Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v6i6.1815
*Biol. Clin. Sci. Res. J., Volume 6(6), **2025**: 1815*
Original Research Article

Frequency of Errors in Inhaler Technique among Patients Using Metered-Dose Inhalers (MDIs) in a Tertiary Care Hospital

Aziz Ur Rehman[1], Shoaib Akhtar[2*]

[1]*Department of Pulmonology, Sheikh Zayed Hospital, Rahim Yar Khan, Pakistan*
[2]*Department of Medicine, Sheikh Zayed Hospital, Rahim Yar Khan, Pakistan*
**Corresponding author`s email address:* shoaib.akhtar161dr@gmail.com

(Received, 24th April 2025, Accepted 18th June 2025, Published 30th June 2025)

Abstract: *Proper use of metered-dose inhalers (MDIs) is essential for optimal drug delivery and management of respiratory conditions such as asthma and COPD. However, incorrect inhaler technique remains a common issue, particularly among patients who do not use spacer devices. Identifying and addressing these errors is crucial to ensure therapeutic efficacy.* ***Objective:*** *This study aims to assess the frequency of errors in inhaler technique among patients using metered-dose inhalers (MDIs) without spacer devices in a tertiary care hospital.* ***Methods:*** *This cross-sectional study was conducted at the Department of Pulmonology, Sheikh Zayed Hospital, Rahim Yar Khan, from November 30, 2020, to May 29, 2021. A total of 96 patients aged 15 to 65 years who used MDIs without spacers for more than three months were included. Patients with physical limitations, newly diagnosed cases, and those using spacers were excluded. Inhaler technique was assessed using a standardised checklist based on handling and inhalational errors, including steps such as shaking the inhaler, maintaining an upright posture, and proper breathing coordination.* ***Results:*** *The mean age of participants was 40.13 ± 7.77 years, with 59.4% males and 40.6% females. Errors in inhaler technique were observed in 39 (40.6%) patients. Handling errors were more common (22.9%) than inhalational errors (17.7%). Common errors included failure to exhale fully before inhalation (6.3%) and not holding breath for at least 10 seconds after inhalation (6.3%).* ***Conclusion:*** *The frequency of errors in inhaler technique among MDI users is high, emphasising the need for patient education and structured training programs to improve inhaler use and disease management outcomes.*

Keywords: Inhaler technique, metered-dose inhalers, errors, asthma, COPD

[***How to Cite:*** Rehman AU, Akhtar S. Frequency of errors in inhaler technique among patients using metered-dose inhalers (MDIs) in a tertiary care hospital. *Biol. Clin. Sci. Res. J.*, **2025;** 6(6): 49-52. doi: https://doi.org/10.54112/bcsrj.v6i6.1815

