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| Internal Medicine |

Evaluation of Knowledge and Skills of Postgraduate Medical Students and Healthcare Assistants in Managing Asthma Using Metered-Dose Inhalers

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| Abstract | Original Research Article |

Background: Asthma remains a significant global health concern, with its rising prevalence particularly challenging in low- and middle-income countries due to factors such as pollution, urbanization, and inadequate healthcare infrastructure. The purpose of this study was to evaluate the knowledge and skills of postgraduate medical students and healthcare assistants in managing asthma using metered-dose inhalers, with the goal of identifying gaps to inform targeted training and educational interventions. ***Aim of the study:*** The aim of the study was to assess the knowledge and skills of postgraduate medical students and healthcare assistants in managing asthma using metered-dose inhalers. ***Methods:*** This cross-sectional observational study in the Department of Internal Medicine at Bangabandhu Sheikh Mujib Medical University (BSMMU) Hospital, Dhaka, was conducted from July to December 2015, involving 200 postgraduate medical students & health-assistants (nurses, ward-boys, pharmacists, drug dispensers). Data were collected through structured interviews and observations, analyzed using SPSS version 17.0, and Chi-square tests, with a significance threshold of $p < 0.05$. Ethical approval and informed consent were obtained. ***Results:*** In a study of 200 postgraduate medical students & health- assistants, with a mean age of 30.8 years, 57.4% were male, and 50% were postgraduate medical students 25% were nurses, 15% were ward-boys, 5% were pharmacist & 5% were drug dispensers. All counseled-on inhaler use, but only 71.8% recommended medications. Most performed initial inhaler steps well, but adherence to final steps was inconsistent. Post gradual medical students generally outperformed nurses & other health-assistants, except in "Breathe out slowly and completely" and "Hold breath for 10-15 seconds" and the nurses out-perform the pharmacist. ***Conclusion:*** Postgraduate medical students display varied proficiency in metered-dose inhaler techniques, with final steps showing significant gaps, most are almost perfects of MD respiratory medicine students compared to other subspecialities underscoring the need for targeted training to enhance asthma management. But targeted training is vital for drug dispenser and pharmacist.
Keywords: Asthma, Inhaler Technique, Postgraduate Medical Students, Healthcare Assistants, Metered-Dose Inhalers.

INTRODUCTION

Asthma is a significant global health concern, affecting approximately 339 million people worldwide [1]. Inhaled medications play a central role in managing asthma, with devices such as metered-dose inhalers (MDIs) being commonly used to deliver medications efficiently and reduce systemic side effects [2]. The prevalence of chronic lung diseases, including asthma, is rising globally, with 300 million people affected by asthma [1] and 210 million by chronic obstructive pulmonary disease (COPD) [3-5]. Despite advances in treatment, asthma remains a leading cause of morbidity, especially in low- and middle-income countries, where 90% of asthma-related deaths occur [6]. The Global

Initiative for Asthma (GINA) forecasts that asthma will continue to pose a significant global healthcare burden, with an additional 100 million people expected to suffer from asthma by 2025, driven by urbanization and pollution [7].

In regions like South Africa, India, and Bangladesh, asthma poses particularly severe challenges. In South Africa, over 3.9 million people are affected, with the death rate among 5-35-year-olds being the fourth highest in the world [8]. Similarly, in India, an estimated 15-20 million individuals suffer from asthma, with a prevalence of 10-15% in children aged 5-11 years [9, 10]. Bangladesh, like other low- and middle-income countries, faces a growing burden of asthma due to rapid

urbanization, increasing pollution, and limited access to quality healthcare services. Although comprehensive national data is limited, the prevalence of asthma in urban areas of Bangladesh is believed to be rising, exacerbated by poor adherence to inhalation therapies and inadequate patient education. These challenges highlight the critical need for targeted interventions and education programs to enhance asthma management, especially in resource-constrained settings.

Inhaled medications are a cornerstone in managing asthma, offering localized drug delivery with minimal systemic side effects [11]. Among the various delivery devices, pressurized metered-dose inhalers (MDIs) and dry powder inhalers (DPIs) are widely utilized, providing substantial benefits when used correctly [12]. However, improper inhaler techniques remain a widespread issue globally, affecting both patients and healthcare providers [13]. Poor inhaler use has been linked to reduced drug efficacy, uncontrolled symptoms, frequent hospital visits, and increased systemic medication use. Contributing factors include inadequate patient education, low adherence, insufficient training for healthcare workers, and the technical challenges of using MDIs, which require precise coordination between device handling and inhalation [14]. Alarmingly, studies reveal low proficiency in inhaler techniques among both patients and healthcare providers, with only a small percentage demonstrating correct usage [15]. This inadequacy extends to pharmacists, physicians, and postgraduate trainees, emphasizing the critical need for regular training and counseling to improve inhaler use and ensure effective disease management [16, 17].

