

RESEARCH PAPER

Knowledge and Attitude Towards Inhaler Use Among Patients with Chronic Obstructive Pulmonary Disease: A Cross-sectional Study from a Tertiary Care Centre in Rural Karnataka

Bommeri Nandakishore¹, Vijayalakshmi³, Deepu C C², Shrilakshmi N¹, Yalamanchili Vaishnavi¹

¹Postgraduate, Department of Respiratory Medicine, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B.G. Nagara, Karnataka, India.

²Professor and Head, Department of Respiratory Medicine, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B.G. Nagara, Karnataka, India.

³Assistant Professor, Department of Respiratory Medicine, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B.G. Nagara, Karnataka, India.

Corresponding Author:

Dr Bommeri Nandakishore, Department of Respiratory Medicine, Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, Karnataka, India.

E-mail: bommeri.nandakishore@gmail.com.

ABSTRACT

Introduction: Inhaled therapy remains central to COPD care, yet its benefit depends not only on prescription but on the patient's ability and willingness to use the device correctly. In routine practice, that link often fails. This study assessed knowledge, attitude, and observed inhaler technique among patients with COPD, and examined the factors associated with correct use. **Material and methods:** A hospital-based cross-sectional study was conducted in the Department of Respiratory Medicine at a tertiary care teaching hospital in rural Karnataka from July to September 2025. A total of 206 consecutive clinically stable COPD patients aged 40 years and above who were using inhaler therapy were included. Knowledge was assessed using a 10-item questionnaire, attitude using an 8-item scale, and inhaler technique by direct observation with a standardised 8-step device-specific checklist. Chi-square test and independent samples t-test were used for inferential analysis, with $p < 0.05$ considered statistically significant. **Results:** The mean age of the participants was 61.23 ± 8.17 years. Males constituted 67.0% and rural residents 61.2% of the cohort. Moderate or good knowledge was seen in 90.7% of patients, with a mean knowledge score of 6.94/10, yet 81.6% demonstrated incorrect inhaler technique and the mean technique score was only 4.11/8. The most frequent critical lapses were failure to exhale fully before inhalation (70.9%) and inadequate breath-holding after inhalation (66.0%). Educational status was significantly associated with knowledge grade and technique performance ($p < 0.001$ for both). Prior inhaler training by a healthcare professional was associated with better technique ($p = 0.002$), whereas mean knowledge score itself was not associated with correct technique ($p = 0.395$). Urban residence showed a significant association with more favourable attitude profiles ($p = 0.021$). **Conclusion:** A clear knowledge-practice gap exists in inhaler use among COPD patients in this rural tertiary care setting. Correct technique cannot be assumed even when patients appear to know the basics. Structured, repeated, device-specific demonstrations and periodic reassessment during routine visits are likely to be more useful than one-time verbal instruction alone.

Keywords: COPD, inhaler technique, patient education, health literacy, rural health, dry powder inhaler, pressurised metered-dose inhaler

How to cite this article: Nandakishore B, Vijayalakshmi, Deepu CC, Shrilakshmi N, Vaishnavi Y. Knowledge and Attitude Towards Inhaler Use Among Patients with Chronic Obstructive Pulmonary Disease: A Cross-sectional Study from a Tertiary Care Centre in Rural Karnataka. *Int J Drug Deliv Technol.* 2026;16(58s): 738-745. DOI: 10.25258/ijddt.16.58s.79

INTRODUCTION

Chronic obstructive pulmonary disease is a common, preventable, and treatable respiratory disorder marked by persistent airflow limitation and chronic respiratory symptoms. Current GOLD guidance continues to place inhaled bronchodilator-based therapy at the centre of long-term management because it delivers medication directly to the airways while limiting systemic exposure [1]. COPD

also remains a major public health problem. The World Health Organization estimated that it caused 3.5 million deaths in 2021 and continues to affect low- and middle-income countries disproportionately [2]. In India, the burden is especially heavy, shaped by smoking, biomass fuel exposure, occupational dust, and ambient air pollution, with wide variation across states and a substantial share of the global chronic respiratory disease burden [3,4].

