

# Prescription of inhalers among pulmonologists and nonpulmonologists: is there a difference?

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**Objective** The objectives of this study were to evaluate prescription of inhalers and to assess knowledge and practice of doctors who can deal with asthma and chronic obstructive pulmonary disease patients, regarding inhalation therapies and inhalation techniques.

**Patients and methods** A prospective, cross-sectional survey was carried out on physicians from different specialties who can deal with asthma and chronic obstructive pulmonary disease patients.

**Results** The questionnaire was completed by 443 respondents. Ninety percent of nonpulmonologists mentioned that they frequently see and manage patients with chronic pulmonary diseases. Totally, 25 physicians reported that they never prescribe inhaler medications. The most common cause for no or little prescription was that 'patients refused to use inhalers' (42.0%). The respondents were pediatricians (37.3%), internists (33.7%), primary-care physicians (16.0%), and pulmonologists (12.9%). About 52% stated that they themselves provided device training for their patients. Pressurized metered dose inhalers were preferred by 64.8% of physicians. Only 21.3% had good general inhaler therapy knowledge (score >2). Pulmonologists scored higher than other specialty groups regarding good knowledge of

inhalation therapy (66.7%), whereas pediatricians scored the lowest (8.3%).

**Conclusion** Prescription of inhalers, knowledge among physicians regarding inhalation therapy, and correct use of inhalers varied between pulmonologists and nonpulmonologists, and was generally inadequate. More effort is needed to change the attitude of physicians toward the concept of inhalation therapy.

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**Keywords:** dry powder inhalers, inhalation, knowledge, metered dose inhaler, physicians, techniques

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## Introduction

Asthma [1] and chronic obstructive pulmonary disease (COPD) [2] are common causes of morbidity and mortality worldwide. Treatment for the two diseases requires regular administration of several drugs through inhalation [3,4]. Although the technical properties of the device system are important in improving the effectiveness of the inhaled medications [5], a high percentage of healthcare professionals is incapable of demonstrating the correct use of inhaler devices [6,7].

It is not only demonstrated that the vast majority of patients improperly use their inhalation devices [8–17], but also that physicians and nurses who prescribe or supervise them have poor knowledge and skills regarding their use [18,19].

The present study was carried out to assess physicians' prescriptions and knowledge of inhaled therapy.

## Patients and methods

### Study site

This study was carried out at Minia and Fayoum governorates.

### Study type

The present study was a prospective, cross-sectional survey.

### Study design

The present study was designed to assess current practice, knowledge, and level of awareness of inhaled therapy among physicians who can deal with asthma and COPD patients (primary-care physicians, pediatricians, internists, and pulmonologist). We developed a questionnaire consisting of 16 questions. Participation in the survey was voluntary, and the questionnaires were distributed to physicians throughout Minia and Fayoum governorates by the researchers themselves. The purpose of the questionnaire was explained to all participants, and verbal consent was obtained from all of them. The survey was carried out from June 2015 to February 2016. The study design was approved by the Ethics in Research Committee of the Institution.

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The 16-item questionnaire (Appendix) took less than 10 min to answer. The first four questions gathered information about the respondent's age, sex, medical specialty, and position. Subsequent questions were developed using a multiple-choice format and included the following: frequency of seeing and managing COPD or asthmatic patients (items 5–6), information about inhaler prescription, preferences, and education activities on inhalation techniques (items 7–12), and level of knowledge (items 13–16).

The correct answers for items 13, 14, 15, and 16 were 1, 1, 3, and 4, respectively. Regarding the correct answer for item 13, there are several aspects that physicians have to consider when prescribing an inhaler, such as age, skill, previous experience, and a patient's cultural background [20–22]. The correct answers for items 14, 15, and 16 are based on the current recommendations for inhalation therapies [7,8,12,23–27], where the critical step for each inhaled maneuver and educational aspects to train the patients were emphasized. The level of knowledge about inhalation therapy was assessed by using the sum of correct answers to items 13–16. Each correct answer was assigned one point. Total scores therefore ranged from 0 to 4. This score generated a new variable, general inhalation knowledge, from which we stratified the sample into two groups: poor (0–2 points) and adequate (3–4 points) inhalation knowledge.

