

Assessment of proper use of Metered Dose Inhaler among patients attending the Out Patient Department of Respiratory Medicine: a cross sectional study

Debmalya Saha,¹ Jyotisma Das,¹ Keya Purkait,¹ Kabita Mandal,¹ Jayanti Mondal,¹ Debasmita Biswas,¹ Dipanjali Paul,¹ Chirantan Banerjee,¹ Debjyoti Mukhopadhyay,¹ Atanu Halder,¹ Debabrata Biswas,¹ Bitwadru Das,¹ Debopriyo Sinha,¹ Kavita Meena,¹ Dipyaban Das,¹ Eashin Gazi,² Abhijit Mukherjee³

1. MBBS students (Batch 2020 - 2025), Nil Ratan Sircar Medical College, Kolkata
2. Assistant Professor, Community Medicine, NRS Medical College and Hospital, Kolkata
3. Associate Professor, Community Medicine, Nil Ratan Sircar Medical College, Kolkata

Abstract

Introduction

Respiratory inhalers are the backbone of asthma and COPD management, targeting drug delivery directly to the airways (target zone). However, inhalers are very often used sub-optimally leading to uncontrolled symptoms and increased drug utilization for relief medication or preventative therapy, thereby increasing the prescription costs for patients.

Objectives:

To find out the socio demographic profile, disease characteristics, type of MDI used and assessing the correct steps of usage of MDI among patients, attending Respiratory Medicine Outpatient Department of Nil Ratan Sircar Medical College, Kolkata.

Materials and methods:

An institutional based observational descriptive study with cross sectional design, was carried out, among 115 patients using MDI, >12 years attending respiratory OPD during the study period were included in the study. Data were collected using a predesigned and pretested schedule, entered into MS excel, cleaned and analysed with SPSS (IBM SPSS version 20). Approval was taken from Institutional Ethics Committee.

Results

The mean (standard deviation) age of the study population was 50 (14.5) years. Almost 53% (52.2%) of the patients were using steroid inhalers, 47.2% of them for > 12 months. Most (93%) had been demonstrated by the treating physician. Only 13% perceived difficulty in MDI use. The common mistakes made by the patients during MDI use were the following; 13.9% sealed the mouth around the inhaler, 29.6% continued breathing after pressing the MDI and 38.3% rinsed their mouth after using steroid inhaler.

Conclusions

Several mistakes are committed by the users of MDI during the process, almost all of which can be minimized by repeated instructions and supervision of MDI technique by the treating physician. Proper MDI use will decrease drug wastage leading to better and cheaper management of symptoms.

Keywords

Metered Dose Inhalers, outpatients, perceived difficulty

Introduction

Respiratory inhalers are the backbone of asthma and COPD management, targeting drug delivery directly to the airways (target zone). However, inhalers are very often used sub-optimally leading to uncontrolled symptoms and increased drug utilization for relief medication or preventative therapy,¹ thereby increasing the prescription costs for patients. Hence there is tremendous potential for improved inhaler technique to lead to better asthma control and reduced prescription costs.² This remains a common problem in the management of asthma and COPD.^{3,4}

Unlike oral medications, inhalers can be difficult for a patient to use correctly. Their use requires individual instruction, mul-

Correspondence Address:

Dr Abhijit Mukherjee
34, S N Banerjee Road, New Barrackpore, Kolkata 131
Email: drabhijit71.1@gmail.com

Articles in The ESRF Research Journal for Undergraduate Medical Students are Open Access articles published under a Creative Commons Attribution-NonCommercial 4.0 International License. (CC BY-NC). This license permits use, distribution, and reproduction in any medium, provided the original work is properly cited, but it cannot be used for commercial purposes and it cannot be changed in any way.