Even so, the success of inhaled treatment is never guaranteed at the moment of prescription. It depends on three linked steps: the patient must understand the role of the inhaler, accept the device as part of daily care, and execute the technique correctly every time. When any one of these steps fails, effective drug delivery falls away. Studies across different COPD populations have repeatedly shown that inhaler misuse is common. Pothirat et al. reported incorrect use in nearly three-quarters of patients, while Jang et al. showed that critical handling errors remain frequent and are strongly linked to lower educational attainment and other patient-level vulnerabilities [5,6]. More recent synthesis has strengthened that concern, showing that inhaler errors are associated with worse clinical outcomes in COPD, including poorer symptom control and greater exacerbation burden [7].

The problem is not purely mechanical. Device choice, age, dexterity, inspiratory flow, comprehension, and confidence all influence how well a patient uses an inhaler in real life [8]. Meta-analytic work focused on inhaler errors has shown that several mistakes occur repeatedly across devices, particularly with metered-dose inhalers [9]. Older patients, those with limited formal education, and those who receive rushed counselling in busy clinics are especially likely to struggle. That matters in rural Indian settings, where literacy barriers, language mismatch, social beliefs about inhalers, and irregular reinforcement during follow-up can all weaken adherence and technique.

A patient may know that the inhaler is important yet still mistrust it, fear dependence on it, or stop using it once symptoms settle. Those attitudes are clinically relevant. Poor technique and negative perceptions together can quietly reduce the value of otherwise appropriate therapy. This study was therefore undertaken to examine knowledge, attitude, and actual inhaler technique among patients with COPD attending a tertiary care teaching hospital in rural Karnataka, and to identify the factors associated with correct device use.

MATERIALS AND METHODS

Study design and setting: This was a hospital-based cross-sectional study carried out in the Department of Respiratory Medicine, Adichunchanagiri Hospital and Research Centre, B.G. Nagara, Karnataka, over a 3-month period from July 2025 to September 2025.

Study population: Patients aged 40 years and above with a diagnosis of COPD who were currently using any inhaler device and who provided written informed consent were enrolled consecutively. Both outpatients and inpatients were eligible.

Inclusion criteria: Clinically stable patients with COPD aged 40 years or older, currently prescribed inhaler therapy, and willing to participate were included.

Exclusion criteria: Patients with acute exacerbation at the time of assessment, significant cognitive or psychiatric impairment interfering with comprehension or consent, visual or neuromuscular deficits affecting independent

inhaler use, and those who declined participation were excluded.

Sample size: The target sample size was 206. This was based on an anticipated prevalence of incorrect inhaler use of 50%, 95% confidence level, 7% absolute precision, and an additional 5% allowance for non-response.

Data collection: Eligible participants were interviewed using a pre-designed, pre-tested structured questionnaire. Demographic variables included age, sex, residence, education, and socioeconomic status. Clinical details included smoking history, smoking intensity, disease duration, GOLD stage, and history of previous inhaler training.

Knowledge assessment: Knowledge regarding inhaler use was assessed using 10 items covering disease indication, dosing frequency, device handling, timing of use, cleaning, and related practical aspects. Each correct response scored 1 point. Total scores were categorised as poor (0-4), moderate (5-7), or good (8-10).

Attitude assessment: Attitude towards inhaler use was assessed using 8 items exploring perceived effectiveness, fear of addiction, embarrassment in public use, preference for oral medication, confidence in self-use, and willingness for periodic review. Total scores were categorised as negative (0-3), neutral/mixed (4-6), or positive (7-8).

Observed inhaler technique: After the interview, participants demonstrated their usual inhaler technique. Performance was assessed directly using a standardised 8-step device-specific checklist. A score of 6 or more correct steps was considered correct technique, while a score below 6 was considered incorrect.

Statistical analysis: Data were entered in Microsoft Excel and analysed using SPSS software. Descriptive statistics were expressed as mean, standard deviation, frequency, and percentage. Pearson chi-square test was used for associations between categorical variables, and independent samples t-test was applied for comparison of mean values. A p-value of less than 0.05 was considered statistically significant.

Ethics approval: Institutional Ethics Committee approval was obtained before study initiation (IEC reference number: _____). Written informed consent was obtained from all participants.

