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OPTIMIZING INHALER TECHNIQUE AND MEDICATION ADHERENCE IN ASTHMA AND COPD: THE ROLE OF PHARMACIST-LED INTERVENTIONS

Prof. Dr. Linu Mohan P.[1], Febin Ashraf P.*[2], Mehra P.[3]

[1]Professor, Pharmacy Practice, Al Shifa College of Pharmacy.

[2,3]Student, Pharmacy Practice, Al Shifa College of Pharmacy.

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***Corresponding Author: Febin Ashraf P.**
Department of Pharmacy Practice, Al Shifa College of Pharmacy, Malappuram, Kerala
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ABSTRACT

Asthma and chronic obstructive pulmonary disease (COPD) are among the most common chronic respiratory disorders worldwide and are associated with significant morbidity, mortality, and healthcare burden. Inhaled therapy delivered through metered dose inhalers (MDIs) and dry powder inhalers (DPIs) remains the cornerstone of disease management; however, incorrect inhaler technique and poor medication adherence continue to compromise treatment effectiveness. This narrative review examines current evidence from prospective and interventional studies published between 2019 and 2024 regarding the optimization of inhaler use in asthma and COPD patients, with particular emphasis on pharmacist-led and clinician-led educational interventions. The reviewed literature demonstrates that structured counseling, practical device demonstrations, video-assisted education, and repeated follow-up significantly reduce critical inhaler technique errors, improve medication adherence as assessed by tools such as the Test of Adherence to Inhalers (TAI), and enhance disease control measured through the Asthma Control Test (ACT) and COPD Assessment Test (CAT). Evidence further indicates that repeated educational reinforcement is essential to prevent technique decay and sustain long-term benefits. Overall, pharmacist-led inhaler optimization programs represent a cost-effective and clinically impactful strategy for improving therapeutic outcomes, reducing exacerbations, and enhancing quality of life in patients with asthma and COPD. Integration of standardized inhaler assessment, adherence monitoring, and clinical pharmacy services into routine respiratory care is strongly recommended to achieve optimal disease management.

KEYWORDS: Asthma, COPD, Metered Dose Inhaler, Dry Powder Inhaler, Inhaler Technique, Pharmacist-Led Intervention, Patient Education, Medication Adherence, TAI, Disease Control, Clinical Pharmacy Practice.

1. INTRODUCTION

Respiratory diseases remain a major global health challenge, with asthma and chronic obstructive pulmonary disease affecting hundreds of millions of people worldwide. According to the Global Burden of Disease Study, asthma affects approximately 262 million individuals, while COPD affects more than 300 million, contributing significantly to morbidity, mortality, and healthcare burden.[1]

Inhaled medications are the cornerstone of asthma and COPD management. Current GINA and GOLD guidelines recommend inhaled corticosteroids (ICS), long-acting beta-2 agonists (LABA), and long-acting muscarinic antagonists (LAMA) as maintenance therapies, while short-acting bronchodilators are used for symptom relief.[2,3]

Despite their proven efficacy, inhaled therapies often fail to achieve optimal outcomes due to poor inhaler technique and inadequate adherence. Studies indicate that 70–90% of patients commit at least one critical inhaler technique error, leading to reduced drug deposition, poor disease control, increased exacerbations, and higher healthcare costs.[4]

Common errors include incorrect inhalation technique, failure to coordinate inhalation with actuation, and inadequate breath-holding after inhalation.

Medication non-adherence further compromises treatment effectiveness, with fewer than half of patients using inhalers as prescribed over the long term.[5] Adherence issues may be intentional, such as concerns about side effects, or unintentional, including forgetfulness and improper device use. The Test of Adherence to Inhalers (TAI) is a validated tool used to assess adherence patterns in asthma and COPD patients.[6]

Pharmacists play a crucial role in inhaler optimization through patient counseling, inhaler technique training, adherence assessment, and follow-up monitoring. Evidence from prospective studies shows that pharmacist-led interventions significantly improve inhaler technique, medication adherence, and disease control outcomes.[7,8] This review examines current evidence on optimizing MDI and DPI use in asthma and COPD, focusing on pharmacist-led interventions, adherence assessment, inhaler technique errors, and their impact on clinical outcomes.