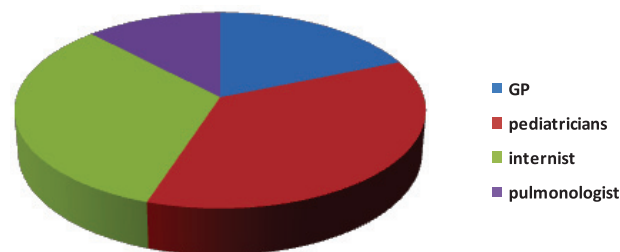
### Statistical analysis

Results for each item are expressed as percentages and compared between specialty groups using the  $\chi^2$  or analysis of variance tests. Statistical significance was set at a *P* value of less than 0.05. Independent variables were included in the model only if they were significant in the bivariate analysis. Analyses were carried out with IBM SPSS statistics version 17 (SPSS for Windows; IBM, Chicago, Illinois, USA).

### Results

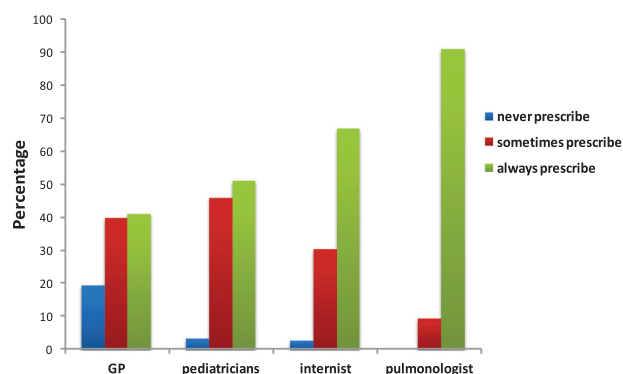
A total of 443 respondents completed the questionnaire. There were 83 general practitioners (GPs), 145 internists, 161 pediatricians, and 45 pulmonologists. Regarding the level of inhaler prescription, 25 physicians reported that they never prescribe inhaled medications. Another 156 physicians mentioned that they do not usually prescribe inhalers. Above 90% of the studied pulmonologists mentioned that they usually prescribe inhalers. About 67% of internists reported that they usually prescribe inhalers. About half of pediatricians reported that they usually prescribe

Figure 1



Total studied sample: general practitioners=83, internists=145, pediatricians=161, and pulmonologist=54. GP, general practitioner.

Figure 2



Patterns of inhaler prescription: in the total studied sample, general practitioner =83 (16 never prescribe, 33 sometimes, 34 usually); internists=145 (four never, 44 sometimes, and 97 usually); pediatricians=161 (five never, 74 sometimes, and two usually); and chest physician=54 (0 never, five sometimes, and 49 usually). GP, general practitioner.

inhalers, and only 41% of GPs mentioned that they usually prescribe inhalers (Figs. 1 and 2).

Tables 1–3 display the response of all physicians – who prescribe inhalers – for all items and compare the results obtained for different specialty groups. The most common causes for never prescribing or rarely prescribing inhalers were ‘patients refuse to use inhalers’ (42.0%) followed by ‘I think patients can’t use inhalers correctly’ (32%) (Tables 4–6). Regarding source of knowledge (item 9), attending scientific meetings and workshops was the most frequent source of knowledge for pulmonologists (44.4%). Primary-care physicians were more likely to depend on their experience in choosing the inhalation device (19.4%).

Regarding the type of device preferred by physicians (item 11), pressurized meter dose inhalers (pMDIs) (with or without spacer) were preferred by 64.8% of physicians. Primary-care physicians and internists were the most common groups that chose pMDI (53.7 and 52.5%,