RESULTS

A total of 206 patients with COPD were included in the analysis. The mean age was 61.23±8.17 years. The largest age band was 60-69 years (39.8%), followed by 50-59 years (35.0%). Men constituted 67.0% of the sample, and 61.2% were from rural areas. Educational attainment was generally low, with 37.4% of participants being illiterate and another 30.6% educated only up to primary level (Table 1). The age profile of the study population is shown in Figure 1.

Clinically, 42.7% were current smokers and the mean smoking intensity among smokers was 24.03 pack-years. The mean duration of COPD was 7.47±3.79 years. Most participants belonged to GOLD stage II or III. Prior inhaler

training had been received by 68.9% of patients, most often from a doctor (Table 2).

The mean knowledge score was 6.94 ± 1.52 out of 10. Good knowledge was observed in 38.8% of participants, moderate knowledge in 51.9%, and poor knowledge in 9.2%. Thus, 90.7% had at least moderate theoretical knowledge regarding inhaler use. The distribution of knowledge grades is presented in Figure 2.

Attitude scores were less strongly favourable. Most patients fell into the neutral or mixed attitude category (80.1%), while only 16.0% showed a clearly positive attitude and 3.9% had negative attitudes (Figure 3). Although many participants believed inhalers were effective, misconceptions persisted. More than one-third considered inhalers potentially addictive, and 40.3% said they would prefer oral medication if given a choice.

Observed practice revealed a far more concerning picture. A total of 168 patients (81.6%) demonstrated incorrect inhaler technique, despite the generally moderate-to-good knowledge profile. The most frequent critical steps missed

were full exhalation before inhalation and adequate breath-holding after inhalation. Figure 4 summarises these key performance gaps alongside knowledge and training indicators. A concise overview of knowledge, attitude, and technique findings is shown in Table 3.

Inferential analysis showed that educational status had a significant association with both knowledge grade and inhaler technique ($p < 0.001$ for each). Prior formal training was significantly associated with better technique performance ($p = 0.002$). Urban residence was associated with a more favourable attitude profile ($p = 0.021$). However, mean knowledge score did not differ significantly between participants with correct and incorrect inhaler technique ($p = 0.395$), underscoring the disconnect between what patients know and what they actually do. Likewise, age and disease duration were not significantly associated with correct technique (Table 4).

Table 1. Socio-demographic profile of the study population (n=206)

Variable	n	%
Age, mean±SD (years)	61.23±8.17	
40-49 years	17	8.3
50-59 years	72	35.0
60-69 years	82	39.8
70-79 years	33	16.0
80-89 years	2	1.0
Male sex	138	67.0
Female sex	68	33.0
Rural residence	126	61.2
Urban residence	80	38.8
Illiterate	77	37.4
Primary education	63	30.6
Secondary education	38	18.4
Higher secondary and above	28	13.6

Table 2. Clinical characteristics and inhaler training history (n=206)

Parameter	n / value	%
Current smoker	88	42.7
Former smoker	37	18.0
Never smoked	81	39.3
Smoking intensity (pack-years), mean	24.03	-
Duration of COPD (years), mean±SD	7.47±3.79	-
GOLD stage I	24	11.7
GOLD stage II	79	38.3
GOLD stage III	81	39.3
GOLD stage IV	22	10.7
Received prior inhaler training	142	68.9
No prior inhaler training	64	31.1

Table 3. Knowledge, attitude, and observed inhaler technique summary (n=206)

Indicator	n / value	%
Knowledge score, mean±SD	6.94±1.52	

Knowledge and Attitude Towards Inhaler Use Among Patients with Chronic Obstructive Pulmonary Disease

Poor knowledge (0-4)	19	9.2
Moderate knowledge (5-7)	107	51.9
Good knowledge (8-10)	80	38.8
Attitude category: Negative	8	3.9
Attitude category: Neutral/mixed	165	80.1
Attitude category: Positive	33	16.0
Incorrect inhaler technique	168	81.6
Correct inhaler technique	38	18.4
Failure to exhale fully before inhalation	146	70.9
Inadequate breath-holding after inhalation	136	66.0
Aware of dosing frequency	158	76.7
Knew device name	136	66.0
Knew need to shake pMDI before use	135	65.5
Believed inhalers are effective	185	89.8
Believed inhalers may be addictive	76	36.9
Preferred oral medication if given a choice	83	40.3
Wanted regular training/review	186	90.3