2. EPIDEMIOLOGY AND BURDEN OF ASTHMA AND COPD

Asthma and COPD represent two distinct yet frequently overlapping chronic respiratory conditions. Asthma is characterized by reversible airway inflammation and bronchoconstriction, while COPD involves progressive airflow limitation associated with chronic inflammation and exposure to harmful particles, particularly tobacco smoke.[9]

COPD remains one of the leading causes of death globally, while asthma continues to impose a significant disease burden across all age groups. Inadequate inhaler technique and poor adherence are recognized risk factors for poor disease control and increased healthcare utilization.[10]

Economic analyses have shown that preventable inhaler errors contribute substantially to healthcare expenditure through increased emergency visits, hospitalizations, and unnecessary treatment escalation.[11] Consequently, interventions aimed at improving inhaler use have important clinical and economic implications.

3. INHALER DEVICES: MDI AND DPI

3.1 Pressurized Metered Dose Inhaler (pMDI)

pMDIs are among the most widely prescribed inhaler devices. Patients must exhale fully, inhale slowly while actuating the device, and hold their breath after inhalation. Failure to perform these steps correctly can significantly reduce pulmonary drug delivery.[12] Spacer devices can improve medication delivery by reducing coordination requirements and minimizing oropharyngeal deposition. They are particularly useful for elderly patients and children.

3.2 Dry Powder Inhaler (DPI)

DPIs deliver medication through the patient's inspiratory effort and do not require propellants. Unlike pMDIs, they require rapid and forceful inhalation to ensure adequate drug dispersion and lung deposition. Consequently, patients with severely impaired inspiratory flow may have difficulty using these devices effectively.[13]

3.3 Comparative Adherence Profiles

A large prospective cohort study comparing MDI and DPI adherence among asthma and COPD patients found that DPIs, particularly once-daily formulations, were associated with significantly higher purchase rates than MDIs, suggesting modestly better adherence patterns with DPIs.[10] However, neither device class achieved optimal adherence, nor overall utilization remained low across the studied population. Prescribers should carefully evaluate actual inhaler use patterns at each clinical encounter and consider patient-specific factors including inspiratory capacity, cognitive ability, manual dexterity, and device preference when selecting an inhaler platform.

4. PREVALENCE AND TYPOLOGY OF INHALER TECHNIQUE ERRORS

Incorrect inhaler technique remains a major obstacle to effective respiratory disease management. A landmark systematic review reported that 70–90% of patients using inhalers make at least one technique error.[4] These errors may be classified as critical errors, which substantially impair drug delivery, and non-critical errors, which reduce treatment effectiveness.

A prospective observational study involving 316 patients found that 88.9% committed at least one inhaler technique error, with skill-based mistakes occurring more frequently than knowledge-related errors.[15] These findings suggest that practical inhaler skills are a major determinant of effective inhaler use. Furthermore, studies have demonstrated "inhaler technique decay," where patients gradually lose correct technique over time, emphasizing the need for regular reassessment and reinforcement.[16]

A prospective study in hospitalized adults also identified poor inhaler technique and suboptimal adherence, highlighting the importance of routine assessment using validated tools such as inhaler checklists and the Test of Adherence to Inhalers (TAI).[17]

5. MEDICATION ADHERENCE IN ASTHMA AND COPD

5.1 Dimensions of Non-Adherence

Medication adherence in inhalation therapy encompasses three interrelated dimensions: initiation (filling the first prescription), implementation (taking doses as prescribed over time), and persistence (continuing therapy without discontinuation). Non-adherence may be unintentional, arising from forgetfulness, complexity of regimen, or

misunderstanding or intentional, driven by health beliefs, concerns about long-term corticosteroid use, cost considerations, or perceived lack of symptomatic benefit.[18]

5.2 The Test of Adherence to Inhalers (TAI)

The Test of Adherence to Inhalers (TAI) is a validated 12-item self-administered questionnaire designed to assess both patient-reported adherence behaviors and the underlying reasons for non-adherence in patients with asthma and COPD.