Despite advancements in asthma management, poor inhaler technique continues to hinder effective disease control and improved patient outcomes. Educational interventions, such as demonstrations by healthcare workers and pharmacist-led programs, have shown potential in enhancing inhaler techniques. However, many healthcare professionals themselves lack the knowledge and skills necessary to use or teach proper inhaler techniques, limiting their ability to educate patients effectively. Additionally, socio-cultural factors, literacy levels, device preferences, and sensory perceptions significantly influence patient adherence and satisfaction [18]. Research underscores the pressing need for regular training and awareness programs for healthcare providers to improve their proficiency in inhaler use. Complementing this, patient-centered strategies, including routine re-education, personalized counseling, and the introduction of simpler inhalation devices, can address barriers to proper inhaler use and foster better therapeutic outcomes for asthma patients. The purpose of the study was to evaluate the knowledge and skills of postgraduate medical students and healthcare assistants in managing asthma using metered-dose inhalers.

Objective

- The aim of the study was to assess the knowledge and skills of postgraduate medical students and healthcare assistants in managing asthma using metered-dose inhalers.

METHODOLOGY & MATERIALS

This cross-sectional, observational study was conducted in the Department of Internal Medicine at Bangabandhu Sheikh Mujib Medical University (BSMMU) Hospital, Dhaka, over a six-month period from July to December 2015. A total of 200 healthcare providers, including both doctors and nurses, were purposively recruited based on predefined inclusion and exclusion criteria.

Inclusion Criteria:

- Post graduate medical students of any gender working at BSMMU Hospital.
- Healthcare providers (Nurses, word-boys, pharmacist, drug dispensers) of any age & sex actively involved in prescribing or demonstrating metered-dose inhaler (MDI) techniques to asthma patients.

Exclusion Criteria:

- Healthcare providers who declined to participate in the study.

Participants were briefed about the study objectives and procedures before providing informed consent, ensuring their voluntary participation and maintaining confidentiality. They were also allowed to withdraw at any point without repercussions. Ethical approval for the study was obtained from the Ethical Review Committee of Bangabandhu Sheikh Mujib Medical University, Dhaka, in accordance with the principles outlined in the Helsinki Declaration. Data collection involved structured interviews and direct observation of participants performing the nine-step MDI technique, evaluated using a validated checklist. Information regarding demographic characteristics and participants' performance in executing the MDI steps was systematically recorded. The collected data underwent cleaning and coding prior to analysis using SPSS software, version 17.0. Descriptive statistics were employed to summarize demographic and performance data. Additionally, the Chi-square (χ^2) test was utilized to assess associations between categorical variables, with a significance threshold set at $p < 0.05$.

RESULTS

Table 1: Distribution of Respondents by Age, Gender, and Professional Identity (n = 200)

| Variables			Frequency	Percentage
Age (years)		< 30	130	65
		30 – 40	45	22.25
		40 – 50	20	10
		≥ 50	5	2.5
		Mean age (years)	30.8 ± 6.3	
		Range (years)	22 – 51	
Gender		Male	126	57.4
		Female	94	42.6
Professional identity	**Post- graduate medical students**	MD medicine students	50	25
		MD Respiratory students	25	12.5
		MD Cardiology students	15	7.50
		Others post graduate students	05	2.50
	Health assistants	Nurses	50	25
		Ward boys	30	15
		Pharmacists	10	05
		Drug dispenser	10	05