Table 4. Inferential analysis of factors associated with study outcomes

Comparison	Test	p-value
Educational status vs knowledge grade	Chi-square	<0.001
Educational status vs inhaler technique	Chi-square	<0.001
Training history vs inhaler technique	Chi-square	0.002
Residence vs attitude grade	Chi-square	0.021
Training source vs knowledge grade	Chi-square	0.012
Mean knowledge score vs correct/incorrect technique	Independent t-test	0.395
Mean age vs correct/incorrect technique	Independent t-test	0.062
Mean COPD duration vs correct/incorrect technique	Independent t-test	0.072

Values are presented exactly as reported in the study analysis. A p-value <0.05 was considered statistically significant.

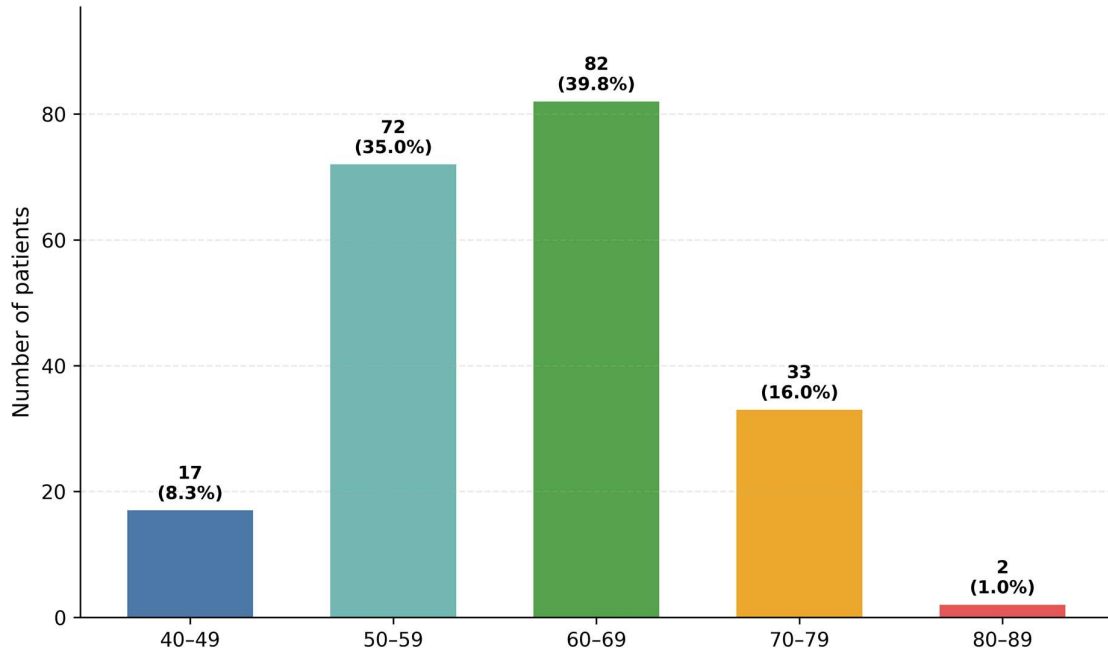


Figure 1. Age-group distribution of the study population.

Italic note: Bars represent patient counts, and the corresponding percentages are shown above each bar.

