

Performance Evaluation of the Metered-Dose Inhaler Technique among Healthcare Providers

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ABSTRACT

Background: Asthma is considered as one of the most common chronic disease worldwide. Literature reveals that the prevalence of asthma in KSA increased significantly from 8% in 1986 to 23% in 1995. Pressurized metered dose (pMDI) inhalers are the most cost effective first line of treatment. Formal training and demonstration of the correct use of inhalers have been shown to improve the skills of inhaler use with better outcomes.

Objectives: To evaluate the physicians' methods of explaining the MDI techniques to asthmatic patients.

Methods: A total of 165 participants (71 physicians and 94 residency training program members) participated in the study. All the participants were asked to breathe into a placebo MDI device and their techniques were evaluated through a nine step checklist based on the MDI manufacturer's instructions and international guidelines.

Results: No significance difference was found between the performance of male and female participants ($p=0.686$). Consultants showed a statistically significant difference on performance of steps 1, 4, 7 and 9 when compared to junior, senior residents and registrar ($p=0.027$, $p=0.006$, $p=0.030$, $p=0.002$ respectively). For steps 2, 3, 5, 6 and 8, no significant

difference was found between the groups.

Conclusion: Age and gender has no bearing on the scores but there is a clear trend with the level of professionalism on successful performance of the MDI techniques.

Keyword: Asthma, Pressurized Metered Dose, Pressurized Metered Dose, Physicians.

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INTRODUCTION

Asthma is considered as one of the most common chronic disease worldwide. The World health organization (WHO) in 2011, estimated that asthma affects more than 235 million people all over the world.¹ Moreover, the WHO stated that asthma is the most common chronic disease among children. In the United States, the number of asthmatics has leapt by over 60% since the early 1980s and deaths have doubled to 5,000 a year.² The number of disability-adjusted life years lost due to asthma worldwide is approximately 15 million per year. In many western countries, the economic burden of asthmatic patients ranged from \$300 to \$1,300 per patient per year.³

In the Kingdom of Saudi Arabia (KSA) the prevalence of asthma is not exactly known but studies conducted in the past thirty years reported an overall prevalence ranged of 8% to 23% among children.⁴ Comparison of the data of Riyadh versus Hail (an inland desert dry environment) and Jeddah versus Gizan (a coastal humid environment) show that the prevalence of asthma in similar populations increased significantly from 8% in 1986 to 23% in

1995.⁵ In KSA, the impact of asthma disease was felt in poor quality of life, loss of work or school days, frequent emergency department visits, hospitalization, and death.⁴

Poor asthma control has been linked to several factors including under diagnosis and inadequate treatment,⁶ poor patient understanding of the disease and its treatment,⁷ non-compliance,⁸ and improper use of inhaler devices.⁹ Inhaled medications are the keystone of asthma treatment.¹⁰ Poor patient inhaler techniques have been identified as a common and persistent problem by many studies worldwide.¹¹

The form of intake is considered the cornerstone of the treatment in asthma. Healthcare professionals use various devices such as spacers, nebulizers, metered dose inhalers, drugs and combinations of these. For years, conventional nebulizers were the only inhalers which were available. The optimum prescribed use of the medication, the technique and the compliance to the medication are important for the control of asthma. The use of inhaled drugs is a basic aspect in the treatment of patients with

asthma, in acute episodes as well as in maintenance therapy. Inhalation mode of delivering therapy is the main suggested route as spacers, nebulizers, and metered dose inhalers to achieve a good control of asthma. With the advent of pressurized metered-dose inhalers, the delivery of drugs such as bronchodilators and corticosteroids into the respiratory tract was optimized, thereby decreasing the local and the systemic side effects.¹²

A systematic review of clinical effectiveness metered dose inhalers versus other hand held inhaler devices for delivering corticosteroid in asthma concluded that pressurized metered dose (pMDI) inhalers are the most cost effective first line of treatment.¹³ Moreover, another systematic review showed no difference in clinical effectiveness between nebulizers and alternative inhaler devices compared to standard pMDI with or without spacer.¹⁴

The correct use of inhalers has been shown to be influenced by patients' characteristics, such as their age and their understanding of asthma and its treatment.⁸ Suggesting that, the magnitude of the problem may vary in different populations. Several studies have been conducted among health care providers to evaluate correct MDI technique. Baddar et al.,¹⁵ evaluated the correctness of metered-dose inhaler (MDI) technique in a sample of healthcare providers practicing in Oman. They concluded that the majority of healthcare providers responsible for instructing patients on the correct MDI technique were unable to perform this technique correctly indicating the need for regular formal training programs on inhaler techniques.