Professional identities distribution
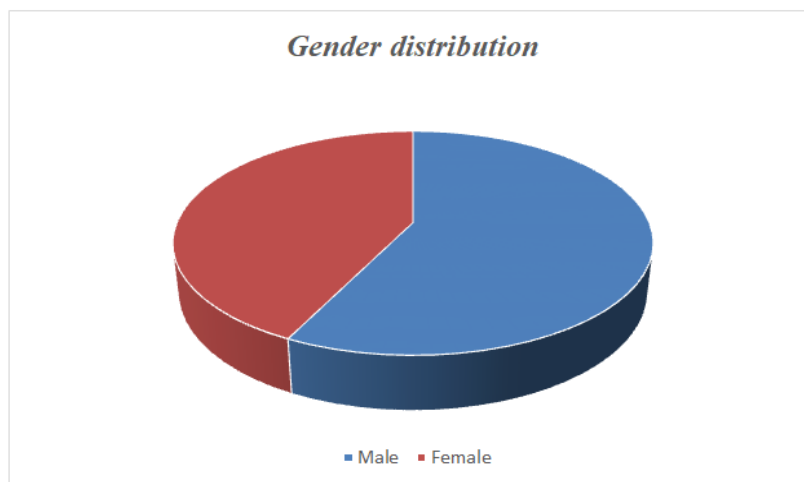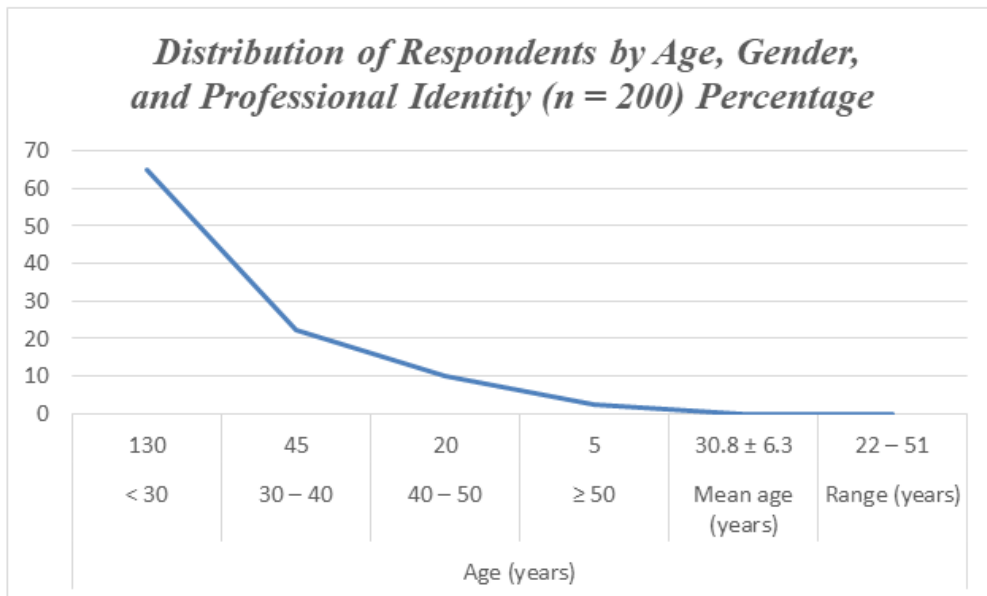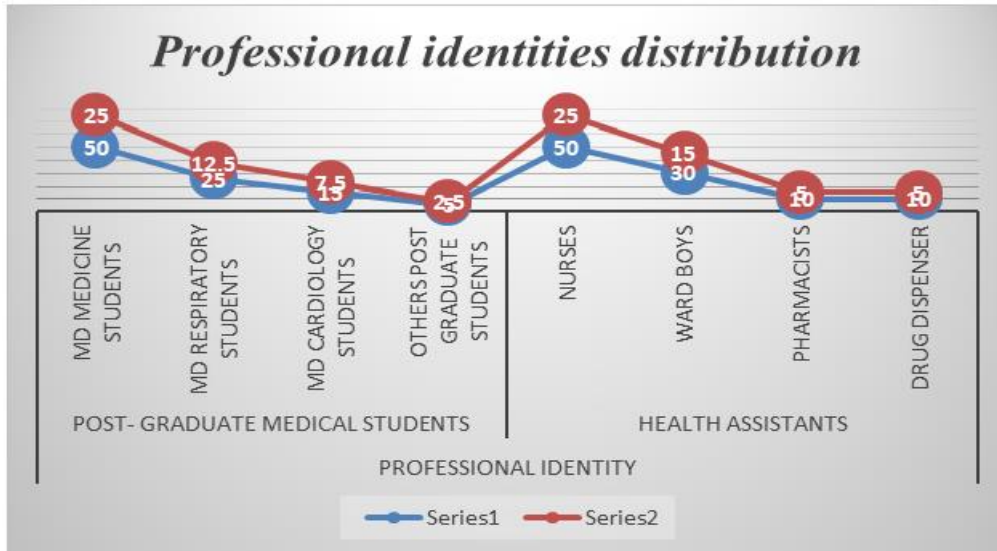
Table 1 summarizes the demographic characteristics and professional identity of the respondents. The mean age of the respondents was 30.8 ± 6.3 years, with a range from 22 to 51 years. The majority (46.4%) of respondents were under 30 years old, followed by 41.8% in their 3rd decade, 8.2% in their 4th decade, and 3.6% aged 50 years or older. Gender distribution showed that 57.4% were male, while 42.6% were female. Regarding professional identity, 50% of the respondents were post-graduate medical students, and 25% were nurses, 15% were ward boys, 5% pharmacist and 5% were Drug dispensers.

