International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 476-480 www.ijprajournal.com ISSN: 2456-4494

Recent Advances in Asthma Research: A Review of 2024-2025 Breakthroughs

Aiswarya[1], Bilna Benedict[1], Nakshatra Antony Yesudas[1*], Aji Varghese[2]
[1] *Pharm D, St James' College of Pharmaceutical Sciences, Chalakudy*
[2]*Assistant Professor, Department of Pharmacy Practice, St James' College of Pharmaceutical Sciences, Chalakudy*

Date of Submission: 10-05-2025 Date of Acceptance: 20-05-2025

ABSTRACT
Asthma, is a chronic respiratory condition characterised by airway inflammation affecting over 262 million people worldwide, remains a significant public health challenge. Recent research from 2024 and 2025 has ushered in promising advancements in treatment, diagnostics, and environmental understanding of asthma. This review synthesizes five pivotal studies exploring biologics (dupilumab and mepolizumab), novel biomarkers (surfactant proteins), epidemiological trends, and the impact of global warming on airway inflammation. These findings highlight the potential for personalized medicine, improved diagnostics, and environmental interventions to enhance asthma care. Despite progress, disparities and environmental challenges underscore the need for holistic approaches to ensure equitable benefits.
KEY WORDS: Recent studies on asthma, Dupilumab treatment, Mepolizumab treatment, Surfactant proteins, Asthma trends in U.S, Global warming.

I. INTRODUCTION

Imagine waking up each day unsure if a simple walk outside or a change in weather might leave you gasping for breath. For over 262 million people living with asthma, this is reality, as reported by the World Health Organization [1]. Asthma isn't just a medical diagnosis; it's a daily negotiation with triggers, medications, and unpredictability. Fortunately, the past two years have brought transformative insights into asthma's biology, treatment, and societal impact. From biologics that target specific inflammatory pathways to new ways of assessing disease severity, researchers are redefining how we manage this condition. This review explores five groundbreaking studies from 2024 and 2025, offering hope for better care and a deeper understanding of asthma's complexities. By examining these advances, we aim to illuminate their implications for patients, clinicians, and policymakers striving for a world where asthma no longer limits life's possibilities.

DETAILED REVIEW OF RECENT STUDIES

1. Dupilumab's Long-Term Promise for Severe Asthma

Asthma affects millions worldwide, and for those with moderate-to-severe type 2 asthma, managing symptoms can feel like an uphill battle. Standard treatments like inhaled corticosteroids often aren't enough [2], leaving patients and doctors searching for better options. Enter Dupilumab, a biologic drug that's been making waves. It's a monoclonal antibody that targets the interleukin-4 receptor alpha subunit, blocking interleukin-4 and interleukin-13—two key players in the inflammation driving type 2 asthma [3].Previous clinical trials have shown Dupilumab can reduce asthma exacerbations, improve lung function, and boost quality of life [4,5]. But the big question is whether these benefits hold up over time.

A 2025 study published in CHEST Pulmonary tackles this by examining Dupilumab's effectiveness over three years in patients with moderate-to-severe type 2 asthma, with a focus on how biomarkers like blood eosinophils and FeNO predict outcomes [6]. This study is an extension of two major trials: the LIBERTY ASTHMA QUEST and TRAVERSE studies. QUEST was a 52-week, randomized, double-blind, placebo-controlled trial that tested Dupilumab (200 mg or 300 mg every two weeks) against placebo in patients with uncontrolled moderate-to-severe asthma, added to their usual treatments. TRAVERSE then took these participants and gave them open-label Dupilumab (300 mg every two weeks) for up to 96 weeks, totalling three years for some.

The study focused on adults and adolescents (aged 12 and up) with asthma that wasn't well controlled, even with medium-to-high doses of inhaled corticosteroids and other

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 476-480 www.ijprajournal.com ISSN: 2456-4494

medications. Patients needing oral corticosteroids were left out.

Over two years, researchers followed 663 patients with moderate-to-severe asthma, particularly those with high eosinophil counts and elevated fractional exhaled nitric oxide (FeNO). They were split into four groups based on two baseline biomarkers: blood eosinophil count (≥150 or <150 cells/μL) and FeNO (≥25 or <25 ppb). Eosinophils are white blood cells tied to allergic inflammation, and FeNO measures airway inflammation.