Another study was conducted in Iran by Zeraati and Nadi to evaluate the adequacy of metered-dose inhaler (MDI) technique in a sample of physicians and nurses practicing in Hamadan University hospitals.¹⁶ The majority of healthcare providers responsible for instructing patients on the correct MDI technique were unable to perform this technique correctly. In addition, in India a study was conducted by Dudyala et al.,¹⁷ to evaluate the knowledge regarding the use of pressurized metered-dose inhalers among the professionals. Only 10.9% of them performed all steps correctly.

Also Stelmach et al.,¹⁸ evaluated residents regarding maintenance treatment of asthma and the technique for using metered dose inhalers. The results demonstrated that, when seeing a typical patient with uncontrolled persistent asthma, most residents were able to correctly identify the drugs indicated for treatment but could not adequately instruct the MDI usage technique.

Formal training and demonstration of the correct use of inhalers have been shown to improve the skills of inhaler use in both patients and healthcare providers.^{19,20} Local baseline information is, therefore, essential for each country to develop its own asthma care services and educational programs targeted at their specific problems and needs.⁶ To the best of our knowledge, no local study had been conducted to address the problem of metered-dose inhaler (MDI) technique. Therefore, the objective of this study was to evaluate the physicians' methods of explaining the MDI technique to asthmatic patients.

METHODS

This cross sectional study was conducted at Prince Sultan military medical city (PSMMC) in Al-wazzarat Health Center, Riyadh, Saudi Arabia. Ethical approval of the department research committee was obtained before conducting the research and informed written consent was taken from each participant. All the

family medicine physicians (71), and family medicine residents (94) in the residency training program at Prince Sultan military medical city, PSMMC, in Al-wazzarat Health Center, Riyadh, participated the study.

Data about age, gender, specialty and level of experience (junior, senior, registrar, and consultant) were collected for all the participants.

Each participant was then asked to demonstrate the use of the MDI by taking two puffs from a placebo MDI device. A trained observer, using a checklist of nine steps based on manufacturer's instructions and international clinical guidelines on the MDI technique,²¹ graded the correctness of each participant technique. Steps 1, 4, 5 and 6 were considered essential for proper delivery of the inhaled medications and the remaining steps were classified as recommended for optimal delivery.

Statistical analysis

Data were analyzed using statistical software SPSS (Statistical Package for Social Sciences, IBM, New York) and presented in terms of percentage correct usage of the MDI device. Comparisons were made using a standard chi-squared (χ^2) test and a $p < 0.05$ was considered significant.

RESULTS

A total of 165 (98 male, 59.4%, 67 female 40.6%) health care professionals in the Family Medicine Department participated in the study. The mean age of participants was 32.78 ± 7.3 years. Majority of them were junior residents (34.5%), followed by registrars (27.9%) and senior residents (22.4%), whereas the consultants were only 15.2% of the participants (Table 1).

Table (2) shows a step-wise evaluation for the major essential steps (1,4,5 and 6). Step 5 showed the highest percentage of correct performance (92.7%) followed by 88.5% for step 6 and 87.9% for step 1, and the lowest percentage of performance was recorded for step 4 (73.9%). Regarding other recommended steps, steps 2 and 8 showed the highest percentages of correct performance representing 87.9% and 68.5%, respectively. Steps 3, 7 and 9 showed the lowest percentages of correct performance (28.5%, 32.7%, and 23.6%, respectively).

Tables (3 & 4) show the percentage of correct performance in both gender, it was found to be nearly similar in both genders. Comparison of correct performance in relation to gender showed no statistically significant difference in all steps.

Figure 1 shows the distribution of studied physicians in relation to gender and total performance score of meter-dose inhaler technique, the effect of gender on total score performance showed no significant difference of the total score percentage ($p=0.739$). The high score percentage of 75% was recorded among 52% of males and 46.3% of females. Low score of <60% was found to be 17.3% for males and 17.9% for females.