**Table 1 Comparison between different specialties regarding the whole questionnaire**

	Total (n=418) [n (%)]	GP (n=67) [n (%)]	Pediatrician (n=156) [n (%)]	Internist (n=141) [n (%)]	Pulmonologist (n=54) [n (%)]	P value
Age	34.6±9.1	32.2±10.4	33.7±8.3	36.3±8.7	35.6±9.8	0.008
Sex						
Male	224 (53.6)	24 (35.8)	80 (51.3)	86 (61.0)	34 (63.0)	0.1
Female	194 (46.9)	43 (64.2)	76 (48.7)	55 (39.0)	20 (37.0)	
Position						
Primary care	67 (16.0)	67 (100)	0 (0)	0 (0)	0 (0)	0.0001
Resident	139 (33.3)	0 (0)	74 (47.4)	45 (31.9)	20 (37.0)	
Specialist	148 (35.4)	0 (0)	65 (41.7)	64 (45.4)	19 (35.2)	
Consultant	64 (15.3)	0 (0)	17 (25.4)	32 (22.7)	15 (27.8)	
Source of inhalation knowledge:						
Scientific meetings	153 (36.6)	19 (28.4)	56 (35.9)	54 (38.3)	27 (50)	0.512
Reading articles or books	110 (26.3)	16 (23.9)	42 (26.9)	39 (27.7)	13 (24.1)	
Reading the pamphlets included	48 (11.5)	13 (19.4)	15 (9.6)	14 (9.9)	6 (11.1)	
Directly from personal experience	107 (25.6)	19 (28.4)	43 (27.6)	34 (24.1)	8 (14.8.4)	
Who trains the patients on the inhaler device?						
You, personally	217 (51.9)	33 (49.3)	90 (57.7)	60 (42.5)	34 (63)	0.131
Nurses	52 (12.4)	13 (19.4)	16 (10.3)	19 (13.5)	4 (7.4)	
Either the nurse or you, it depends	73 (17.5)	9 (13.4)	25 (16.0)	19 (13.5)	10 (18.5)	
I provide written information	57 (13.6)	6 (8.9)	21 (13.5)	25 (17.7)	5 (9.3)	
I do not give any training	19 (4.5)	6 (8.9)	4 (2.6)	8 (5.7)	1 (1.9)	
Which device do you prefer?						
pMDI	196 (46.9)	36 (53.7)	71 (45.5)	74 (52.5)	15 (27.8)	0.0001
pMDI with spacer	75 (17.9)	9 (13.4)	56 (35.9)	6 (4.3)	4 (7.4)	
Turbuhaler	65 (15.6)	12 (17.9)	15 (9.6)	27 (19.1)	11 (20.4)	
Diskus	31 (7.4)	6 (8.9)	9 (5.8)	11 (7.8)	5 (9.3)	
Aerolizer	51 (12.2)	4 (6.0)	5 (3.2)	23 (16.3)	19 (35.2)	
Why do you prefer this device?						
Easy to use	154 (36.8)	23 (34.3)	60 (38.5)	53 (37.6)	18 (33.3)	0.421
Cheap	137 (32.8)	24 (35.8)	43 (27.6)	54 (38.3)	16 (29.6)	
More effective	127 (30.4)	20 (29.9)	53 (33.9)	34 (24.1)	20 (37.1)	
Do you (or another healthcare worker) assess the patient's skill with inhaler use?						
Always	264 (63.2)	39 (58.2)	101 (58.3)	80 (52.8)	44 (81.4)	0.051
Sometimes	141 (33.7)	25 (37.3)	50 (32.1)	56 (39.7)	10 (18.5)	
Never	13 (3.1)	3 (4.5)	5 (3.2)	5 (3.5)	0 (0)	
Which of the following variables do you consider most important when you prescribe an inhaler device?						
The patient's preferences	79 (18.9)	17 (25.4)	31 (19.9)	17 (12.1)	14 (25.9)	0.001
The patient's age	105 (25.1)	13 (19.4)	53 (34.0)	26 (18.4)	13 (24.1)	
The patient's previous experience using a device	73 (17.5)	18 (26.9)	23 (14.7)	26 (18.4)	6 (11.1)	
The patient's cultural background	81 (19.4)	12 (17.9)	22 (14.1)	39 (27.7)	8 (14.8)	
Cost	80 (19.1)	7 (10.4)	27 (17.3)	33 (23.4)	13 (24.1)	
The most important step for correct pMDI inhalation						
Shake the device before inhalation	122 (29.2)	19 (28.4)	46 (29.5)	41 (29.1)	16 (29.6)	0.064
Exhale deeply before inhalation	79 (18.9)	11 (16.4)	29 (18.6)	31 (22.0)	8 (14.8)	
Firing the device after beginning inspiration	82 (19.6)	11 (16.4)	23 (14.7)	33 (23.4)	15 (27.8)	
Inhale deeply and forcefully	84 (20.1)	18 (26.9)	36 (23.1)	26 (18.4)	4 (7.4)	
Continue deep, slow inspiration	51 (12.2)	8 (11.9)	22 (14.1)	10 (7.1)	11 (20.4)	
The most important step for correct DPI inhalation						
Shake the device before inhalation	81 (19.4)	16 (23.9)	34 (21.8)	27 (19.1)	4 (7.4)	
Exhale deeply before inhalation	72 (17.2)	11 (16.4)	34 (21.8)	18 (12.8)	9 (16.7)	0.0001