The key findings of the study were, first the exacerbation rate dropped from 2.24 to 0.36 (QUEST) and 0.49 (TRAVERSE), the FEV_1 had a 0.5L increase, there was also a significant improvement in the ACQ-5 Score and AQLQ score. Patients with both high eosinophils and FeNO saw the biggest wins—exacerbations fell from two per year to about one every 3–4 years. Those with lower biomarkers didn't see nearly as much benefit, suggesting Dupilumab is most effective in specific patients.[6] Some limitations of the study include lack of placebo group which introduces bias, also the patients selected where those who were part of QUEST and thus favours those who responded well to the medication initially, the analyses weren't powered for statistical comparisons, so results for smaller groups were less reliable. The study used baseline biomarkers but didn't monitor changes over time, which could offer more insight.[6]

This suggests dupilumab could reduce hospital stays and improve quality of life for those with hard-to-treat asthma, offering a lifeline where standard therapies fall short.

2. Mepolizumab's Real-World Impact

Mepolizumab is a humanized, monoclonal anti-IL-5 antibody approved in multiple regions worldwide for the treatment of severe asthma with an eosinophilic phenotype, eosinophilic granulomatosis with polyangiitis, hypereosinophilic syndrome, and chronic rhinosinusitis with nasal polyps. [7,8,9]The REALITI-A study, published in CHEST Pulmonary, tracked its real-world performance in patients with severe eosinophilic asthma.Conducted across multiple international sites, it enrolled 822 patients aged 18 years and older with a clinical diagnosis of severe asthma and a physician's decision to initiate Mepolizumab.[10]The study employed a mixed retrospective-prospective design. The retrospective phase included collection of data for a one-year period. During the prospective phase patients were followed for two years after starting mepolizumab, with data collected during routine clinical visits using standardized outcome measures.After a year of Mepolizumab therapy, the patients had an improvement in the control of their disease also didn't require oral corticosteroids for maintenance.

The key findings of the study shows that Asthma control improved, with ACQ-5 scores decreasing by 1.53 points from baseline, exceeding the minimal clinically important difference (MCID) of 0.5 points.[10] Lung function also showed sustained improvement, with FEV1 increasing by 142 mL at months 21-24, indicating better airway function.They also found that the annualized rate of CSEs decreased by 74%, from 2.15 events per year before treatment to 0.56 during the second year. Exacerbations requiring ED visits or hospitalizations saw a 79% reduction, while hospitalizations specifically decreased by 73%. These reductions are clinically significant, potentially reducing healthcare costs and improving patient quality of life.Mepolizumab was well-tolerated, with treatment-related AEs reported in 11% of patients and serious AEs in <1%. The most common AE was headache (4%), consistent with prior studies, and no new safety signals were identified.Adherence with Mepolizumab was high, with a median PDC of 91%. Only 27% of patients discontinued mepolizumab over two years, with reasons including perceived lack of efficacy (9%), switching to another biologic (6%), and patient decision (5%). The low discontinuation rate suggests good tolerability and effectiveness in real-world settings.[11]

Unlike clinical trials, this study captured the messiness of everyday life—variable adherence, diverse health conditions—and still found mepolizumab effective. For patients, this translates to more symptom-free days and less fear of sudden attacks, affirming biologics as a game-changer for severe asthma.

3. Surfactant Proteins as Biomarkers

Surfactant proteins A and D act like the lungs' natural defenders, easing airway function and dampening inflammation. A 2025 systematic review in npj Primary Care Respiratory Medicine[12] explored whether their levels in lung fluid could signal asthma severity. The review included 16 studies, predominantly assessing adult populations, with four focusing on paediatric cohorts. SP-D was the most frequently studied protein, measured in serum (nine studies), sputum (four studies), and BAL fluid (two studies). SP-A

