function, and improving quality of life. Pharmacological treatment includes anti-inflammatory agents, bronchodilators, leukotriene modifiers, methylxanthines, and biologic therapies. Non-pharmacological management includes avoidance of triggers, smoking cessation, vaccination, patient education, and adherence to inhaler therapy.

2. Pathophysiology of Asthma

Asthma is associated with chronic inflammation of the bronchial airways. Inflammatory mediators released by mast cells, eosinophils, macrophages, and T lymphocytes lead to airway edema, mucus hypersecretion, and smooth muscle contraction. Exposure to allergens activates immunoglobulin E-mediated hypersensitivity reactions [5]. This leads to mast cell degranulation and release of histamine, leukotrienes, prostaglandins, and cytokines. These mediators produce bronchoconstriction and airway inflammation. Persistent inflammation results in airway remodeling characterized by smooth muscle hypertrophy, epithelial damage, fibrosis, and thickening of the airway wall. These changes contribute to chronic airflow limitation and severe asthma.

The pathophysiological changes in asthma include:

- Bronchoconstriction
- Airway inflammation
- Mucus hypersecretion
- Airway edema
- Airway remodeling
- Hyperresponsiveness of bronchial smooth muscles

3. Classification of Asthma

Asthma may be classified according to etiology and severity.

3.1 Based on Etiology

- Allergic asthma
- Non-allergic asthma
- Occupational asthma
- Exercise-induced asthma
- Drug-induced asthma
- Nocturnal asthma

3.2 Based on Severity

- Intermittent asthma
- Mild persistent asthma
- Moderate persistent asthma
- Severe persistent asthma

4. Diagnosis of Asthma

Diagnosis of asthma is based on clinical symptoms, physical examination, and pulmonary function tests.

Diagnostic Methods

- Spirometry
- Peak Expiratory Flow Rate (PEFR)
- Bronchodilator reversibility test
- Allergy testing
- Chest X-ray
- Blood eosinophil count
- Fractional exhaled nitric oxide (FeNO)

Common symptoms include wheezing, cough, chest tightness, shortness of breath, and nocturnal symptoms.

5. Major Categories of Asthma Drugs

5.1. Long-Term Controller Medications: These medications are taken regularly to prevent asthma symptoms and reduce airway inflammation.

Drug Class	Examples	Main Role	Safety Concerns	Clinical Considerations
Inhaled Corticosteroids (ICS)	Budesonide, Fluticasone, Beclomethasone, Mometasone, Ciclesonide	Reduce airway inflammation and mucus production	Oral thrush, throat irritation, mild growth delay in children	Rinse mouth after use; first-line maintenance therapy
Leukotriene Modifiers	Montelukast, Zafirlukast, Zileuton	Block leukotriene-mediated inflammation and bronchoconstriction	Neuropsychiatric effects may occur	Useful in allergy-associated asthma
Long-Acting Beta Agonists (LABAs)	Salmeterol, Formoterol	Long-acting bronchodilation	Increased risk of severe asthma if used alone	Must always be combined with ICS
Long-Acting Muscarinic Antagonists (LAMAs)	Tiotropium	Relax the airway smooth muscle	Dry mouth; caution in glaucoma	Add-on therapy in severe asthma
Combination Inhalers (ICS + LABA)	Fluticasone/Salmeterol, Budesonide/Formoterol	Anti-inflammatory and bronchodilator effects	Combined adverse effects of ICS and LABA	Effective and convenient therapy
Methylxanthines	Theophylline	Bronchodilation and improved diaphragmatic function	Narrow therapeutic index, arrhythmias, seizures	Requires blood-level monitoring

5.2. Quick-Relief (Rescue) Medications: These medications provide rapid relief during acute asthma attacks.

Drug Class	Examples	Main Role	Safety Concerns	Clinical Considerations
Short-Acting Beta Agonists (SABAs)	Albuterol, Levalbuterol	Rapid bronchodilation	Tremors, palpitations	Rescue inhalers
Anticholinergic Bronchodilators	Ipratropium	Relieves bronchospasm	Dry mouth	Often combined with albuterol
Systemic Corticosteroids	Prednisone, Methylprednisolone	Control severe inflammation	Weight gain, osteoporosis, hypertension	Short-term use preferred

5.3 Allergy-Related Treatments in Asthma Management: Medications and therapies used to prevent, relieve, or manage allergic reactions and associated asthma symptoms.