Table 2: Distribution of Respondents by Management of Asthma Patients

Management	Frequency (n = 200)	Percentage (%)
Counsel patients about inhaler	200	100.0
Suggest inhaler medication	144	71.8

All the service providers, 200 (100.0%), reported counseling asthma patients about inhaler use and demonstrating the proper technique. However, 144 (71.8%) of them recommended inhaler medications to asthma patients.

Table 3: Distribution of Service Providers by Their Performance Skills on Nine-Step Metered-Dose Inhaler Technique (n = 200)

Performance Skills	Frequency	Percentage
Remove cap & shake vigorously	140	70.0
Breathe out slowly & completely	192	96.36
Hold inhaler in upright position	158	79
Insert canister into the mouth between closed lips/up to 4 cm in open mouth	163	81.81
Disperse the canister	158	79
Slow deep inhalation	140	70.0
Remove inhaler with closed lips	132	66.36
Hold breath for 10-15 seconds	43	21.81
Wait for 20-30 seconds before starting 2nd puff	56	28

Approximately 140 (70.0%) of the respondents, reported removing the cap and shaking the container vigorously before use. A majority, 192 (96.36%), breathed out slowly and completely, and 158 (79%) held the inhaler in an upright position. Additionally, 90 (81.8%) inserted the canister into the mouth between closed lips or up to 4 cm in an open mouth, while 158 (79%) dispersed the canister. A total of 140 (70.0%) performed slow deep inhalation, and 132 (66.36%) removed the inhaler while keeping their lips closed. However, fewer respondents, 43 (21.8%), held their breath for 10–15 seconds, and only 56 (28%) waited for 20–30 seconds before starting the second puff.

Table 4: Comparison of different steps between post-graduate medical students and Health assistants (n=200)

| Performance skills	Group		P-value
	Doctors (n = 100)	Health assistants (n = 100)	
Remove cap & shake vigorously	77 (77%)	35 (35%)	0.01
Breathe out slowly & completely	94 (94%)	96 (96%)	0.38
Hold inhaler in upright position	93 (93%)	14 (14%)	< 0.001
Insert canister into the mouth between closed lips/up to 4 cm in open mouth	92 (92%)	48 (48%)	< 0.001
Disperse the canister	94 (93%)	25 (25%)	< 0.001
Slow deep inhalation	63 (63%)	17 (17%)	< 0.001
Remove inhaler with closed lips	63 (63%)	18 (18%)	< 0.001
Hold breath for 10-15 seconds	27 (27%)	6 (6%)	0.16
Wait for 20-30 seconds before starting 2nd puff	32 (32%)	13 (13%)	0.03
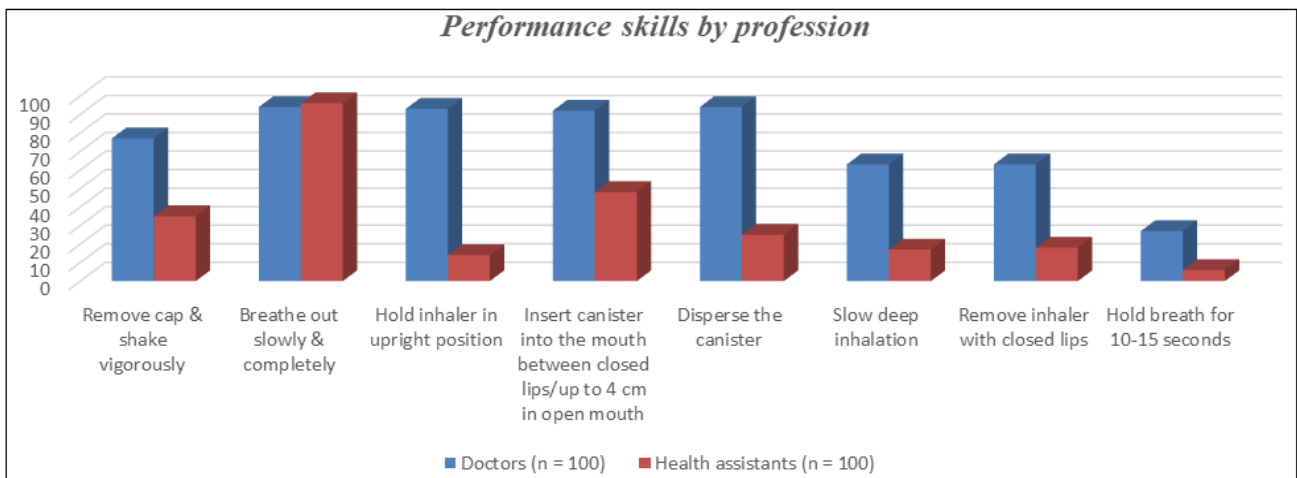
Table 5: Distribution of services of post-graduate medical students by their specialties