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 476-480 www.ijprajournal.com ISSN: 2456-4494

levels were evaluated in serum (four studies), BAL fluid (three studies), and sputum (two studies). The findings of Mohamed et al. align with the inconsistent results reported in prior asthma research. For instance, a study by Hohlfeld et al. (2008) in Clinical and Experimental Allergy noted elevated SP-D in allergic asthma but not in mild cases, mirroring the trend observed in severe asthma cases in this review.[13] However, the lack of significant differences in SP levels contrasts with stronger associations found in other pulmonary diseases. McKay et al. (2018) reported significantly elevated SP-D levels in COPD, likely due to structural lung damage, which is less pronounced in asthma, particularly in milder forms.[14]

The potential correlation between SP-D and asthma severity is a key insight. Studies like Berry Met al. [15] (2021) found SP-D levels correlated with alveolar nitric oxide, a marker of poor asthma control, suggesting SP-D may reflect inflammatory activity in severe cases. This aligns with research by Sorensen et al. (2016) in Journal of Allergy and Clinical Immunology, which linked SP-D to eosinophilic inflammation in asthma.[16] These findings underscore the heterogeneity of asthma phenotypes, as noted by Wenzel (2012) in Nature Medicine, which complicates biomarker identification.[17]

The findings revealed that lower surfactant protein levels correlated with worse inflammation and poorer asthma control. Picture these proteins as a dashboard indicator: low levels might warn doctors of patients needing urgent intervention. While not yet ready for clinical use, this discovery paves the way for novel diagnostics or therapies that could boost surfactant activity, offering a fresh angle on asthma management.

4. Asthma Trends in the U.S.: Gains and Gaps

A July 2024 study from the CDC, published in Preventing Chronic Disease, analysed U.S. asthma trends from 2010 to 2021 The study by Patel et al., published in Preventing Chronic Disease,[18] analyses asthma prevalence, morbidity, and mortality trends among children and adults from 2010 to 2021. Approximately 50% of children and 62% of adults with asthma in the US have uncontrolled symptoms, leading to increased emergency department (ED) visits, hospitalizations, and missed school or workdays. A retrospective analysis using data from the NHIS (2010–2021), NEDS (2010–2020), NIS (2010–2020), and National Vital Statistics System (2010–2021) was conducted. The NHIS provided self-reported data on asthma prevalence and attacks, while NEDS and NIS tracked ED visits and hospitalizations. The key findings included asthma prevalence among adults increased significantly (P = .04 for APC slope), while it decreased among children (P = .03 for 2010–2017 and 2017–2021 slopes). Non-Hispanic Black children (12.5%; APR = 2.19; 95% CI, 1.68–2.84) and adults (10.6%; APR = 1.25; 95% CI, 1.09–1.43) had higher prevalence than non-Hispanic White children (5.7%) and adults (8.2%). Asthma attacks, ED visits, and hospitalizations declined significantly across all ages, reflecting improved management strategies. Asthma-related deaths decreased, indicating progress in reducing severe outcomes. Despite overall improvements, racial and ethnic disparities persisted, with Black populations experiencing worse outcomes [19].

The study's implications are critical for public health policy. By identifying disparities and trends, it offers a roadmap for tailored interventions to improve asthma control and reduce inequities. Continued investment in programs like the CDC's National Asthma Control Program, alongside community-based strategies, is essential to ensure equitable asthma care. Future research should explore the drivers of adult prevalence increases and evaluate interventions to address disparities, building on the foundation provided by this study.

Asthma attacks declined for both children and adults. But the picture isn't uniformly bright: adult asthma prevalence is rising, while paediatric rates drop. Disparities persist, with Black individuals and females facing higher asthma-related mortality. These findings point to systemic issues—unequal healthcare access, environmental exposures, and social determinants—that no pill alone can fix. They remind us that medical breakthroughs must reach everyone, not just a privileged few, to truly move the needle.