(Continued)

**Table 1 (Continued)**

	Total (n=418) [n (%)]	GP (n=67) [n (%)]	Pediatrician (n=156) [n (%)]	Internist (n=141) [n (%)]	Pulmonologist (n=54) [n (%)]	P value
Firing the device after beginning inspiration	69 (16.5)	10 (14.9)	21 (13.5)	30 (21.3)	8 (14.8)	
Inhale deeply and forcefully	134 (32.1)	10 (14.9)	45 (28.8)	49 (34.7)	30 (55.6)	
Continue deep and slow inspiration	62 (14.8)	20 (29.9)	22 (14.1)	17 (12.1)	3 (5.6)	
Knowledge						
Good knowledge	89 (21.3)	10 (14.9)	13 (8.3)	30 (21.3)	36 (66.7)	0.0001
Poor knowledge	329 (78.7)	57 (85.1)	143 (91.7)	111 (78.7)	18 (33.3)	

DPI, dry powder inhalers; GP, general practitioner; pMDI, pressurized meter dose inhaler.

**Table 2 Classification of physicians according to level of knowledge about inhalation therapy**

	Poor ( $\leq 2$ points) (n=329)	Adequate ( $> 2$ points) (n=89)	P value
Specialty			
Primary-care physician	57 (85.1)	10 (14.9)	0.0001
Pediatrician	143 (91.6)	13 (8.4)	
Internist	111 (78.7)	30 (21.3)	
Pulmonologist	18 (33.3)	36 (66.7)	
Position			
Primary-care physician	57 (85.1)	10 (14.9)	0.127
Resident	112 (80.6)	27 (19.4)	
Specialist	116 (78.4)	32 (21.6)	
Consultant	44 (68.8)	20 (31.2)	
Place of work			
General hospitals	217 (83.5)	43 (16.5)	0.001
Teaching hospitals	112 (70.9)	46 (29.1)	
Sex			
Male	174 (77.7)	50 (22.3)	0.333
Female	155 (79.9)	39 (20.1)	
Age	34.4 $\pm$ 9.1	35.2 $\pm$ 9.3	0.461

**Table 3 Comparison between the studied physicians regarding their level of inhaler prescription**

	Physicians never or sometimes prescribe inhalers (n=181)	Physicians usually prescribe inhalers (n=262)	P value
Specialty			
Primary-care physician	49 (59)	34 (41)	0.0001
Pediatrician	79 (49)	82 (51)	
Internist	48 (33.1)	97 (66.9)	
Pulmonologist	5 (9.3)	49 (90.7)	
Position			
Primary-care physician	48 (58.5)	34 (41.5)	0.001
Resident	68 (47.2)	76 (52.8)	
Specialist	48 (31.6)	104 (68.4)	
Consultant	17 (16.8)	84 (83.2)	
Place of work			
General hospitals	125 (43.9)	160 (56.1)	0.052
Teaching hospitals	56 (35.4)	102 (64.6)	
Knowledge			
Good knowledge	18 (20.2)	71 (79.8)	0.0001
Poor knowledge	163 (46)	191 (54)	
Sex			
Male	93 (39.7)	141 (60.3)	0.342
Female	88 (42.1)	121 (57.9)	
Age	32.9 $\pm$ 8.4	35.5 $\pm$ 9.3	0.003

**Table 4 Reasons for never or little inhaler prescription**

Causes	n (181)
Patients refuse to use inhalers	76 (42)
You think patients cannot use inhalers in a correct way	58 (32)
You do not trust the effectiveness of the inhalers	12 (6.6)
You do not have enough information about inhalers	35 (19.4)

respectively), while chest physicians were the least common (27.8%). Spacers were used most commonly by pediatricians (35.9%). Dry powder inhalers (DPIs) (aerolizer, turbuhaler, and discus) were selected by 35.2% of physicians, and a significant proportion of chest physicians (64.9%) preferred DPIs than other specialty groups. Aerolizer was the most common DPI device preferred by chest physicians (34.2%).