The TAI comprises two subscales: a 10-item patient-facing component addressing adherence behaviors and a 2-item clinician-facing component identifying adherence barriers.[6] A multicenter Spanish study using the TAI found that fewer than 40% of asthma and COPD outpatients demonstrated high adherence, with unwitting non-adherence, characterized by device misuse and misunderstanding of prescribed regimens-being the most prevalent pattern.[19]

5.3 Clinical Consequences of Non-Adherence

Suboptimal adherence to inhaled therapy is strongly associated with poor disease control, increased exacerbation frequency, preventable emergency department visits, accelerated lung function decline, and greater healthcare resource utilization. A systematic narrative review confirmed that non-adherence to ICS-containing inhaled regimens in both asthma and COPD is linked to significantly worse clinical and economic outcomes, reinforcing the imperative for routine adherence assessment in clinical practice.[20] The clinical profile of patients presenting to emergency departments for acute exacerbations includes disproportionately high rates of suboptimal inhaler technique and non-adherence, underscoring the bidirectional relationship between these modifiable factors and disease instability.[21]

6. PHARMACIST-LED INTERVENTIONS FOR INHALER OPTIMIZATION

6.1 Evidence Base for Clinical Pharmacy Interventions

Clinical pharmacists play an important role in improving inhaler use through counseling, education, and adherence monitoring. Studies conducted in Nepal and Africa demonstrated that pharmacist-led interventions significantly improved inhaler technique, medication adherence (TAI scores), and disease control outcomes, including ACT and CAT scores, among asthma and COPD patients.[8] Benefits were observed across both MDI and DPI users, supporting the effectiveness of structured pharmacist involvement.[25]

6.2 Structured Counseling and Demonstration Approaches

Educational interventions involving practical inhaler demonstrations and follow-up assessments have consistently improved inhaler technique and disease control. A Pakistani study reported significant improvements in inhaler technique, ACT scores, and CAT scores following a structured counseling program, regardless of patient educational level.[22] Similarly, a pharmacist-led pharmaceutical care program in China improved DPI technique and reduced exacerbation rates.[2]

6.3 Community Pharmacy and Outpatient Clinic Settings

Community pharmacists are well positioned to provide repeated inhaler education and adherence support. Studies have shown that pharmacist-led interventions in community and outpatient settings improve inhaler technique, medication use, symptom control, and healthcare outcomes.[3,7] A systematic review and meta-analysis further confirmed that pharmacist-led educational programs significantly enhance adherence and inhaler technique across diverse healthcare settings.[23] However, regular reinforcement is necessary to maintain long-term benefits.

7. PATIENT EDUCATION AND COUNSELING STRATEGIES

Effective inhaler education involves individualized instruction, device demonstration, patient return-demonstration, and regular follow-up. A systematic review identified device-specific training, use of demonstrator devices, and periodic reassessment as key factors for improving inhaler technique.[23] Video-based educational tools may further enhance technique retention.

An interventional study in India showed that structured training by pharmacists and nurses significantly reduced inhaler technique errors and improved disease control among asthma and COPD patients.[26] Commonly corrected errors included improper exhalation and inspiratory flow, highlighting the importance of practical, device-specific instruction.

Patient-centered counseling that addresses adherence barriers and incorporates reminder tools can further improve treatment outcomes. Pharmacist-led counseling programs have been associated with better patient satisfaction, self-management, and quality of life.[8]

8. REPEATED INHALER EDUCATION AND THE PHENOMENON OF TECHNIQUE DECAY

Inhaler technique decay refers to the gradual loss of correct inhaler use following initial training. Studies show that technique often deteriorates within weeks to months without ongoing reinforcement.[16] A prospective study in Korean COPD patients demonstrated that repeated inhaler education over six months reduced critical errors from 43.2% to 8.8% ($p < 0.001$) and improved adherence, quality of life, and inhaler satisfaction.[24] These findings indicate that repeated education is more effective than one-time counseling for maintaining inhaler proficiency.

A meta-analysis further confirmed that while education significantly reduces inhaler errors in MDI and DPI users, some critical errors persist and may reappear after training ends.[17] Therefore, routine inhaler technique assessment and reinforcement should be integrated into every respiratory care consultation.