Introduction

Bronchial asthma is a chronic inflammatory disorder of the airways, characterised by the activation of mast cells, eosinophils, and T-lymphocytes, which orchestrate the release of a cascade of inflammatory mediators, including cytokines, chemokines, and leukotrienes. (1) This inflammatory process leads to airway hyperresponsiveness (AHR), reversible bronchial obstruction, and recurrent respiratory symptoms such as wheezing, dyspnea, chest tightness, and coughing, particularly at night or in the early morning. (2) Airway obstruction in bronchial asthma arises from multiple factors, including bronchoconstriction triggered by allergens or irritants, airway wall thickening due to oedema and vascular dilation, luminal narrowing from mucus plug accumulation, and structural remodelling involving fibrosis, smooth muscle hypertrophy, and angiogenesis, potentially leading to irreversible airflow restriction. (1-4)
COPD is a heterogeneous disorder characterised by chronic respiratory symptoms and persistent airflow obstruction. (5) The Global Initiative for Chronic Obstructive Lung Disease (GOLD) defines chronic obstructive pulmonary disease (COPD) as a preventable and treatable condition characterized by persistent respiratory symptoms and progressive airflow limitation attributable to structural abnormalities of the airways and/or alveoli, typically caused by prolonged exposure to noxious particles or gases, with tobacco smoke representing the predominant etiological agent. (6)
Bronchodilators, inhaled corticosteroids (ICS), and other anti-inflammatory agents remained the mainstay of treatment in both asthma and chronic obstructive pulmonary disease (COPD) for the management of symptoms as well as to slow down the disease progression. (7-9)
Despite the availability of various dosage forms, inhaled therapies are fundamental in treating obstructive lung diseases, which affect approximately 15% of the global population. Inhaled medications are among the most complex treatment modalities for patients with chronic respiratory conditions, as they require precise self-administration. Successful delivery of these therapies relies on the patient's ability to perform specific breathing techniques in coordination with the activation of the inhaler device. (10) A wide range of inhaler devices, each with distinct handling techniques to ensure optimal delivery, are utilised in the management of asthma and chronic obstructive pulmonary disease (COPD). Patients are often prescribed separate devices for reliever and maintenance therapies, which can result in confusion and improper use, potentially compromising treatment efficacy.
Pressurised metered-dose inhalers (MDIs), introduced in the 1950s, are widely used portable devices for treating pulmonary conditions. They consist of a drug formulation (dissolved or suspended) and hardware components, including a canister to hold the formulation, a metering valve for consistent dosing, an actuator mouthpiece to deliver the aerosol, and often a dose-counter to track remaining doses. For metered dose inhalers, various add-on devices have been developed that include the spacer, holding chambers, reverse flow devices, etc. Spacers are the MDI mouthpiece actuator extension. Large-volume spacers and holding chambers enable the actuation of metered-dose inhalers (MDIs) before inhalation, eliminating the need for patients to synchronise device activation with their breath. (11, 12) Training patients in proper inhaler technique under the guidance of a healthcare professional is a critical yet often underappreciated component of effective disease management. Despite its importance, inhaler misuse remains prevalent, with minimal evidence of improvement over time, highlighting a significant gap in patient care. Persistent errors in inhaler use are strongly correlated with suboptimal disease control and increased healthcare costs, worsening

symptoms, and increased exacerbations, underscoring the need for enhanced education and support in this area. (13-16)

Therefore, achieving optimal therapeutic outcomes relies heavily on the correct use of inhaler devices. This study aimed to assess inhaler techniques among patients with asthma and COPD to identify the frequency of prevalent errors in MDIs in a tertiary care setting.

Methodology

A cross-sectional study was conducted at the Department of Pulmonology, Sheikh Zayed Hospital, Rahim Yar Khan, from November 30, 2020, to May 29, 2021.

A sample size of 96 patients was calculated using a 95% confidence interval and a 10% margin of error. Sequential sampling was used to enrol patients aged 15 to 65 years who had been using MDIs without spacers for more than three months. Patients with physical limitations, newly diagnosed cases, and those using spacers were excluded.

Patients were assessed for inhaler technique errors, which were categorised into handling errors (e.g., shaking the inhaler, maintaining upright posture) and inhalational errors (e.g., breath coordination, holding breath after inhalation). Data were collected using a pre-designed proforma.

Data were analysed using SPSS. Frequencies and percentages were calculated for categorical variables, while mean and standard deviation were used for continuous variables. Stratification was done based on age, gender, duration of inhaler use, diagnosis, education, and income. A p-value of ≤0.05 was considered significant.

Results

The mean age of participants was 40.13 ± 7.77 years, with 59.4% males and 40.6% females. The majority (54.2%) were aged 15-40 years. The mean duration of inhaler use was 7.96 ± 2.89 months.

Errors in inhaler techniques were observed in 39 (40.6%) patients. Handling errors were more common (22.9%) than inhalational errors (17.7%). Common errors included failure to exhale fully before inhalation (6.3%) and not holding breath for at least 10 seconds after inhalation (6.3%).

No significant differences were found in error rates based on age, gender, duration of inhaler use, diagnosis, education, or income.