**Table 5 Preferred inhalation device and the cause**

	pMDI [n (%)]	pMDI with spacer [n (%)]	Turbuhaler [n (%)]	Discus [n (%)]	Aerolizer [n (%)]	P value
N	196 (46.9)	75 (17.9)	65 (15.6)	31 (7.4)	51 (12.2)	
Etiology						
Easy to use	64 (32.7)	35 (46.7)	25 (38.5)	9 (29.0)	21 (41.2)	0.0001
Cheap	114 (58.2)	5 (6.6)	9 (13.8)	1 (3.2)	8 (15.7)	
More effective	18 (9.1)	35 (46.7)	31 (47.7)	21 (67.7)	22 (43.1)	
Specialty						
Primary care	36 (18.4)	9 (12.0)	12 (18.5)	6 (19.4)	4 (7.5)	0.0001
Pediatrician	71 (36.2)	56 (74.7)	15 (23.1)	9 (29.0)	5 (9.8)	
Internists	74 (37.8)	6 (8.0)	27 (41.5)	11 (35.5)	23 (45.1)	
Chest physician	15 (7.7)	4 (5.3)	11 (16.9)	5 (16.1)	19 (37.3)	
Position						
Primary care physician	36 (18.4)	9 (18.0)	12 (18.5)	6 (19.5)	4 (7.8)	0.009
Resident	63 (32.1)	30 (40.0)	23 (35.4)	13 (41.9)	10 (19.6)	
Specialist	74 (37.8)	29 (38.7)	18 (27.7)	7 (22.6)	20 (39.2)	
Consultant	23 (11.7)	7 (9.3)	12 (18.5)	5 (16.1)	17 (33.3)	
Place of work						
Teaching hospitals	76 (38.8)	26 (34.7)	28 (43.1)	14 (45.2)	14 (27.5)	0.380
General hospitals	120 (61.2)	49 (65.3)	37 (56.9)	17 (54.8)	37 (72.5)	
Knowledge						
Good knowledge	34 (17.3)	8 (10.7)	20 (30.8)	7 (22.6)	20 (39.2)	0.0001
Poor knowledge	162 (82.7)	67 (89.3)	45 (69.2)	24 (77.4)	31 (60.8)	

pMDI, pressurized meter dose inhalers.

**Table 6 Comparison between pulmonologists and nonpulmonologists**

	Pulmonologists (n=54)	Nonpulmonologists (n=364)	P value
Physicians usually prescribe inhalers			
Most of the times	90.7	58.5	0.02
Sometimes and never	9.3	41.5	
Types of device			
pMDI	35.2	69.2	0.0001
DPI	64.8	30.8	
Source of knowledge			
Meetings, courses, or workshop	34/54 (63)	183/364 (50)	
Other sources	20/54 (37)	181/364 (50)	0.6
Who trains the patients on how to use the device?			
Doctors	34/54 (62.9)	183/364 (50.3)	0.3
Other persons	20/54 (37.1)	181/364 (49.7)	
Level of knowledge			
Adequate	66.7	14.6	0.0001
Poor	33.3		
Reasons for choosing specific device			
Easy to use	18/54 (33)	136/364 (37)	
Cheap	16/54 (30)	121/364 (33)	
Effective	20/45 (37)	107/364 (30)	0.5
Assessing patient skill on using the inhaler			
Usually	44/54 (81)	220/364 (60)	
Not usually	10/54 (19)	144/364 (40)	0.004

DPI, dry powder inhaler; pMDI, pressurized meter dose inhalers.



Results for item 13 (which of the following variables do you consider most important when you prescribe an inhaler device?) revealed that only 18.9% of physicians selected the correct answer (patient's preferences), and between specialty groups chest physicians significantly chose this option more frequently than any other group (25.9%).

Regarding item 14 (do you – or another healthcare worker – assess the patient's skill with inhaler use), 29.7% of physicians chose the correct answer (always). Chest physicians were the most common to choose the correct answer (48.1%).

Regarding general inhaled therapy knowledge, only 21.3% had good knowledge (score >2). Chest physicians scored higher compared with other groups regarding good knowledge (66.7%), whereas pediatricians scored the lowest (8.3%). Neither sex nor age was significantly associated with general inhaled therapy knowledge score. Physicians who prescribe DPIs [especially for aerolizer (39.2%) and turbuhaler (30.8%)] were found to have higher knowledge than those who prescribe metered dose inhalers (MDIs) (17.3%) or spacers (10.7%).