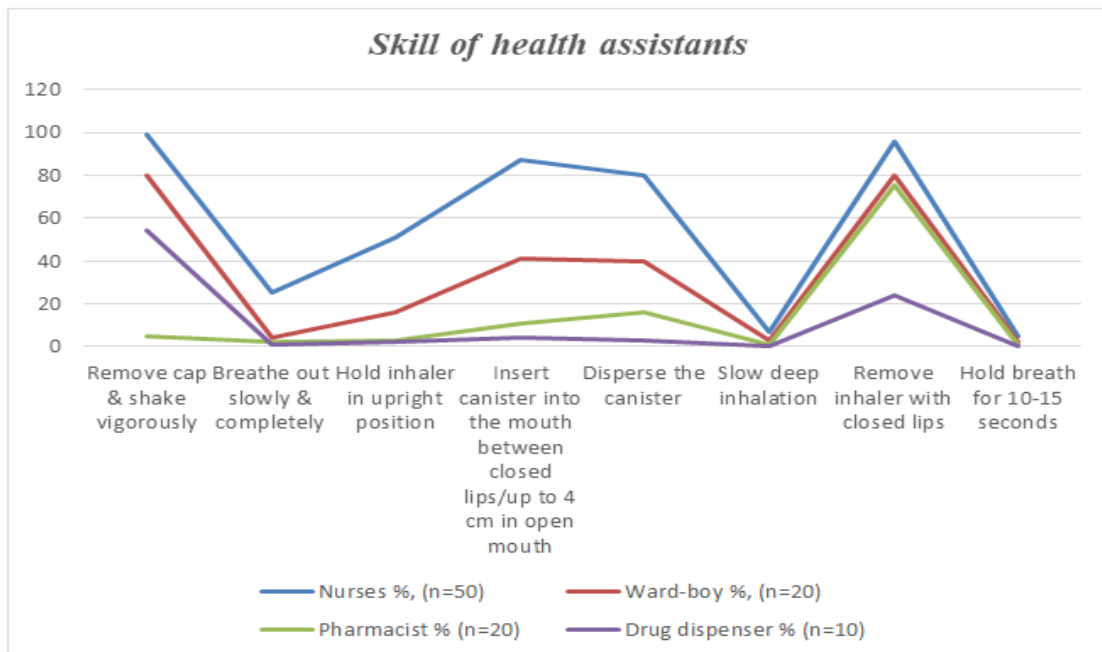| Nine steps	Skill of post-graduate medical students	MD-Medicine students	MD-Respiratory medicine students	MD-Cardiology students	Others
1	Remove cap & shake vigorously	99	100	50	16
2	Breathe out slowly & completely	94	100	60	11
3	Hold inhaler in upright position	97	100	95	34
4	Insert canister into the mouth between closed lips/up to 4 cm in open mouth	100	100	100	100
5	Disperse the canister	94	100	85	45
6	Slow deep inhalation	63	95	55	21
7	Remove inhaler with closed lips	63	96	45	22
8	Hold breath for 10-15 seconds	27	85	5	2