multiple steps for use.³ Difficulty in using MDIs has been documented in several studies from around the world. In a meta-analysis of 24 studies, Brocklebank et al,⁵ found that nearly 77% of international (non-U.S.) patients with asthma or COPD made at least 1 error while using MDIs. Another MA study reported that 86.8% of patients with asthma or COPD made errors using an MDI.⁶ In India, Padmavathy et al,⁷ Although spacers have been recommended for better MDI utilisation, there is little evidence that shows the use of a spacer reduces inhalation technique errors. Indeed, approximately 60% of patients, continue to report difficulty using MDIs correctly even with a spacer.^{4,8,9} The United Kingdom guidelines and Global Strategy for Asthma Management and Prevention (GINA) recommends inhaler techniques to be regularly assessed in all asthma patients.¹⁰ Common mistakes reported in patients on inhalers are not shaking the canister before use, not exhaling completely before inhaler use, not holding breath for the recommended duration and not rising the mouth/ palate after steroid inhaler use.^{11,12}

Although several studies have been undertaken from all around the world, there is hardly any literature from India regarding the proper use of inhalers among users attending government tertiary care settings.

Objectives

1. To find out the socio demographic profile of the patients using MDI, attending respiratory medicine OPD.
2. To describe disease characteristics and the type of inhalers being used by the study population
3. To assess correct steps of usage of MDI among patients

Materials and methods:

Study type: The present study was an institutional based observational descriptive study with cross sectional design.

Study setting: It was conducted in the outpatient department of the department Respiratory medicine, NRS Medical College, Kolkata.

Study Population: Population >12 years attending respiratory OPD during the study period were included in the study.

Inclusion criteria:

- Any patient using MDI and willing to participate in the study

Exclusion Criteria: The following patients were not included in the study

- Severely ill patients needing admission
- Patients using Using Dry Powder inhaler (DPI)
- Patients suffering from active tuberculosis despite being on MDI

- Patients suffering from any co-morbid condition, that can interfere with use of inhalation device

Study duration- The study was conducted between 2nd May and 31st May, a period of 1 month.

Sample size and design- A purposive sample of 115 patients were included in the study.

Study tools and variables- Predesigned and pretested schedule containing questions on

- **Sociodemographic variables:** Age (in complete years), Sex (Male/ Female/ Others), Religion (Hindu / Muslim / Others, Caste (General/ Scheduled Caste/ Scheduled Tribe/ Other Backward classes (OBC), Marital status (Married / Unmarried /Others), Residence (Urban / Rural), Education, Occupation, Total family income, Addiction
- **Diseases related & MDI related:** Diagnosis, Type of inhaler use (Steroid, Non-steroid/ Both), Duration of inhaler use, Key demonstrator of MDI use, any difficulty during MDI use (yes/No), Any other family member using MDI (Yes/No)
- **Observational check list for MDI use:** (based on National Heart, Lung and Blood institute. How to use a metered dose inhaler. 2021 guidelines.
 1. Take off the cap from the inhaler
 2. Shake the inhaler well
 3. If you use a spacer, put the inhaler in the rubber ring on the end of the spacer
 4. Stand up or sit up straight
 5. Breathe out completely to empty your lung
 6. Place the mouthpiece in your mouth and close the lips around it to form a tight seal
 7. As you start to breathe in, press down firmly on the top of the medicine canister to release one 'puff' of medicine. Continue to breathe in slowly for 3-5 seconds. Take as big a breath as possible.
 8. Take the mouthpiece out of your mouth
 9. Hold the breath and count to 10 or as long as comfortable
 10. Release your breath
 11. If your action plan says to take more than 1 puff of medicine, wait 1 minute between puffs. Repeat steps 3 through 8 for each puff you need to take.
 12. Put the cap back on the inhaler.
 13. If your medicine is an inhaled corticosteroid, rinse your mouth with water and spit it out. (Based on answers provided)
 14. Whether put the medicine canister in water (Based on answers provided)

15. Whether brush/wipe inside the spacer
(Based on answers provided)

- Dummy MDI and spacer

Study technique: A person to person interview was conducted to collect information on the sociodemographic, disease and inhaler related variables. The observation check list and dummy inhalers and spacers were used to check the steps of inhaler use, except the steps of priming, rinsing of mouth, washing canister and cleaning of spacer, data for which was collected through interview.