Treatment Type	Examples	Main Role	Safety Concerns	Clinical Considerations
Subcutaneous Immunotherapy (SCIT)	Pollens, dust mites, molds	Gradual allergen desensitization	Risk of anaphylaxis	Administered under medical supervision
Sublingual Immunotherapy (SLIT)	Odactra, Grastek, Ragwitek	Immune desensitization	Oral itching, throat irritation	Useful in allergy-associated asthma
Antihistamines	Cetirizine, Loratadine, Fexofenadine	Relieve allergic symptoms	Sedation with first-generation drugs	Second-generation agents preferred
Decongestants	Pseudoephedrine, Oxymetazoline	Reduce nasal congestion	Rebound congestion with prolonged use	Avoid nasal sprays for >3–5 days
Nasal Corticosteroids	Fluticasone, Budesonide, Mometasone	Reduce nasal inflammation	Mild nasal irritation	Most effective for allergic rhinitis
Cromolyn	Cromolyn sodium	Stabilizes mast cells	Minimal side effects	Preventive therapy before allergen exposure

5.4. Biologic Therapies for Severe Asthma: Targeted medications that block specific immune pathways involved in severe asthma to reduce inflammation and asthma attacks.

Biologic Agent	Mechanism	Indication	Safety Concerns
Omalizumab	Anti-IgE monoclonal antibody	Allergic asthma	Rare anaphylaxis
Mepolizumab	Anti-IL-5 monoclonal antibody	Eosinophilic asthma	Injection-site reactions
Reslizumab	Anti-IL-5 monoclonal antibody	Severe eosinophilic asthma	Hypersensitivity reactions
Benralizumab	IL-5 receptor antagonist	Severe eosinophilic asthma	Headache, injection reactions
Dupilumab	Blocks IL-4 and IL-13 pathways	Eosinophilic asthma	Injection-site reactions
Tezepelumab	Blocks thymic stromal lymphopoietin (TSLP)	Severe uncontrolled asthma	Generally, well tolerated
Depemokimab	Long-acting IL-5 inhibitor	Severe eosinophilic asthma	Hypersensitivity reactions

6. Revised Classification of Asthma Drugs

6.1. Anti-Inflammatory Controller Drugs: These drugs reduce chronic airway inflammation and prevent asthma exacerbations.

Drug Class	Examples	Mechanism of Action	Common Adverse Effects
Inhaled Corticosteroids (ICS)	Budesonide, Fluticasone, Beclomethasone, Mometasone, Ciclesonide	Suppress inflammatory cytokines and airway edema	Oral candidiasis, dysphonia, throat irritation
Systemic Corticosteroids	Prednisone, Prednisolone, Methylprednisolone, Hydrocortisone	Potent anti-inflammatory action during severe exacerbations	Osteoporosis, hyperglycemia, hypertension, adrenal suppression
Leukotriene Receptor Antagonists (LTRAs)	Montelukast, Zafirlukast	Block leukotriene-mediated bronchoconstriction and inflammation	Neuropsychiatric effects, headache
5-Lipoxygenase Inhibitor	Zileuton	Inhibits leukotriene synthesis	Hepatotoxicity, liver enzyme elevation
Mast Cell Stabilizers	Cromolyn sodium, Nedocromil	Prevent mast cell degranulation	Throat irritation, cough