Table (5) shows the Comparison of correct performance in relation to professional level, it showed significant differences in steps 1, 4, 6 and 9. Consultants always had the highest frequency of correct performance of the abovementioned steps. For step one, 77.2% of junior residents showed correct performance which increased to 89.2% for senior residents and 93.5% for registrar while 100% of consultants correctly performed it ($p=0.012$). For step four, 63.2% and 73.0% of junior and senior residents showed correct performance compared to 73.9% and 100.0% among registrar and consultants ($p=0.004$). The same observation of high

performance among consultants compared to other groups was observed for steps 6 and 9 where 100.0% and 52.0% of consultants performed correctly steps 6 and 9 respectively compared to 78.9 % and 15.8 % among junior and senior

residents, respectively (p=0.028 and 0.001, respectively). For the recommended steps (2, 3, 5, 6, and 8) although consultants still showed higher correct performance than other professional levels, the differences were not statistically significant.

Table 1: Demographic data of the studied sample

	Professional Level				Age in years				
	Junior resident	Senior resident	Registrar	Consultant	25-30	30-35	35-40	40-45	45-60
Males (n=98)	37	23	20	18	37	35	9	8	9
Females (n=62)	20	19	14	9	36	12	2	5	7
Total (n=160)	57	42	37	27	73	47	11	13	16

Table 2: The correct performance in different procedure in all studied subjects.

Procedure	Correct Performance	
	No.	%
1. Remove cap and shake the inhaler vigorously	145	87.9
2. Breath out slowly and completely	145	87.9
3. Hold the inhaler in the upright position	47	28.5
4. Insert the mouthpiece into mouth between closed lips or up to 4 centimeters in front the open mouth	122	73.9
5. Depress the canister once	153	92.7
6. At the same time begin slow deep inhalation continue to total lung capacity (co-ordination)	146	88.5
7. Remove the inhaler with closed lips	54	32.7
8. Hold breaths for 10-15 seconds.	113	68.5
9. Wait for 20-30 seconds before starting the second puff.	39	23.6

Table 3: Distribution of studied physicians in relation to gender and Correct performance of meter-dose inhaler technique

Procedure	Correct Performance					
	Males (n=98)		Females (n=67)		Total (n=165)	
	No.	%	No.	%	No.	%
1 Remove cap and shake the inhaler vigorously	85	86.7	60	89.6	145	87.9
2 Breath out slowly and completely	88	89.9	57	8.1	145	87.9
3 Hold the inhaler in the upright position	25	25.5	22	32.8	47	28.5
4 Insert the mouthpiece into mouth between closed lips or up to 4 centimeters in front the open mouth	74	75.5	48	71.6	122	73.9
5 Depress the canister once	91	92.9	62	92.5	153	92.7
6 At the same time begin slow deep inhalation continue to total lung capacity (co-ordination)	89	90.8	57	85.1	146	88.5
7 Remove the inhaler with closed lips	30	30.6	24	35.8	54	32.7
8 Hold breaths for 10-15 seconds.	69	70.4	44	65.7	113	68.5
9 Wait for 20-30 seconds before starting the second puff.	25	25.5	14	20.9	39	23.6

Table 4: Comparison between male and females regarding the correct performance of Meter-dose inhaler technique

Procedure	Correct Performance					
	Males (n=98)		Females (n=67)		X ²	p
	No.	%	No.	%		
1 Remove cap and shake the inhaler vigorously	85	86.7	60	89.6	0.091	0.386
2 Breath out slowly and completely	88	89.9	57	8.1	0.833	0.250
3 Hold the inhaler in the upright position	25	25.5	22	32.8	1.04	0.198
4 Insert the mouthpiece into mouth between closed lips or up to 4 centimeters in front the open mouth	74	75.5	48	71.6	0.309	0.352
5 Depress the canister once	91	92.9	62	92.5	0.006	0.583
6 At the same time begin slow deep inhalation continue to total lung capacity (co-ordination)	89	90.8	57	85.1	1.28	0.187
7 Remove the inhaler with closed lips	30	30.6	24	35.8	0.49	0.297
8 Hold breaths for 10-15 seconds.	69	70.4	44	65.7	0.414	0.317
9 Wait for 20-30 seconds before starting the second puff.	25	25.5	14	20.9	0.469	0.311