Technique of data collection: The researchers were divided into 5 groups, with 8 to 10 students each. The Respiratory Medicine outpatient department of the college was visited daily between 10 am to 12 noon for data collection. Patients using MDI and fulfilling the inclusion and exclusion criteria were identified, interviewed & observed.

Ethical Issues: Approval was taken from Institutional Ethics Committee & also from Head of the department of respiratory medicine. Verbal consent was taken from patients due to lack of time. In case of minors, assent was taken from their legal guardians.

Data Compilation & Analysis: Data were entered into Excel(Microsoft Corp., USA) and analysed using SPSS (Version 20).Data were presented using mean, standard deviation and percentages. Pie Charts, Bar Diagrams were used for graphical presentation of the data.

Results

The mean(standard deviation) age of the study population was 50 (14.5) years. Most patients were in the 40-60 years age group (53.9%), Males (50.4%), Hindus (61.7%), of general caste (57.4%), married (93.4%), living in rural areas (67%), ing housewives (40%), of socio-economic status class V (based on the Kuppuswamy SES scale) (34.8%) and non-smokers (60.9%) education up to secondary level (51.3%), unemployed includ.

Discussion

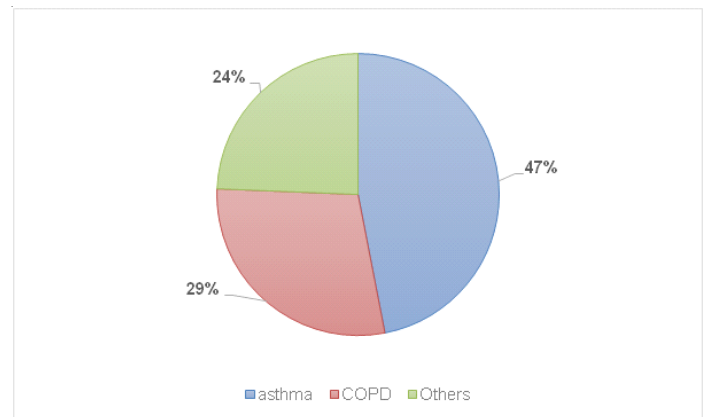
The present study noted a higher proportion of males, between the age of 40 to 50 years of ageusing MDIs. A similar observation among patients in their study population, were made by Alsufyani,¹ Aydemir,² and Jade et al³, from different parts of the globe.Chauhan A et al,⁴ reported that among patients of asthma and chronic obstructive pulmonary disease (COPD) patients at a tertiary health care hospital, men with a mean (SD) age of 43.7 (13.6) years, were in the majority proportions.

The present study reported Hindus to be the majority population, in agreement with the population distribution of religion in the state of West Bengal. Most of the study popula-

Table 1: Socio-demographic characteristics of the study population

Variable	Level	Frequency	Percentage
Age group	<18	4	3.5
	18-40	27	23.5
	40-60	62	53.9
	>60	22	19.1
	Sex Male	58	50.4
	Female	57	49.6
Religion	Hinduism	71	61.7
	Others	44	38.3
Caste	General	66	57.4
	SC	12	10.4
	OBC	24	20.9
	Not specified	13	11.3
Marital status	Married	107	93.0
	Unmarried/ Widowed	8	7.0
Residence	Urban	38	33.0
	Rural	77	67.0
Education	Illiterate	33	28.7
	Primary	9	7.8
	Secondary	59	51.3
	Higher Secondary	5	4.3
	Graduate and Above	3	2.6
	Not Specified	6	5.2
Occupation	Semi-professional	7	6.1
	Business	8	7.0
	Skilled labour	23	20.0
	Unskilled labour	21	18.3
	retired from work	4	3.5
	Unemployed &housewives	52	45.2
SES (BG Prasad scale)	Class I	8	7
	Class II	13	11.3
	Class III	16	13.9
	Class IV	40	34.8
	Class V	38	33.0
Addiction	None	70	60.9
	Smoked tobacco	32	27.8
	Smokeless tobacco	9	7.8
	Alcohol	4	3.5
	Total	115	100.0