## Discussion

The findings of the present study showed that a significant proportion of asthmatic and COPD patients are managed by nonpulmonologists – for example, GP, internists, and pediatricians. Our results are not surprising, as even in developed countries many asthmatic and COPD patients are managed by family physicians or by general physicians [28,29].

In the present study, 25 physicians never prescribed inhalers, and another 156 physicians mentioned that they do not usually prescribe inhalers. Therefore, about 41% of the studied physicians do not consider inhalation therapy as the foundation of treatment for asthma and COPD patients. Our results are comparable with that of Bedi [30] where only 40.5% of the studied physicians prescribed inhalers for asthmatic patients; however, there was a long gap of time between our study and his study, which was carried out about 22 years earlier, and Bedi's study sample included only GPs.

The most common cause of never or little prescription was 'patients refuse to use inhalers' (42.0%). By looking at these results, we can notice that the main reasons for never or little inhalation prescription are physician-related factors (58%), which are as follows: doctors

think that patients cannot use the inhaler correctly (32%), doctors lack information about the inhalers (19.4%), or they do not trust the effectiveness of the inhaler (6.6%). Even in our opinion, we feel that patient refusal to a significant extent is related to poor communication between patients and doctors, simply because doctors do not do their best in explaining to their patients the nature of their diseases, the value, and the advantages of inhalation therapy. They do not have time to explore what are the causes of such refusal. Therefore, to achieve better control of asthma and COPD, these issues must be considered carefully, and more effort is needed to change the physician concept about the value of inhalation therapy.

Item 7 was related to the source of inhaled therapy knowledge. Primary-care physicians were the most common group who depended on their experience in choosing the inhaler device (28.4%). Chest physicians were the most common group who depended on meetings, courses, and workshops for choosing the inhaler device (44.4%). Çalışkaner *et al.* [31] reported that the most common sources of information were the Internet and drug leaflets.

To evaluate the effectiveness of different sources of knowledge about the correct use of inhalation devices, a study involving first-year interns looked at the level of improvement on the basis of the type of education provided. Initially, only 5% of interns could use an MDI without error. After a lecture and demonstration, 13% showed an error-free technique. However, when each intern participated in an intensive one-on-one session, the error-free rate reached 73%. The researchers' conclusion was as follows: lectures are relatively ineffective in teaching interns about inhaler technique compared with a one-on-one approach [32]. Another study revealed the same result [33].

In the present study, 53.8% of physicians themselves provided device training for their patients, and no significant difference exists between different specialties regarding this point. The results are different compared with previous studies. Çalışkaner *et al.* [31] reported that about 70% of physicians stated that they themselves provided initial training and education about the inhaler devices prescribed to patients. The remaining included healthcare providers other than physicians, including nurses (16.2%), respiratory physiotherapists or technicians (3.4%), and residents (1.5%). Among physicians, 10.2% stated that they were unable to provide initial education. Lenney *et al.* [34] reported slightly higher results (73.2%). They also showed that

among the preferred ways of inhaler training were demonstration (56.3%), video (19%), and brochures and leaflets (18%). Lenney *et al.* [31] compared patients learning the use of MDI from the brochure with patients learning from a physician, and they found that the rates of correct usage were 21% in patients who learned from the brochure and 52% in patients who were educated by a physician. In contrast to the previous results, Barthwal *et al.* [29] reported that 26.7% of the physicians provide patient training.

An important point that has to be mentioned here is that about half of the studied physicians do not educate their patients on how to use inhaler devices, but they depend on nurses, drug leaflets, or do not provide training at all. Important questions include 'Do we have enough nursing staff for training patients?', 'Are our nurses capable of demonstrating to the patients how to use inhaler devices?', 'Do they receive training on how to use the inhaler?', and 'Do they have time to demonstrate to their patients how to use inhalers?'. In developed countries, although there are specialized nurses who can train patients on the correct way of using inhalers, the percentage of nurses who were able to demonstrate the correct use of inhaler devices was low [18,19]. In our locality, we do not have enough nursing staff, we do not have specialized respiratory nurses, and nurses do not receive any formal training on how to use the inhaler. Therefore, we could not find any explanation why a significant portion of physicians depend on nurses for training patients on the correct way of using inhaler devices. Similarly, we feel that depending on providing leaflets to patients is not an effective way of training, especially in areas where the level of illiteracy is high.