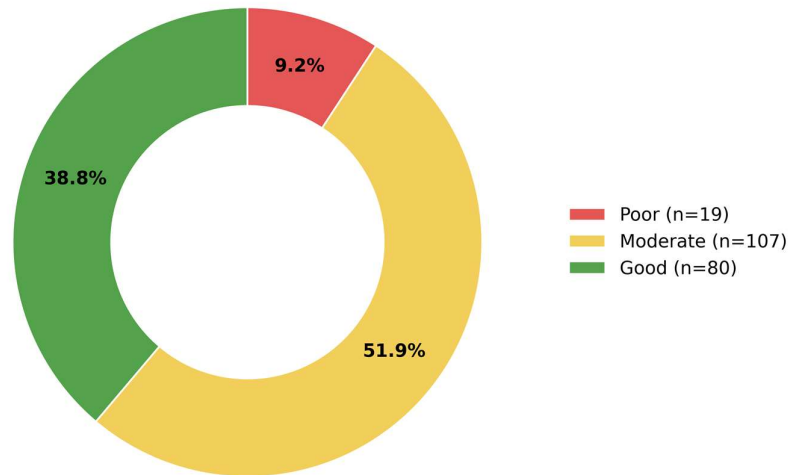


Figure 2. Distribution of knowledge grades regarding inhaler use.

Italic note: Donut chart shows the proportion of patients with poor, moderate, and good knowledge scores.

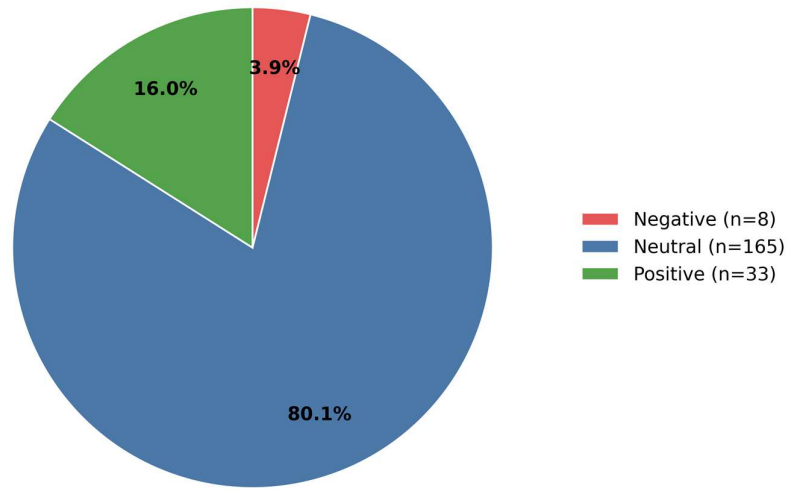


Figure 3. Attitude profile towards inhaler use among study participants.

Italic note: Pie chart displays the distribution of negative, neutral/mixed, and positive attitude categories.

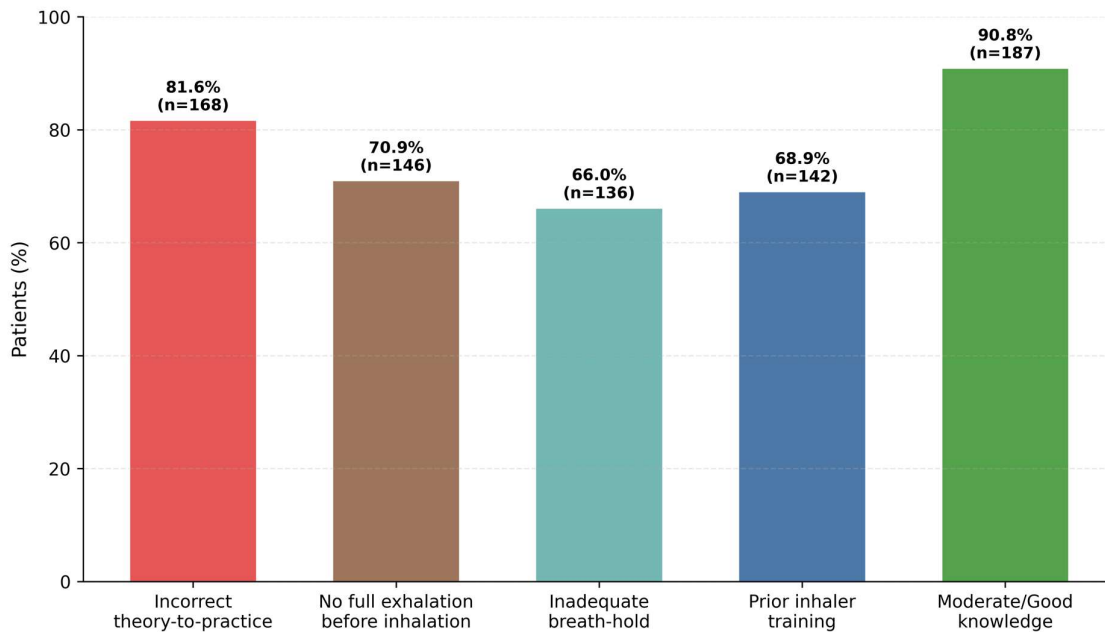


Figure 4. Key inhaler-use findings in the study cohort.