6.2. Bronchodilator Drugs: These drugs relax bronchial smooth muscles and improve airflow.

Drug Class	Examples	Mechanism of Action	Common Adverse Effects
Short-Acting β2-Agonists (SABAs)	Salbutamol (Albuterol), Levalbuterol, Terbutaline	Rapid bronchodilation via β2 receptor stimulation	Tremor, tachycardia, palpitations
Long-Acting β2-Agonists (LABAs)	Salmeterol, Formoterol, Vilanterol	Prolonged bronchodilation	Increased risk if used without ICS
Short-Acting Muscarinic Antagonists (SAMAs)	Ipratropium bromide	Blocks muscarinic receptors causing bronchodilation	Dry mouth
Long-Acting Muscarinic Antagonists (LAMAs)	Tiotropium	Long-acting bronchodilation	Constipation, blurred vision
Methylxanthines	Theophylline, Aminophylline	Phosphodiesterase inhibition and bronchodilation	Arrhythmias, seizures, nausea

6.3. Combination Therapy: Combination inhalers improve compliance and therapeutic efficacy.

Combination	Examples	Clinical Use
ICS + LABA	Budesonide/Formoterol, Fluticasone/Salmeterol, Mometasone/Formoterol	Moderate to severe persistent asthma
ICS + LABA + LAMA	Fluticasone/Umeclidinium/Vilanterol	Severe uncontrolled asthma
SABA + SAMA	Albuterol + Ipratropium	Acute severe bronchospasm

6.4. Target-Specific Monoclonal Antibodies in Severe Asthma Therapy: These biologic therapies selectively target inflammatory mediators involved in severe uncontrolled asthma and are particularly beneficial in eosinophilic and type-2 inflammatory asthma phenotypes.

Biologic Agent	Molecular Target	Therapeutic Benefit	Important Adverse Effects
Omalizumab	IgE	Reduces allergic inflammation and asthma exacerbations	Anaphylaxis
Mepolizumab	IL-5	Lowers eosinophil count and decreases exacerbations	Injection-site reactions
Reslizumab	IL-5	Improves lung function and symptom control	Hypersensitivity
Benralizumab	IL-5 receptor	Rapid eosinophil depletion and improved asthma control	Headache
Dupilumab	IL-4/IL-13	Reduces airway inflammation and corticosteroid use	Injection reactions
Tezepelumab	TSLP	Effective across multiple asthma phenotypes, Severe uncontrolled asthma	Arthralgia, pharyngitis
Depemokimab	Long-acting IL-5 inhibitor	Extended dosing interval and prolonged eosinophil suppression	Hypersensitivity reactions

6.5 Supportive Therapies for Allergic Asthma and Allergic Rhinitis: These supportive therapies are commonly used to control allergic manifestations associated with asthma, improve airway comfort, and reduce exposure-related respiratory symptoms.

Drug/Therapy	Examples	Therapeutic Purpose	Therapeutic Purpose
Antihistamines	Cetirizine, Loratadine, Fexofenadine	Reduce histamine-mediated allergic symptoms	Helpful in seasonal and perennial allergies
Nasal Corticosteroids	Fluticasone, Mometasone	Control nasal inflammation and congestion	Most effective treatment for allergic rhinitis
Decongestants	Pseudoephedrine, Oxymetazoline	Provide temporary relief from nasal blockage	Short-term use recommended
Immunotherapy (SCIT/SLIT)	Pollens, dust mite extracts	Modify immune response to allergens	Reduces long-term allergic sensitivity

7. Newly Approved and Emerging Asthma Drugs

Drug	Class	Special Features
Tezepelumab	Anti-TSLP biologic	Effective across multiple asthma phenotypes
Depemokimab	Ultra-long-acting IL-5 inhibitor	Extended dosing interval
Fevipiprant	DP2 receptor antagonist	Investigational anti-inflammatory drug
Astegolimab	Anti-ST2 monoclonal antibody	Targets IL-33 pathway
Itepekimab	Anti-IL-33 monoclonal antibody	Investigational biologic therapy