Skill of post-graduate medical students
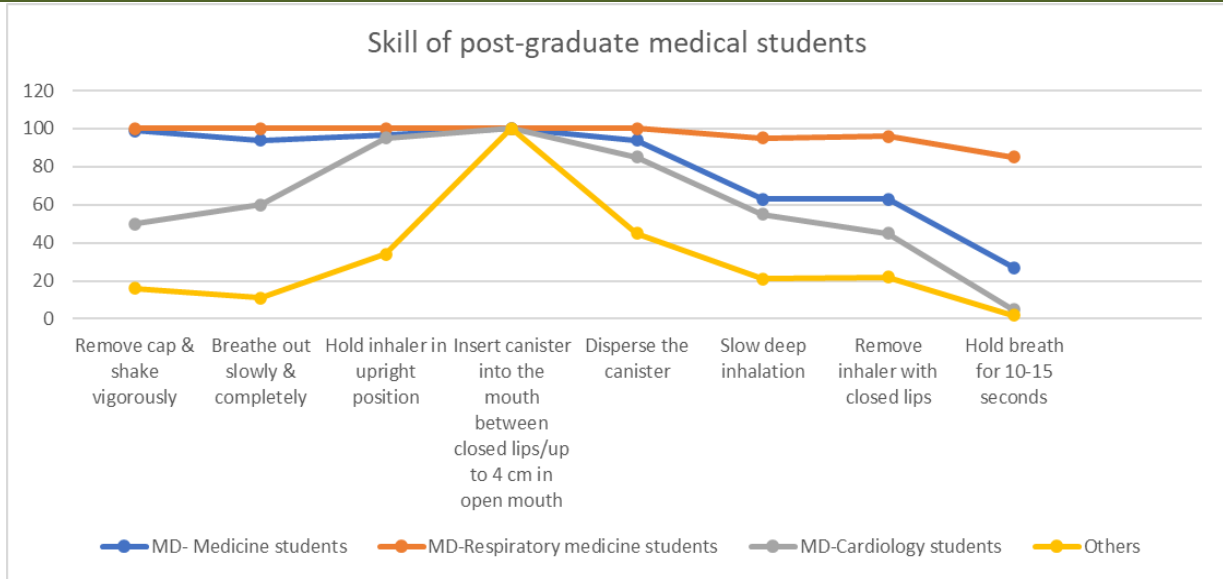
Table 6: Distribution of skills of health-assistant by their identities

Skills by profession and percentage	Nurses %, (n=50)	Ward-boy %, (n=20)	Pharmacist % (n=20)	Drug-dispenser % (n=10)
Remove cap & shake vigorously	99	80	5	54
Breathe out slowly & completely	25	4	2	1
Hold inhaler in upright position	51	16	3	2
Insert canister into the mouth between closed lips/up to 4 cm in open mouth	87	41	11	4
Disperse the canister	80	40	16	3
Slow deep inhalation	7	3	1	0
Remove inhaler with closed lips	96	80	75	24
Hold breath for 10-15 seconds	5	2	1	0

Skill of health assistants

The comparison of performance skills between post graduate medical doctors and health-assistant revealed that doctors performed significantly better than health-assistants in most of the steps of the nine-step metered-dose inhaler technique ($p < 0.05$). Exceptions were observed in the second step, "Breathe out slowly and completely," where the performance was almost similar between the groups ($p = 0.38$), and in the eighth

step, "Hold breath for 10-15 seconds," where the difference was not statistically significant (p = 0.16).

DISCUSSION

This study, conducted in the Department of Internal Medicine at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, highlights the knowledge and skills of healthcare providers, including doctors and nurses, in managing asthma using metered-dose inhalers. The findings reveal significant gaps in the proper execution of critical steps in the nine-step inhaler technique, which may hinder optimal asthma management. Despite universal involvement in counseling patients about inhaler use, discrepancies in performance between doctors and nurses highlight the need for targeted training programs. These results emphasize the importance of regular skill assessments and educational interventions to enhance healthcare providers' proficiency and improve asthma outcomes.

In our study, the participants had a mean age of 30.8 ± 6.3 years, with the majority (46.4%) being under 30 years old, reflecting a younger professional population. Gender distribution showed a slight predominance of males (57.4%) over females (42.6%), suggesting a moderate gender imbalance among healthcare providers. Regarding professional identity, postgraduate medical students constituted the majority (50%), with nurses making up 25% of the respondents, word-boys 15% & others 20%. This distribution highlights predominance of doctors in the sample, which could influence the overall level of skill and observed in this study. These demographic characteristics provide a representative snapshot of the healthcare workforce involved in asthma care, enhancing the relevance of our findings to similar professional settings.