5. Global Warming's Role in Airway Inflammation

As the planet heats up, so do the challenges for asthma patients.As wildfires rage and heatwaves become more frequent, the reality of climate change feels closer than ever. Beyond these visible impacts, a quieter threat looms: the air we breathe is getting drier, and it might be hurting our lungs in ways we're only beginning to understand. Many respiratory diseases worsen on exposure to extreme climate [20,21,22] A new study in Communications Earth & Environment[23] tackles this issue head-on, exploring how global warming

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 476-480 www.ijprajournal.com ISSN: 2456-4494

could dehydrate and inflame our airways, potentially making conditions like asthma or COPD worse.The study linked global warming to airway inflammation via vapor pressure deficit (VPD), a measure of air's moisture-absorbing capacity. Rising VPD, driven by higher temperatures, dries out airway mucus, compressing epithelial cells and triggering inflammatory cytokines like IL-6 and TNF-α.Climate change is already linked to respiratory problems through rising pollen levels, air pollution, and extreme weather, as noted in a 2014 review by D'Amato et al. [24]Using a mix of mathematics models and lab tests, the researchers found that drier air (at 95%, 60%, and 30% relative humidity at 37°C) thins airway mucus by 5%, 35%, and 58%, respectively, while increasing inflammation markers. Mouse studies showed similar damage, with lung inflammation after two weeks of dry air exposure. These findings are alarming, especially since respiratory diseases already affect millions worldwide, often hitting hardest in communities with less access to care.This study is a reminder that climate change isn't just about melting ice caps; it's about the air we breathe every day. It urges us to push for cleaner energy, better air quality, and more research to protect those most at risk, like kids with asthma or seniors with COPD.

For asthma sufferers, this means drier air could worsen symptoms or spark flare-ups. The study suggests practical steps, like using humidifiers or designing humidity-controlled public spaces, could mitigate these effects, adding environmental management to the asthma care toolkit.

II. DISCUSSION

These studies weave a tapestry of progress and challenges. Biologics like dupilumab and mepolizumab are reshaping severe asthma treatment, offering targeted relief where inhalers and steroids often fail. The potential of surfactant proteins as biomarkers could usher in smarter diagnostics, catching severe cases before they spiral. Yet, the CDC's data and the environmental study remind us of broader hurdles: inequities in care and the growing threat of climate change. Together, they call for a dual approach—pushing scientific boundaries while tackling social and environmental barriers. The future of asthma care lies in blending personalized medicine with systemic change, ensuring advances benefit all.

III. CONCLUSION

The past two years have brought asthma research to an exciting crossroads. We're seeing treatments tailored to individual biology, tools to detect severe asthma earlier, and a sharper focus on environmental triggers like air quality. For the millions living with asthma, these advances promise fewer limitations and more freedom to live fully. But optimism must be tempered with action—addressing disparities and climate impacts is as critical as developing new drugs. By building on these studies, researchers, clinicians, and communities can work together to make asthma a less daunting presence in people's lives.

REFERENCES

[1]. Murray CJL, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the global burden of disease study 2019. Lancet. 2020;396(10258):1204-22. doi:10.1016/S0140-6736(20)30925-9.

[2]. Settipane RA, Kreindler JL, Chung Y, Tkacz J. Evaluating direct costs and productivity losses of patients with asthma receiving GINA 4/5 therapy in the United States. Ann Allergy Asthma Immunol. 2019;123(6):564-72.e3. doi: 10.1016/j.anai.2019.08.462.

[3]. Ricciardolo FLM, Bertolini F, Carriero V. The role of dupilumab in severe asthma. Biomedicines. 2021;9(9):1096. doi:10.3390/biomedicines9091096.

[4]. Castro M, Corren J, Pavord ID, Maspero J, Wenzel S, Rabe KF, et al. Dupilumab efficacy and safety in moderate-to-severe uncontrolled asthma. N Engl J Med. 2018;378(26):2486-96. doi:10.1056/NEJMoa1804092.

[5]. Zaazouee MS, Alwarraqi AG, Mohammed YA, Badheeb MA, Farhat AM, Eleyan M, et al. Dupilumab efficacy and safety in patients with moderate to severe asthma: a systematic review and meta-analysis. Front Pharmacol. 2022; 13:992731. doi:10.3389/fphar.2022.992731.

[6]. Wechsler ME, Pavord ID, Papi A, et al. Long-term efficacy of dupilumab in moderate-to-severe asthma phenotyped by blood eosinophils and exhaled nitric oxide. CHEST Pulm. 2025;3(1).