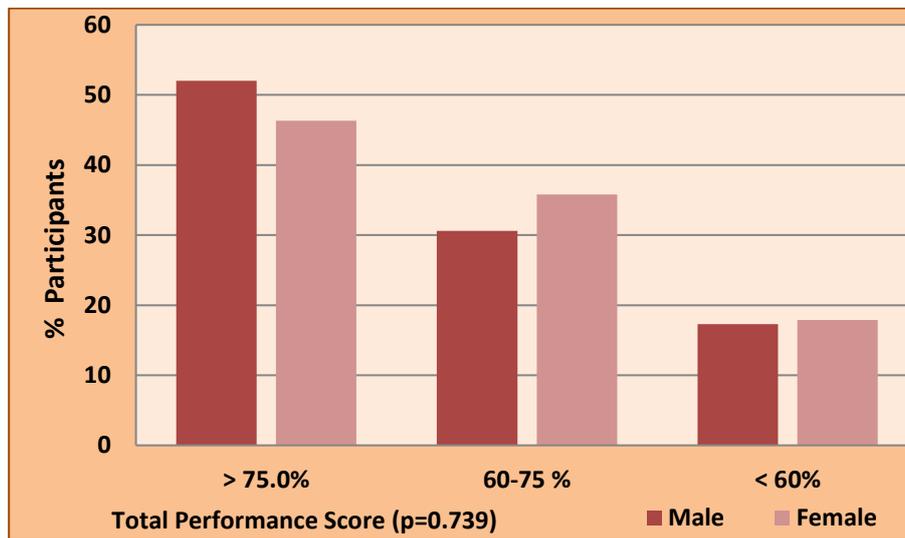


Figure 1: Distribution of studied physicians in relation to gender and Total performance score of meter-dose inhaler technique

Table 5: Distribution of studied physicians in relation to professional level and Correct performance of meter-dose inhaler technique

Procedure	Correct Performance								X ² p
	Consultant (n=25)		Registrar (n=46)		Senior residence (n=37)		Junior residence (n=57)		
	n	%	n	%	n	%	n	%	
Remove cap and shake the inhaler vigorously	25	100.0	43	93.5	33	89.2	44	77.2	10.97 0.012*
Breath out slowly and completely	23	92.0	39	84.8	32	86.5	51	89.5	1.01 0.797
Hold the inhaler in the upright position	10	40.0	13	28.3	13	35.1	11	19.3	4.79 0.188
Insert the mouthpiece into mouth between closed lips or up to 4 centimeters in front the open mouth	25	100.0	34	73.9	27	73.0	36	63.2	12.26 0.007*
Depress the canister once	25	100.0	39	84.8	35	94.6	54	94.7	6.7 0.079
At the same time begin slow deep inhalation continue to total lung capacity (co-ordination)	25	100.0	42	91.3	34	91.9	45	78.9	9.12 0.028*
Remove the inhaler with closed lips	12	48.0	12	26.1	16	43.2	14	24.6	7.15 0.067
Hold breaths for 10-15 seconds.	20	80.0	26	56.5	25	67.6	42	73.7	5.31 0.150
Wait for 20-30 seconds before starting the second puff.	13	52.0	4	8.7	13	35.1	9	15.8	21.5 0.001*

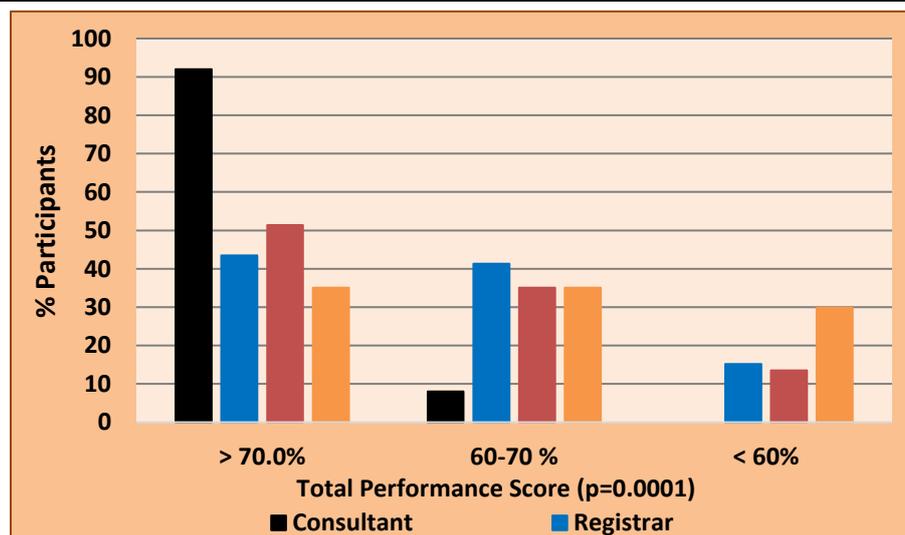


Figure 2: Distribution of studied physicians in relation to position and Total performance score of meter-dose inhaler technique