Table I: Distribution of patients according to Age (n=96)

Age (in years)	No. of Patients	%age
15-40	52	54.2
41-65	44	45.8
Total	96	100.0

Mean ± SD = 40.13 ± 7.77 years

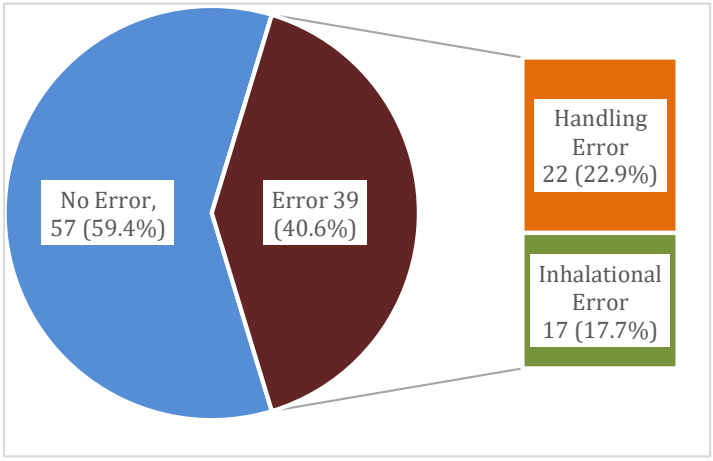

Figure I: Frequency of errors in inhaler technique in patients using MDIs (n=96)

Table II: Frequencies of types and subtypes of errors in inhaler technique in patients using MDIs (n=96)

Type of Error	Subtype of Error	Frequency & Percentage Out of Total Error
Handling Error 22 (22.9%)	Removing/Opening the cap	01 (1.0%)
	Shaking the device before actuation	03 (3.1%)
	Upright posture during inhalation	03 (3.1%)
	Holding the inhaler in an upright posture	04 (4.1%)
	Full exhalation before pressing the inhaler	06 (6.3%)
	Mouthpiece is tightly enclosed with the lips	05 (5.2%)
Inhalational Error 17 (17.7%)	Complete exhalation before inhalation	05 (5.2%)
	Holding breath for 10 seconds after inhalation	06 (6.3%)
	Taking deep & slow breathing	04 (4.1%)
	Breathing out with pursed lips	02 (2.1%)

Table III: Stratification of errors in inhaler technique concerning age, gender, duration of inhaler use, underlying diagnosis, educational status and monthly income

Variables		Yes (n=39)	No (n=57)	p-value
Age (years)	15-40	25 (64.1%)	27 (47.4%)	0.106
	41-65	14 (35.9%)	30 (52.6%)	
Gender	Male	21 (53.8%)	36 (63.2%)	0.362
	Female	18 (46.2%)	21 (36.8%)	
Duration (months)	≤6	11 (25.2%)	23 (40.4%)	0.222
	>6	28 (71.8%)	34 (59.6%)	
Diagnosis	Asthma	22 (56.4%)	43 (75.4%)	0.112
	COPD	14 (35.9%)	10 (17.6%)	
	Other	03 (7.7%)	04 (7.0%)	
Education	Uneducated	7 (18.0%)	16 (28.1%)	0.218
	Below matric	10 (25.6%)	19 (33.3%)	
	Matric & above	22 (56.4%)	22 (38.6%)	
Monthly income	<25000	08 (20.5%)	13 (22.8%)	0.699
	25000-50000	17 (43.6%)	20 (35.1%)	
	>50000	14 (35.9%)	24 (42.1%)	

Discussion

The study found a high rate of recurrence of errors in inhaler technique among MDI users, consistent with previous research. Poor inhaler technique compromises drug delivery, leading to suboptimal disease control and increased healthcare utilisation. Educational interventions are essential to improve inhaler techniques and patient outcomes. These findings highlight the need for regular assessment and reinforcement of proper inhaler use, particularly in resource-limited settings.