Figure 1: Pie chart showing the distribution of study patients based on the diagnosis (n=115)



*Others include post tubercular bronchiectasis, interstitial lung disease, post pneumonia bronchospasm

Table 2: Distribution of study participants based on the MDI characteristics (n=115)

Variable	Level	Frequency	Percentage
Type of inhaler use	Steroid containing	60	52.2
	No steroids	55	47.8
Duration of inhaler use	< 12 months	60	52.2
	≥ 12 months	55	47.8
Instructor for inhaler use	Physician	107	93.0
	HCP other than physicians	8	7.0
Inhaler dose frequency per day	SOS	11	9.6
	1	99	86.1
Perceived difficulty of MDI use	2 or more	5	5
	No	100	87.0
	Yes	15	13.0
Other family member using MDI	Yes	8	7.0
	No	107	93.0
	Total	115	100.0

Table 3: Steps of MDI use

Steps	Description	Number	Frequency
1A	Take off cap	112	97.4
1 B	Shake inhaler	68	59.1
2 A	If use spacer puts inhaler at rubber end of spacer (n=32)		
3	Stood/sat upright while taking the inhaler	101	87.8
4	Breathed out completely to empty their lungs prior to inhaler intake	53	46.1
5 A	Placed mouthpiece to mouth and close the lips around it to form a tight seal	99	86.1
5 B	Seal by mouth	16	13.9
6 A	Pressed the canister	81	70.4
6 B	Continued breathing during the inhaler in use	34	29.6
7	Hold their breath for 10 seconds after inhaling the puff	47	40.9
8 A	Took mouthpiece out of mouth after use	109	94.8
8 B	Released breath following this step	102	88.7
9 A	Wait 1 minutes between two puffs (n=35)	17	48.6
9 B	Repetition of steps 3 to 8 (n=35)	32	91.4
10	Put the cap back on the inhaler, after use	112	97.4
11	Rinse mouth after using corticosteroid inhaler (n= 60)	23	38.3
12	Put canister in water	11	9.6
13	Wipe spacer (n=32)	13	28.7

tion, in the present study had a rural residence who had completed secondary level of education. Alsufyani,¹⁴ and Sourav et al,¹⁷ both reported similar demography in terms of residence and literacy. Asmare et al,⁵ from Ethiopia, reported that highest number of participants in their cohort of asthmatics on inhalers had no formal education.

Most of the participants in the present study were explained the proper use methods by their physicians. This was similar to studies by Chauhan et al,¹⁶ and Ramkillawan et al,⁶ who reported that more than half of their study population were demonstrated the use of MDI by their treating physicians. Perceived difficulty in the use of MDI was noted in 15 (13.0%) of the study population. In contrast, a number of studies, reported a higher number of patients with perceived difficulties in usage of MDI.^{7,8} Ramkillawan et al,²⁰ Shealy et al,⁹ and Aydemir et al,¹⁵ have all reported figures of upto 40% in terms

of perceived difficulty. This is higher in case of low-income countries, where literacy plays an important part in explaining the proper use and training of MDI.¹⁰

Studies evaluating the parameters that affect the incorrect use of inhaler devices have reported conflicting results. In the present study, only 11 of the total participants were observed to have used their MDI properly. The most common mistake that participants made while using the inhaler was breath holding after the puff deployment. Most of the participants did not hold their breath for 10 seconds. Sodhi et al,¹¹ Asmare et al,¹⁸ and Shealy et al,²³ have also reported improper breath holding to be the most common misstep by MDI users. On the other hand, studies have also demonstrated that improper seal by mouth and incomplete expiration were other missteps among MDI users.^{2,12,13}

In patients taking multiple puffs of the MDI, the most common malpractice was not waiting for one minute between puffs as recommended in the guidelines.¹² Jade et al reported that synchronization of MDI was the most difficult part of its use, while another study employing technology in the form of acoustic signature to objectify MDI reported that patients had often misjudged the timings and/or did not adequately and steadily breathe after release of the puff.¹⁴

Studies have repeatedly shown that MDI use requires a high level of training and skill to be effective. Errors in using a MDI can occur despite repeat reinforcement and education.¹⁵ It is suggested that repeat instructions can improve MDI technique.¹⁶ Weinberg et al.¹⁷ demonstrated that by repeated training and supervised dosing improved correct MDI technique from 32% to 86%.