8. Commonly Used Asthma Medications and Their Clinical Significance

Drug	Category	Clinical Significance
Salbutamol	SABA	Preferred rescue inhaler
Formoterol	LABA	Rapid onset and long duration
Budesonide	ICS	Widely used maintenance therapy
Montelukast	LTRA	Useful in exercise-induced asthma
Tiotropium	LAMA	Add-on therapy in severe asthma
Omalizumab	Biologic	Used in IgE-mediated asthma
Dupilumab	Biologic	Effective in eosinophilic asthma
Aminophylline	Methylxanthine	Intravenous use in severe attacks

9. Safety and Efficacy of Asthma Medications

The efficacy of asthma medications depends on their ability to reduce airway inflammation, relieve bronchoconstriction, prevent exacerbations, and improve pulmonary function. Inhaled corticosteroids remain the cornerstone of long-term asthma management because of their strong anti-inflammatory effects and proven efficacy in reducing asthma-related morbidity and mortality [6]. Short-acting beta-agonists provide rapid symptom relief during acute asthma attacks and are highly effective as rescue medications. However, excessive dependence on rescue inhalers may indicate poorly controlled asthma and an increased risk of exacerbations [7]. Combination therapy with ICS and LABAs has demonstrated superior efficacy compared to monotherapy in moderate to severe persistent asthma. LABAs should never be used alone because monotherapy may increase the risk of severe asthma-related complications. Leukotriene modifiers are particularly useful in patients with allergic asthma or exercise-induced bronchospasm, although neuropsychiatric adverse effects require careful monitoring. Theophylline has bronchodilator effects but is less commonly used because of its narrow therapeutic index and risk of toxicity. Biologic therapies have significantly improved outcomes in patients with severe, uncontrolled asthma by targeting specific inflammatory pathways, including IgE, IL-5, IL-4, IL-13, and TSLP. Although highly effective, these therapies are expensive and require administration under medical supervision because of possible hypersensitivity reactions [8-20], asthma medications are considered safe and effective when prescribed appropriately, used with proper inhaler technique, and monitored regularly.

10. Important Safety Measures in Asthma Therapy

- Use inhalers with correct technique.
- Rinse the mouth after corticosteroid inhalation to prevent oral candidiasis.
- LABAs should never be used alone in asthma treatment.
- Frequent rescue inhaler use indicates poorly controlled asthma.
- Avoid prolonged use of nasal decongestant sprays (>3–5 days).
- Monitor theophylline blood levels regularly.
- Biologic therapies should be administered under medical supervision.
- Follow prescribed dosing schedules consistently.
- Maintain regular follow-up and symptom monitoring.

Conclusion

Asthma is a chronic inflammatory airway disease characterized by reversible airflow obstruction, bronchial hyperresponsiveness, and recurrent respiratory symptoms. Proper diagnosis, identification of triggers, and appropriate pharmacological management are essential for achieving effective asthma control.

Inhaled corticosteroids remain the cornerstone of long-term asthma therapy because of their proven efficacy in reducing airway inflammation and preventing exacerbations. Rescue medications such as short-acting beta-agonists provide rapid symptom relief during acute attacks, while combination therapies and biologic agents improve outcomes in moderate to severe asthma. Allergy-directed therapies are also beneficial in patients with allergic asthma. The safety and effectiveness of asthma medications depend on appropriate drug selection, adherence to therapy, correct inhaler technique, and regular monitoring for adverse effects. Patient education, trigger avoidance, and individualized treatment plans play vital roles in minimizing complications and improving quality of life. With proper management and continuous follow-up, most patients with asthma can achieve good symptom control and lead healthy, active lives.

Modern asthma pharmacotherapy has evolved significantly from conventional bronchodilators to targeted biologic therapies. Advances in biologic agents such as omalizumab, dupilumab, and tezepelumab have transformed the management of severe asthma and improved clinical outcomes in patients with refractory disease.