Figure 2 shows the distribution of studied physicians in relation to position and total performance score of meter-dose inhaler technique. Professional level was found to affect significantly the total score percentage of performance of metered-dose inhaler ($p=0.001$). There was a trend of increased percentage of the higher score percentage of >75% with increased level of profession. Among junior residents the score of >75% was reported among 35.1% which increased to 51.4% and 43.5% among senior residents and registrar, respectively. The highest frequency was reported among consultants who reported a percentage of 92.0%.

DISCUSSION

The transition from the use of oral to inhaled medications as the preferred route of administration has been one of the most important developments in asthma treatment. The introduction of metered dose inhalers is a major revolution in the therapeutic management of bronchial asthma and chronic obstructive airway disease. These devices enable the direct delivery of medication to the respiratory system, hence reducing the first pass effect. Inhaler therapy is now the recommended mode of delivery of many drugs used in the treatment of asthma and chronic obstructive pulmonary disease.²² The major benefits of inhalation therapy are the direct delivery and rapid action of medications in much smaller effective doses compared to systemic routes, thus reducing side-effects.²²

The important restraint of inhaler devices is that they are more difficult to use and less convenient than tablets. Each inhaler device has its own specific sequence of steps for optimal drug delivery and it is therefore necessary to give careful and correct instruction to patients.²¹ MDI, the most commonly used device, requires the patient to co-ordinate inhalation with action of the device (actuation) which can be difficult for some.²² Patients with asthma have been shown to have poor inhaler using technique, an important cause of poor asthma control.^{10,11,16} As a result, clinical guidelines of International Asthma Management emphasize the importance of demonstrating the correct inhaler technique at initial diagnosis and correcting patient performance at each follow-up visit.²¹

In agreement with our study, Raza et al., found that, Junior-most medical residents have grossly sub-optimal performance at steps of MDI use which improves only after individualized demonstration sessions but deteriorate rapidly close to baseline low in difficult-to-learn steps.²³

Unfortunately, numerous studies consistently show that healthcare providers also have poor inhaler technique.^{24,25} The reported rate of correct inhaler technique among various groups of physician is in the range of 28-69% in different studies with respiratory specialist and internists performing relatively better than others.²⁶ For nurses, the reported rate of correct inhaler techniques was within the range of 15-66% and the respiratory therapists performed better than physicians.²⁷

In a different study, asthmatic patients performed better than both physicians and nurses.²⁸ In a study from Iran, which included physicians and nurses, only 6.93% could demonstrate MDIs correctly.²⁹ In a study conducted by Hira, established that the doctors who were involved with the MDI use, should learn and become familiar with the proper recommendations for its optimal aerosol delivery.³⁰ The poor inhaler technique showed in this

study is also due to the lack of any formal training for residents in the correct use of inhalers. However, this universal problem has been shown to improve by formal and regular training of both patients and healthcare providers.³¹

In conclusion, healthcare providers' skills about the MDI technique are limited. Gender had no effect on the performance of each individual when performing the test indicating that the determining factor is the level of training of the participant. This was corroborated by a clear trend between level of professionalism and success of performance of the MDI technique with fully trained consultants scoring the highest on all steps while registrars, senior residents and junior residents scored lower but at different levels for each step. This shows that increased training is the key to correct performance of MDI techniques and should be encouraged further.

Current study indicates implementation of regular trainings and workshops must be conducted for healthcare professionals, especially for junior residents and registrars, evaluation of performance of MDI techniques of junior doctors and healthcare professionals by consultants' can improve outcome of asthma treatment and carrying out more research to ascertain other factors which may help improve efficacy of MDI technique, can improve the efficacy of use of MDI technique by healthcare professionals:

This study is limited in scope as it is confined to prince sultan military medical city, PSMMC, in Al-wazzarat Health Center, Riyadh, KSA. Larger studies across different health care facilities are likely to reveal more representative information to evaluate the ability of family medicine physicians who are working in the family medicine center and family medicine residents in the residency training program to explain the use of metered-dose inhaler in a proper way.

Due to time limitation the investigator used a convenience sample of primary care physicians at one health care center in the kingdom of Saudi Arabia, and thus the results may not be generalizable to other primary health care training centers.

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