In our study, all healthcare providers (100%) reported counseling asthma patients about inhaler use and demonstrating the proper technique, underscoring their active role in patient education. However, only 71.8% of the respondents recommended inhaler medications to asthma patients, indicating a gap between counseling practices and direct prescription recommendations. This finding highlights the need to explore factors influencing the decision-making process for prescribing inhaler medications, as well as potential barriers to ensuring consistent asthma management practices among healthcare providers.

The findings of our study highlight critical gaps in the execution of the metered-dose inhaler (MDI) technique among healthcare providers. While the initial steps, such as removing the cap and shaking the container (70.0%), breathing out completely (96.36%), and inserting the canister correctly (81.81%), were performed well by most respondents, significant deficiencies were observed in the later, more crucial steps. Only 21.81% of the respondents held their breath

for 10–15 seconds, and just 28% waited for 20–30 seconds before starting the second puff. These errors align with the global trend of incorrect inhaler techniques, which have been consistently reported as a common issue in various studies [20]. Poor inhaler technique significantly reduces the efficiency of drug delivery to the airways, leading to suboptimal therapeutic outcomes and compromised asthma management. If healthcare providers themselves do not master these critical steps, they are likely to transmit incorrect instructions to their patients, perpetuating the cycle of suboptimal inhaler use and reduced treatment efficacy [21-25].

The comparison of inhaler technique performance between doctors and nurses in our study underscores the importance of targeted training programs. Postgraduate medical students demonstrated significantly better skills than nurses & other health-assistants in most steps of the nine-step metered-dose inhaler technique (p < 0.05), reflecting their comparatively higher proficiency. However, no significant differences were observed in the second step, "Breathe out slowly and completely" (p = 0.38), or the eighth step, "Hold breath for 10-15 seconds" (p = 0.16). These findings highlight areas where both groups require improvement. Formal training and regular demonstrations of the correct inhaler technique could help address these skill gaps and ensure that healthcare providers are adequately equipped to educate their patients effectively, as highlighted in previous studies [26].

Limitations of the study
This study had some limitations:
- Conducted at a single center, limiting diversity and affecting external validity.
- The sample size was small, may limit generalizability.
- Relied on self-reporting, introducing potential bias.

CONCLUSION

The study found that postgraduate medical students and healthcare assistants demonstrated varying levels of proficiency in the metered-dose inhaler technique. While most participants could perform the initial steps adequately, there was a noticeable decline in adherence to the final steps, such as holding the breath and waiting before a second puff. Postgraduate medical students showed significantly better performance compared to nurses & others health-assistant, highlighting a critical need for enhanced training, especially for nurses, ward- boys to ensure effective asthma management.

REFERENCES

1. Aherkar, R. Y., Bhamare, C. G., Ghongane, B. B., & Deshpande, P. K. Assessment of Medical

Student's Knowledge on Metered Dose Inhaler Technique and Asthma in a Tertiary Care Teaching Hospital.

2. Kishore, P. V., Palaian, S., Alam, K., Shankar, P. R., Bajracharya, B., & Van den Ende, J. (2008). Correct use of a metered dose inhaler: A prospective interventional study among healthcare professionals in a Nepalese Teaching Hospital. *J Clin Diagn Res*, 2, 720-725.

3. World Health Organization (WHO). Asthma.

4. Van Gemert, F., van der Molen, T., Jones, R., & Chavannes, N. (2011). The impact of asthma and COPD in sub-Saharan Africa. *Primary Care Respiratory Journal*, 20(3), 240-248.

5. Wong, M. L., Maepa, H. M., & Menezes, C. N. (2019). Evaluation of the knowledge and correct use of metered-dose inhalers by healthcare professionals and medical students in Gauteng Province. *African Journal of Thoracic and Critical Care Medicine*, 25(3), 111-115.

6. Beran, D., Zar, H. J., Perrin, C., Menezes, A. M., & Burney, P. (2015). Burden of asthma and chronic obstructive pulmonary disease and access to essential medicines in low-income and middle-income countries. *The Lancet Respiratory Medicine*, 3(2), 159-170.

7. Sodhi, R., Prasad, R., Kushwaha, R. A. S., Kant, S., Verma, S. K., Garg, R., ... & Prakash, V. (2013). A study to know the knowledge, attitude, and practices of patients of bronchial asthma. *International Journal of Medicine & Public Health*, 3(3).

8. World Health Organization (WHO). (2002). WHO strategy for prevention and control of chronic respiratory diseases. Geneva: WHO.