9. THERAPEUTIC OUTCOMES AND DISEASE CONTROL

The primary objective of inhaler optimization is to improve clinical outcomes. Disease control is commonly assessed using validated instruments such as the Asthma Control Test (ACT) and the COPD Assessment Test (CAT).

Prospective studies consistently report significant improvements in ACT and CAT scores following pharmacist-led inhaler optimization programs.[8,22] Enhanced inhaler technique and improved adherence have also been associated with reductions in exacerbation frequency, emergency department visits, and hospital admissions.[25] These findings demonstrate that interventions targeting inhaler use can translate into meaningful clinical benefits beyond improvements in technical proficiency alone.

10. CLINICAL PHARMACY PRACTICE: INTEGRATION INTO RESPIRATORY CARE PATHWAYS

The available evidence strongly supports the integration of pharmacists into multidisciplinary respiratory care teams.

Pharmacists are uniquely positioned to assess inhaler technique, identify adherence barriers, provide individualized education, and monitor treatment outcomes.

An effective pharmacist-led inhaler optimization program should include inhaler technique assessment, adherence evaluation using validated tools such as the TAI, individualized counseling, device demonstration, educational materials, and regular follow-up.[8,22,25]

Collaborative care models involving physicians, pharmacists, and patients have demonstrated benefits in inhaler adherence, patient satisfaction, and disease control.[26] Such models facilitate comprehensive management of asthma and COPD and maximize the therapeutic effectiveness of inhaled medications.

11. CONCLUSION

Correct inhaler technique and sustained medication adherence are essential for effective asthma and COPD management. Despite advances in inhaler technology and treatment guidelines, inhaler misuse and non-adherence remain common and contribute significantly to poor disease control.

Evidence consistently demonstrates that pharmacist-led interventions, including inhaler technique training, adherence assessment, patient counseling, and repeated follow-up, significantly improve inhaler use and clinical outcomes.

Improvements have been observed across diverse healthcare settings and patient populations, highlighting the broad applicability of these interventions.

Routine inhaler technique assessment, regular adherence evaluation using validated tools such as the TAI, and integration of pharmacists into multidisciplinary respiratory care teams should become standard practice. Continued investment in pharmacist-led inhaler optimization programs has the potential to improve disease control, reduce healthcare utilization, and enhance quality of life for patients with asthma and COPD.

12. DISCUSSION

The findings of this review demonstrate that inhaler technique errors and poor medication adherence remain major barriers to optimal asthma and COPD management despite advances in inhaler technology. Studies consistently report that 70–90% of patients commit at least one critical inhaler error, leading to reduced drug delivery and poor disease control.[4]

Comparison between pMDIs and DPIs suggests that both devices present unique challenges; pMDIs require coordination between actuation and inhalation, whereas DPIs depend on adequate inspiratory flow. Although DPIs may show slightly better adherence, overall adherence remains suboptimal across both device types.[14]

Several studies reviewed demonstrated that pharmacist-led educational interventions significantly improve inhaler technique, medication adherence, and disease control. Interventional studies conducted in Nepal, Pakistan, and Nigeria reported significant improvements in TAI, ACT, and CAT scores following structured counseling and inhaler training programs.[8,25]

Repeated inhaler education was found to be more effective than single-session training due to the phenomenon of inhaler technique decay. A prospective Korean study showed that repeated education reduced critical inhaler errors from 43.2% to 8.8%, highlighting the importance of continuous reinforcement.[24]

Improved inhaler technique and adherence were consistently associated with better asthma and COPD control, fewer exacerbations, and reduced healthcare utilization.[8,25] These findings support the integration of pharmacists into multidisciplinary respiratory care teams to provide ongoing inhaler assessment, adherence monitoring, and patient education.[22]

Despite positive outcomes, most studies had relatively short follow-up periods, and variations in study design limit direct comparisons. Future research should focus on long-term outcomes, cost-effectiveness analyses, and the role of digital technologies such as smart inhalers in sustaining adherence and inhaler technique improvements.[20]

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