Italic note: Bars show selected performance gaps and contextual indicators, highlighting the marked discordance between theoretical knowledge and observed technique.

DISCUSSION

This study brings out a striking contradiction. Most participants had at least moderate theoretical knowledge regarding inhaler use, yet more than four-fifths failed to demonstrate correct technique. That gap is clinically important because inhaled therapy works only when the drug actually reaches the lower airways in an effective

manner. In other words, knowledge on paper does not necessarily translate into competent performance in the clinic.

The overall prevalence of incorrect technique in this series was higher than that reported in some earlier COPD cohorts, although it remains directionally consistent with prior work that has shown inhaler misuse to be common and persistent [10,11]. Our most frequent errors, failure to exhale fully before inhalation and inadequate breath-holding afterward, are not trivial mistakes. Both directly reduce the efficiency of aerosol deposition. Similar high-frequency step-specific errors have been described in

device evaluation studies, including work on soft mist inhalers and broader analyses of inhaler handling in COPD [12,13].

Educational attainment emerged as the strongest determinant of both knowledge grade and correct technique. That finding is unsurprising, but it deserves emphasis in the Indian setting. Written instructions, quick verbal counselling, and device leaflets often assume levels of health literacy that many patients do not possess. In this cohort, more than two-thirds of participants were either illiterate or educated only up to primary school. For such patients, demonstration, repetition, visual reinforcement, and return-demonstration are likely to matter much more than one-time explanation.

Another important observation was that prior training improved technique, but did not eliminate errors. Nearly seven out of ten participants reported having received earlier instruction, yet incorrect technique still remained overwhelmingly common. This suggests that the problem is not merely whether teaching occurred, but how it occurred, who delivered it, and whether it was reinforced over time. Pharmacist-led and structured training models have shown benefit in improving inhaler performance and related outcomes, and trials of more focused educational approaches continue to support repeated technique review rather than isolated teaching episodes [14,15].

The lack of a significant association between mean knowledge score and actual technique is perhaps the most revealing finding in the study. Patients may remember the reason for an inhaler, the number of times it should be used, or even some of the steps, yet still fail at the moment of execution. That distinction between declarative knowledge and procedural competence explains why simple counselling often underperforms. It also explains why direct observation should remain part of follow-up in COPD clinics.

Attitudinal findings add another layer. Only a small fraction of participants expressed strongly negative attitudes, but clearly positive attitudes were also uncommon. Misconceptions persisted, particularly around addiction and preference for oral drugs. These beliefs may not always produce open refusal, but they can weaken adherence quietly. Reviews on inhaler selection and patient-centred device choice have repeatedly argued that technique, confidence, preference, and usability must be addressed together, not in isolation [8,16].

The present study has limitations. It was conducted at a single tertiary care centre, and the findings may not represent all COPD populations. The cross-sectional design also limits causal interpretation. Some factors, such as prior training and attitude, were based on patient response and may have been influenced by recall or social desirability. In addition, device-wise subgroup analysis could not be expanded beyond the available dataset. Even so, the pattern observed here is coherent and clinically useful.

In practical terms, the message is simple. Inhaler counselling in COPD cannot stop at prescription. It needs structured demonstration, patient return-demonstration,

repetition at follow-up, and rechecking whenever symptoms remain poorly controlled despite treatment. In low-literacy settings, locally understandable visual education and hands-on teaching may make a greater difference than printed instructions alone.

CONCLUSION

COPD patients in this rural tertiary care setting showed a substantial disconnect between what they appeared to know about inhalers and how they actually used them. Educational status and formal inhaler training influenced performance, but even trained patients frequently made critical errors. Routine, device-specific, repeated demonstration with direct observation should therefore become a standard part of COPD follow-up, particularly for individuals with limited literacy or persistent symptoms.