Conclusions

Several mistakes are committed by the users of MDI during the process, almost all of which can be minimized by repeated instructions and supervision of MDI technique by the treating physician. Proper MDI use will decrease drug wastage leading to better and cheaper management of symptoms.

Limitations

Due to limited time frame each participant could not be evaluated minutely based on their diagnostic criteria. All participants did not carry inhaler/ spacer with them; hence some practices may have been modified by the user during demonstration to researcher.

Acknowledgement

The authors would like to thank all the participants in the study. In addition, the authors would like to acknowledge the help received from the department of respiratory medicine and community medicine in the conduction of the study.

References

1. Bousquet J, Mantzouranis E, Cruz AA, Ait-Khaled N, BaenaCagnani CE, Bleecker ER, et al. Uniform definition of asthma severity, control, and exacerbations: document presented for the World Health Organization Consultation on Severe Asthma. *J Allergy Clin Immunol* 2010 Nov;126(5):926e38.
2. Price D, Bosnic-Anticevich S, Briggs A, Chrystyn H, Rand C, Scheuch G, Bousquet J, Inhaler Error Steering Committee. Inhaler competence in asthma: common errors, barriers to use and recommended solutions. *Respiratory medicine*. 2013 Jan 1;107(1):37-46.
3. Melani AS, Bonavia M, Cilenti V, Cinti C, Lodi M, Martucci P, et al. Inhaler mishandling remains common in real life and is associated with reduced disease control. *Respir Med* 24011 Jun; 105(6):930e8.
4. Press VG, Arora VM, Shah LM, Lewis SL, Ivy K, Charbeneau J, et al. Misuse of respiratory inhalers in hospitalized patients with asthma or COPD. *J Gen Intern Med* 2011 Jun;26(6):635e42.
5. Brocklebank D, Ram F, Wright J, et al. Comparison of the effectiveness of inhaler devices in asthma and chronic obstructive airways disease: a systematic review of the literature. *Health Technol Assess*. 2001; 5(26):1-149. doi: <https://doi.org/10.3310/hta5260>
6. Chrystyn H, van der Palen J, Sharma R, et al. Device errors in asthma and COPD: systematic literature review and metaanalysis. *NPJ Primary Care Respir Med*. 2017;27(1):22. z
7. Padmavathy R, Geethu N, SajilaSylus S, Zacharia TZ. Assessment of knowledge, attitude, practice towards asthma and the impact of patient counseling on inhalation techniques in asthmatics. *Int Res J Pharm*. 2019;10(6):48-51.
8. Mulhall AM, Zafar MA, Record S, Channell H, Panos RJ. A tablet-based multimedia education tool improves provider and subject knowledge of inhaler use techniques. *Respir Care*. 2017;62(2):163-171