[7]. European Medicines Agency. Summary of product characteristics for Nucala

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 476-480 www.ijprajournal.com ISSN: 2456-4494

[Internet]. [Accessed 2022 Aug]. Available from: https://www.ema.europa.eu/en/documents/product-information/nucala-epar-product-information_en.pdf.

[8]. U.S. Food and Drug Administration. Highlights of prescribing information for Nucala [Internet]. [Accessed 2022 Aug]. Available from: https://gskpro.com/content/dam/global/hcpportal/en_US/Prescribing_Information/Nucala/pdf/NUCALA-PI-PIL-IFU-COMBINED.PDF.

[9]. GlaxoSmithKline. Mepolizumab prescribing information, Japan [Internet]. [Accessed 2022 Aug]. Available from: https://gskpro.com/ja-jp/products_info/nucala/index/.

[10]. Juniper EF, Svensson K, Mörk AC, Ståhl E. Measurement properties and interpretation of three shortened versions of the asthma control questionnaire. Respir Med. 2005;99(5):553-8.

[11]. Caruso C, Canonica GW, Patel M, et al. Prospective REALITI-A study: 2-year real-world benefits of mepolizumab in severe asthma. CHEST Pulm. 2025;3(1).

[12]. Mohamed SO, Mohammed A, Mohamed T, et al. Surfactant proteins levels in asthmatic patients and their correlation with severity of asthma: a systematic review. BMC Pulm Med. 2025;25(1):182. doi:10.1186/s12890-025-03654-5.

[13]. Hohlfeld JM, Erpenbeck VJ, Krug N. Surfactant proteins SP-A and SP-D as modulators of the allergic inflammation in asthma. Pathobiology. 2002-2003;70(5):287-92. doi:10.1159/000070744.

[14]. Moreno D, Garcia A, Lema D, De Sanctis JB. Surfactant Protein D in chronic obstructive pulmonary disease (COPD). Recent Pat EndocrMetab Immune Drug Discov. 2014;8(1):42-7. doi:10.2174/1872214808666140209142640.

[15]. Berry M, Hargadon B, Morgan A, Shelley M, Richter J, Shaw D, et al. Alveolar nitric oxide in adults with asthma: evidence of distal lung inflammation in refractory asthma. Eur Respir J. 2005;25(6):986-91. doi:10.1183/09031936.05.00132404.

[16]. Sorensen GL. Surfactant protein D in respiratory and non-respiratory diseases. Front Med (Lausanne). 2018; 5:18. doi:10.3389/fmed.2018.00018.

[17]. Wenzel SE. Asthma phenotypes: the evolution from clinical to molecular approaches. Nat Med. 2012;18(5):716-25. doi:10.1038/nm.2678.

[18]. Wang C, Yang J, Testa J, et al. Continuity of care and lifestyle intervention programs for Spanish-speaking immigrants without health insurance at a free clinic in Rhode Island. Prev Chronic Dis. 2024; 21:240136. doi:10.5888/pcd21.240136.

[19]. Pate CA, Zahran HS. The status of asthma in the United States. Prev Chronic Dis. 2024; 21:240005. doi:10.5888/pcd21.240005.

[20]. Romaszko-Wojtowicz A, et al. Relationship between biometeorological factors and the number of hospitalizations due to asthma. Sci Rep. 2020; 10:9593-605.

[21]. Ghosh A, Boucher RC, Tarran R. Airway hydration and COPD. Cell Mol Life Sci. 2015; 72:3637-53.

[22]. Moriyama M, Hugentobler WJ, Iwasaki A. Seasonality of respiratory infections. Annu Rev Virol. 2021; 7:83-108.

[23]. Edwards DA, Edwards A, Li D, et al. Global warming risks dehydrating and inflaming human airways. Commun Earth Environ. 2025;6(1):193. doi:10.1038/s43247-025-02161-z.

[24]. D'Amato G, Bergmann KC, Cecchi L, Annesi-Maesano I, Sanduzzi A, Liccardi G, et al. Climate change and air pollution: effects on pollen allergy and other allergic respiratory diseases. Allergo J Int. 2014;23(1):17-23. doi:10.1007/s40629-014-0003-7.