Conclusion

The frequency of errors in inhaler technique among MDI users is high, emphasising the need for systematic educational programs to improve inhaler use. Proper training can reduce morbidity, mortality, and healthcare costs associated with incorrect inhaler technique.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-SHZH-21)
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

AUR
Manuscript drafting, Study Design,
SA
Review of Literature, Data entry, Data analysis, and drafting articles.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

References

1. Umarova T, Kudratova Z, Maxmudova D, editors. Pathogenesis of bronchial asthma development at the present stage. International Conference on Modern Science and Scientific Studies; 2024.
2. Asher MI, Rutter CE, Bissell K, Chiang C-Y, El Sony A, Ellwood E, et al. Worldwide trends in the burden of asthma symptoms in school-aged children: Global Asthma Network Phase I cross-sectional study. The Lancet. 2021;398(10311):1569-80.
3. Kheradmand A, Tabeie F, Seif P, Rezaei O, Yasamy MT. Effect of low-level laser therapy (LLLT) on cognitive impairment among patients with chronic schizophrenia: a double-blind randomised placebo-controlled clinical trial. Lasers in Medical Science. 2022;37(6):2717-25.
4. Bereda G. Bronchial asthma: aetiology, pathophysiology, diagnosis and management. Austin J Pulm Respir Med. 2022;9(1):1085.
5. Sandelowsky H, Weinreich UM, Aarli BB, Sundh J, Høines K, Stratelis G, et al. COPD–do the right thing. BMC family practice. 2021;22(1):244.
6. Gutiérrez Villegas C, Paz-Zulueta M, Herrero-Montes M, Parás-Bravo P, Madrazo Pérez M. Cost analysis of chronic obstructive pulmonary disease (COPD): a systematic review. Health Economics Review. 2021;11:1-12.
7. Cazzola M. Current opinion: Pharmacological approaches in asthma and COPD. Breathe. 2009;6(1):24-35.
8. Almeshari MA, Alobaidi NY, Sapey E, Usmani O, Stockley RA, Stockley JA. Small airways response to bronchodilators in adults with asthma or COPD: a systematic review. International journal of chronic obstructive pulmonary disease. 2021:3065-82.
9. Miller-Larsson A, Selroos O. Advances in Asthma and COPD Treatment: Combination Therapy with Inhaled Corticosteroids and Long-Acting β2-Agonists. Current pharmaceutical design. 2006;12(25):3261-79.
10. Chan AH, Pleasants RA, Dhand R, Tilley SL, Schworer SA, Costello RW, et al. Digital inhalers for asthma or chronic obstructive pulmonary disease: a scientific perspective. Pulmonary Therapy. 2021;7(2):345-76.

11. Behl D, Naved T, Kalonia H, Babbar M. Development of smart metered-dose inhalers for self-medication purposes (Drug-Device-Software). Journal of Pharmaceutical Negative Results. 2022;13(6):2826-41.
12. Volerman A, Balachandran U, Siros M, Akel M, Press VG. Mask use with spacers/valved holding chambers and metered dose inhalers among children with asthma. Annals of the American Thoracic Society. 2021;18(1):17-22.
13. Monteiro C, Maricoto T, Prazeres F, Simões PA, Simões JA. Determining factors associated with inhaled therapy adherence on asthma and COPD: A systematic review and meta-analysis of the global literature. Respiratory Medicine. 2022;191:106724.
14. Liang Y, Mak JC. Inhaled therapies for asthma and chronic obstructive pulmonary disease. Current Pharmaceutical Design. 2021;27(12):1469-81.
15. Usmani OS, Hickey AJ, Guranlioglu D, Rawson K, Stjepanovic N, Siddiqui S, et al. The impact of inhaler device regimen in patients with asthma or COPD. The Journal of Allergy and Clinical Immunology: In Practice. 2021;9(8):3033-40. e1.
16. Usmani OS, Levy ML. Effective respiratory management of asthma and COPD and the environmental impacts of inhalers. NPJ Primary Care Respiratory Medicine. 2023;33(1):24.