9. Jindal, S. K., Aggarwal, A. N., Gupta, D., Agarwal, R., Kumar, R., Kaur, T., ... & Shah, B. (2012). Indian study on epidemiology of asthma, respiratory symptoms and chronic bronchitis in adults (INSEARCH). *The international journal of tuberculosis and lung disease*, 16(9), 1270-1277.

10. Peter, J. B., Longo, D. L., Fauci, A. S., Kasper, D. L., Hauser, S. L., & Jameson, J. L. (2012). New Delhi, Mc Graw Hill publication. In: Harrison's Principles of Internal Medicine. p. 2102–2115.

11. Iqbal, T., Iqbal, Q., Ali, B., Ullah, R., & Naz, S. (2023). Assessment of Metered-Dose Inhalers with Spacer Technique among Postgraduate Trainees. *Journal of Gandhara Medical and Dental Science*, 10(1), 41-44.

12. Cho-Reyes, S., Celli, B. R., Dembek, C., Yeh, K., & Navaie, M. (2019). Inhalation technique errors with metered-dose inhalers among patients with obstructive lung diseases: a systematic review and meta-analysis of US studies. *Chronic Obstructive Pulmonary Diseases: Journal of the COPD Foundation*, 6(3), 267-280.

13. Broeders, M. E., Sanchis, J., Levy, M. L., Crompton, G. K., & Dekhuijzen, P. N. (2009). The ADMIT series—issues in inhalation therapy. 2) Improving technique and clinical effectiveness. *Primary Care Respiratory Journal*, 18(2), 76-82.

14. Dudvarski Ilic, A., Zugic, V., Zvezdin, B., Kopitovic, I., Cekerevac, I., Cupurdija, V., ... & Barac, A. (2016). Influence of inhaler technique on asthma and COPD control: a multicenter experience. *International Journal of Chronic Obstructive Pulmonary Disease*, 2509-2517.

15. Lavorini, F., Pistolesi, M., & Usmani, O. S. (2017). Recent advances in capsule-based dry powder inhaler technology. *Multidisciplinary respiratory medicine*, 12, 1-7.

16. Dudyala, N. S., Amarendra, M. A., & Subbarao, P. V. (2012). The use of metered dose inhalers: where are we? *J Clin Diagn Res*, 6, 612-614.

17. Basheti, I. A., Armour, C. L., Reddel, H. K., & Bosnic-Anticevich, S. Z. (2009). Long-term maintenance of pharmacists' inhaler technique demonstration skills. *American journal of pharmaceutical education*, 73(2).

18. Gupta, M. C., Khanna, J., & Chaudhry, D. (2019). Patients' sensory perception and satisfaction with use of metered dose inhalers and dry powder inhalers in moderate persistent asthma. *International Journal of Basic & Clinical Pharmacology*, 8(9), 1.

19. Leung, J. M., Bhutani, M., Leigh, R., Pelletier, D., Good, C., & Sin, D. D. (2015). Empowering family physicians to impart proper inhaler teaching to patients with chronic obstructive pulmonary disease and asthma. *Canadian Respiratory Journal*, 22(5), 266-270.

20. Sawsan, A., Baddar, O. A., & Kassim, A. (2001). Metered-dose inhaler technique among healthcare providers practising in Oman. *Medical Sciences*, 1, 39-43.

21. Zeraati, E. N. F. (2005). Evaluation of the metered-dose inhaler technique among healthcare providers. *Acta Medica Iranica*, 268-272.

22. O'Donnell, J., Birkinshaw, R., Burke, V., & Driscoll, P. A. (1997). The ability of A&E personnel to demonstrate inhaler technique. *Emergency Medicine Journal*, 14(3), 163-164.

23. Tsang, K. W., Lam, W. K., Ip, M., Kou, M., Yam, L., Lam, B., ... & Kumana, C. R. (1997). Inability of physicians to use metered-dose inhalers. *Journal of Asthma*, 34(6), 493-498.

24. Plaza, V., & Sanchis, J. (1998). Medical personnel and patient skill in the use of metered dose inhalers: a multicentric study. *Respiration*, 65(3), 195-198.

25. Jones, J. S., Holstege, C. P., Riekse, R., White, L., & Bergquist, T. (1995). Metered-dose inhalers: do emergency health care providers know what to teach?. *Annals of emergency medicine*, 26(3), 308-311.

26. Gracia-Antequera, M. (1999). An intervention to improve the inhalatory technique of children and adolescents with asthma. *Allergologia et immunopathologia*, 27(5), 255-260.