Abbreviations

Abbreviation	Full Form
ICS	Inhaled Corticosteroids
SABA	Short-Acting Beta Agonists
LABA	Long-Acting Beta Agonists
LAMA	Long-Acting Muscarinic Antagonists
PEFR	Peak Expiratory Flow Rate
SCIT	Subcutaneous Immunotherapy
SLIT	Sublingual Immunotherapy
COPD	Chronic Obstructive Pulmonary Disease
IL	Interleukin
IgE	Immunoglobulin E
TSLP	Thymic Stromal Lymphopoietin
DPI	Dry Powder Inhaler
MDI	Metered-Dose Inhaler

References

1. Global Initiative for Asthma (GINA). *Global Strategy for Asthma Management and Prevention*. 2024 Update.
2. World Health Organization (WHO). Asthma. *World Health Organization Fact Sheets*. 2024.
3. National Heart, Lung, and Blood Institute (NHLBI). *Guidelines for the Diagnosis and Management of Asthma*. Bethesda, MD: NHLBI; 2020.
4. National Institute for Health and Care Excellence (NICE). *Asthma: Diagnosis, Monitoring and Chronic Asthma Management*. NICE Guideline NG80; 2024.
5. Brunton LL, Hilal-Dandan R, Knollmann BC. *Goodman & Gilman's The Pharmacological Basis of Therapeutics*. 13th ed. New York: McGraw-Hill Education; 2018.
6. Katzung BG, Trevor AJ. *Basic and Clinical Pharmacology*. 15th ed. New York: McGraw-Hill Education; 2021.
7. Jameson JL, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscalzo J. *Harrison's Principles of Internal Medicine*. 21st ed. New York: McGraw-Hill Education; 2022.
8. Barnes PJ. Inhaled corticosteroids. *Pharmaceuticals (Basel)*. 2010;3(3):514–540.
9. Reddel HK, Bacharier LB, Bateman ED, et al. Global Initiative for Asthma strategy 2024: executive summary and rationale for key changes. *Eur Respir J*. 2024;63(2):2302730.

10. Castro M, Corren J, Pavord ID, et al. Dupilumab efficacy and safety in moderate-to-severe uncontrolled asthma. *N Engl J Med*. 2018;378(26):2486–2496.
11. Busse WW, Maspero JF, Rabe KF, et al. Liberty Asthma QUEST: Phase 3 randomized trial of dupilumab efficacy and safety in uncontrolled asthma. *J Allergy Clin Immunol*. 2018;142(6):1792–1804.
12. Menzies-Gow A, Corren J, Bourdin A, et al. Tezepelumab in adults and adolescents with severe uncontrolled asthma. *Lancet Respir Med*. 2021;9(12):1299–1312.
13. Bleecker ER, FitzGerald JM, Chanez P, et al. Efficacy and safety of benralizumab for patients with severe asthma. *Lancet*. 2016;388(10056):2115–2127.
14. Ortega HG, Liu MC, Pavord ID, et al. Mepolizumab treatment in patients with severe eosinophilic asthma. *N Engl J Med*. 2014;371(13):1198–1207.
15. Humbert M, Beasley R, Ayres J, et al. Benefits of omalizumab as add-on therapy in patients with severe persistent asthma. *Allergy*. 2005;60(3):309–316.
16. Peters SP, Kunselman SJ, Icitovic N, et al. Tiotropium bromide step-up therapy for adults with uncontrolled asthma. *N Engl J Med*. 2010;363(18):1715–1726.
17. Nelson HS, Weiss ST, Bleecker ER, et al. The Salmeterol Multicenter Asthma Research Trial. *Chest*. 2006;129(1):15–26.
18. Holgate ST. Pathogenesis of asthma. *Clin Exp Allergy*. 2008;38(6):872–897.
19. Fahy JV. Type 2 inflammation in asthma — present in most, absent in many. *Nat Rev Immunol*. 2015;15(1):57–65.
20. Chung KF, Wenzel SE, Brozek JL, et al. International ERS/ATS guidelines on definition, evaluation and treatment of severe asthma. *Eur Respir J*. 2014;43(2):343–373.