Source of Funding: Nil.

Conflict of Interest: None declared.

REFERENCES

1. Global Initiative for Chronic Obstructive Lung Disease. Global strategy for prevention, diagnosis and management of COPD: 2025 report. GOLD; 2025.
2. World Health Organization. Chronic obstructive pulmonary disease (COPD) [Internet]. Geneva: WHO; 2024 [cited 2026 Apr 2].
3. India State-Level Disease Burden Initiative CRD Collaborators. The burden of chronic respiratory diseases and their heterogeneity across the states of India: the Global Burden of Disease Study 1990-2016. *Lancet Glob Health*. 2018;6(12):e1363-e1374.
4. Verma A, Gudi N, Yadav UN, Roy MP, Mahmood A, Nagaraja R, et al. Prevalence of COPD among population above 30 years in India: a systematic review and meta-analysis. *J Glob Health*. 2021;11:04038.
5. Pothirat C, Chaiwong W, Phetsuk N, Pisalthanapuna S, Chetsadaphan N, Choomuang W. Evaluating inhaler use technique in COPD patients. *Int J Chron Obstruct Pulmon Dis*. 2015;10:1291-1298.
6. Jang JG, Chung JH, Shin KC, Jin HJ, Lee KH, Ahn JH. Comparative study of inhaler device handling technique and risk factors for critical inhaler errors in Korean COPD patients. *Int J Chron Obstruct Pulmon Dis*. 2021;16:1051-1059.
7. Halpin DMG, Mahler DA. Systematic review of the effects of patient errors using inhaled delivery systems on clinical outcomes in COPD. *BMJ Open Respir Res*. 2024;11(1):e002211.
8. Usmani OS. Choosing the right inhaler for your asthma or COPD patient. *Ther Clin Risk Manag*. 2019;15:461-472.
9. Cho-Reyes S, Celli BR, Dembek C, Yeh K, Navaie M. Inhalation technique errors with metered-dose inhalers among patients with obstructive lung diseases: a systematic review and meta-analysis of U.S. studies. *Chronic Obstr Pulm Dis*. 2019;6(3):267-280.
10. Maricoto T, Correia-de-Sousa J, Taborda-Barata L, Teixeira L, Gama JMR. Inhaler technique education in elderly patients with asthma or COPD: impact on disease

- exacerbations-a systematic review and meta-analysis. *Expert Rev Respir Med.* 2019;13(1):89-98.
11. Kebede AT, Trapnes E, Lea M, Abrahamsen B, Mathiesen L. Effect of pharmacist-led inhaler technique assessment service on readmissions in hospitalized COPD patients: a randomized, controlled pilot study. *BMC Pulm Med.* 2022;22(1):210.
12. Vázquez-González N, Leiva-Fernández J, Cotta-Luque VM, Leiva-Fernández F, Rius-Díaz F, Martos-Crespo F, et al. Effectiveness of an educational intervention about inhalation technique in healthcare professionals in primary care: a cluster randomized trial. *Front Pharmacol.* 2023;14:1266095.
13. Zhang W, Xu L, Gao S, Ding N, Shu P, Wang Z, et al. Technical evaluation of soft mist inhaler use in patients with chronic obstructive pulmonary disease: a cross-sectional study. *Int J Chron Obstruct Pulmon Dis.* 2020;15:1471-1479.
14. Ahn JH, Chung JH, Shin KC, Jin HJ, Lee KH, Ahn JH. Critical inhaler handling error is an independent risk factor for frequent exacerbations of chronic obstructive pulmonary disease: interim results of a single center prospective study. *Int J Chron Obstruct Pulmon Dis.* 2019;14:2767-2775.
15. Schreiber J, Sonnenburg T, Luecke E. Inhaler devices in asthma and COPD patients-a prospective cross-sectional study on inhaler preferences and error rates. *BMC Pulm Med.* 2020;20:222.
16. Cataldo D, Hanon S, Peché RV, Schuermans DJ, Degryse JM, De Wulf IA, et al. How to choose the right inhaler using a patient-centric approach? *Adv Ther.* 2022;39(3):1149-1163.