9. Press VG, Arora VM, Shah LM, et al. Teaching the use of respiratory inhalers to hospitalized patients with asthma or COPD: a randomized trial. *J Gen Intern Med.* 2012;27(10):1317- 1325.
10. Levy MK, Hardwell A, Mcknight E, Holmes J: Asthma patient's inability to use a pressurized metered-dose inhaler (pMDI) correctly correlates with poor asthma control as defined by the Global Initiative for Asthma (GINA) strategy: a retrospective analysis. *Prim Care Respir J.* 2013, 22:406-11.
11. Coelho A. C., Souza-Machado A., Leite M., et al. Use of inhaler devices and asthma control in severe asthma patients at a referral center in the city of Salvador, Brazil. *Jornal Brasileiro de Pneumologia.* 2011;37(6):720-728.
12. Lavorini F, Magnan A, Dubus JC, et al.: Effect of incorrect use of dry powder inhalers on management of patients with asthma and COPD. *Resp Med.* 2008, 102:593-604.
13. Alsufyani AM. An evaluation of metered-dose inhaler administration technique among patients of asthma and chronic obstructive pulmonary disease in Saudi Arabia. *The Egyptian Journal of Chest Diseases and Tuberculosis.* 2021 Jan 1;70(1):54-9.
14. Aydemir Y. Assessment of the factors affecting the failure to use inhaler devices before and after training. *Respiratory medicine.* 2015 Apr 1;109(4):451-8.
15. Jade J, Lee J, Hussain SF. A cross-sectional study examining inpatients' metered dose inhaler technique and the impact of assessment and education on its effective use.
16. Chauhan A, Patel P, Gandhi A, Desai M. An evaluation of Metered-Dose inhaler administration technique in patients of asthma and chronic obstructive pulmonary disease. *Journal of Applied Pharmaceutical Science.* 2016 Feb 27;6(2):115-8.
17. Asmare T, Belayneh A, Dessie B. Practice on Metered Dose Inhaler Techniques and Its Associated Factors among Asthmatic Patients at Debre Markos Comprehensive Specialized Hospital, East Gojjam, Ethiopia: A Prospective Study. *The Scientific World Journal.* 2021 Aug 12;2021.
18. Ramkillawan Y, Prins M, Van Rooyen C, Seedat RY. Assessment of metered-dose inhaler technique: A study at the pulmonology clinic of a tertiary hospital in the Free State, South Africa. *African Journal of Thoracic and Critical Care Medicine.* 2019 Apr 1;25(1):5-9.
19. Padmavathy GN, Sajila-Sylus ZTS. Assessment of knowledge, attitude, practice towards asthma and the impact of patient counselling on inhalation techniques in asthmatics. *International Research Journal of Pharmacy* 2019; 10 (6): 151-158.
20. Mohamed OM, Karamah WK. Knowledge, attitude and behaviour of asthmatic patients regarding asthma in primary care setting in Abu Dhabi, United Arab Emirates. *World Family Medicine Journal: Incorporating the Middle East Journal of Family Medicine.* 2015 Jul;99(2129):1-8.
21. Shealy KM, Paradiso VC, Slimmer ML, Campbell DL, Threatt TB. Evaluation of the prevalence and effectiveness of education on metered-dose inhaler technique. *Respiratory Care.* 2017 Jul 1;62(7):882-7.
22. Choraó P, Pereira AM, Fonseca JA. Inhaler devices in asthma and COPD-an assessment of inhaler technique and patient preferences *Respir Med.* 2014;108:968-975
23. Sodhi MK. Incorrect inhaler techniques in Western India: still a common problem. *Int J Res Med Sci.* 2017 Aug;5(8):3461.
24. Sanchis J, Gich I, Pedersen S, Team AD. Systematic review of errors in inhaler use: has patient technique improved over time?. *Chest.* 2016 Aug 1;150(2):394-406.
25. Usmani OS, Lavorini F, Marshall J, Dunlop WC, Heron L, Farrington E, Dekhuijzen R. Critical inhaler errors in asthma and COPD: a systematic review of impact on health outcomes. *Respiratory research.* 2018 Dec;19:1-20.
26. Taylor TE, Zigel Y, Egan C, Hughes F, Costello RW, Reilly RB. Objective assessment of patient inhaler user technique using an audio-based classification approach. *Scientific reports.* 2018 Feb 1;8(1):2164.

27. Green RJ, Greenblatt MM, Plit M, Jones S, Adam B. Asthma management and perceptions in rural South Africa. *Ann Allergy Asthma Immunol.* 2001;86(3):343–347..
28. Shaddock E, Richards G. Pharmacological management of chronic obstructive pulmonary disease. *S Afr Med J.* 2015;105(9):790..
29. Weinberg E, Naya I. Treatment preferences of adolescent patients with asthma. *Pediatr Allergy Immunol.* 2000;11:49–55.