In the present study, pMDIs (with or without spacer) were preferred by 64.8% of physicians. About 47% of our physicians chose pMDI, and 17.8% chose pMDI with spacer. The pMDI is still the most frequently prescribed inhaler device worldwide, despite the fact that most patients cannot use it correctly [27,34,35]. This is because pMDIs require good coordination of patient inspiration and inhaler activation to ensure correct inhalation and deposition of the drug in the lungs [35].

This result is in agreement with a study carried out in Malaysia, which stated that more than half of government and private physicians chose pMDI as their first-choice device. pMDI plus spacer ranked second regarding use by government physicians (24.1%), whereas among private physicians three types of inhaler devices (pMDI plus spacer,

turbuhaler, and nebulizer) ranked second (14.2% in each). The relatively low cost and the wide variety of medications available in the pMDI device have contributed to the popularity of this delivery system [36]. In contrast to our results, Plaza *et al.* [6] reported that physicians preferred DPI (61.2%).

In an Egyptian study, the majority (70.5%) of patients used MDI. The authors attributed this result to the fact that MDI is the cheapest inhalation device available in the Egyptian market, and it is the main inhalation device distributed by state-funded health services [37].

Another finding that deserves comment is that, although pMDI (with or without spacer) was the preferred device by 64.8% of physicians, only 19.6% identified the correct answer for the most important step in the pMDI inhalation maneuver. In addition, although DPI was the preferred device by 35% of physicians, 32.1% identified the correct answer for the most important step in the DPI inhalation maneuver. This inconsistency adds to the general deficiencies identified in knowledge of inhalation therapy in the sample surveyed. These results are in agreement with similar studies from other countries [19,23].

The present study revealed that pMDI was the preferred device by primary-care physicians than other specialties, and spacers were preferred by pediatricians than other specialties. The proportion of preference for DPI was higher among chest physicians than other specialties. This may be explained by the higher knowledge about inhalation therapy among chest physicians than other specialties.

There are several aspects that physician's have to consider when prescribing an inhaler, such as age, skill, previous experience, and a patient's cultural background. However, patient opinion and preference are considered to play a critical role, because including patients in decision making improves disease outcomes and treatment compliance [22].

In our study, when physicians were asked about factors to be considered for choosing inhaler devices, they stated that the patient's age is the most important factor (25.1%), and the other factors were near equally chosen (see Table 1). A previous study reported that the reasons for choosing inhaler devices by physicians included simplicity of use (38%), degree of penetration into the bronchial tree (15%), opinion of the patient (12%), and cost of the system (7%) [5]. In a survey carried out in Malaysia, the majority of government physicians

quoted technical ability as their primary concern for choosing inhaler devices, whereas cost and personal preferences ranked equally as main primary concerns with private physicians [38]. One remarkable result of the Malaysian survey was that private physicians prescribed oral bronchodilators more frequently. The most common reasons for private physicians to prescribe oral preparation were cost and patient reluctance to use inhaler devices. In contrast, inability to correctly handle an inhaler device was the most quoted reason by government physicians.

About 20% (19.6%) of our sample successfully identified the critical step for pMDI, and 32.1% identified the correct step for DPI. Lower figures have been obtained by previous studies carried out in Nepal, Iran, and Oman: 0, 6.93, and 15% of healthcare physicians, respectively, could demonstrate pMDIs correctly [39–41]. Similarly, in previous studies, the rate of correct usage of inhaler devices by patients was found to be quite low [42,43].

Two studies conducted in Spain to evaluate healthcare professionals' skills in the use of inhalation devices asked participants to give a practical demonstration with a placebo inhaler [26,27]. One of these studies showed that only 28% of 428 physicians managed the pMDI correctly [26], and the other showed that only 27% of 118 physicians and nurses used the Turbuhaler DPI correctly [26]. These results are far lower than that of Plaza *et al.* [6], who reported that 72% successfully identified the critical step for the pMDI, and 46.1% identified the correct step for the DPI. In addition, our results are lower than that of Unlu *et al.* [17] who found rates of correct usage of inhalers by health workers to be 76.8% for MDI, 50.8% for turbuhaler, and 44.5% for discus.

In our study, when general inhalation therapy knowledge (composite variable) was studied, we found only 21.3% of the sample had adequate knowledge of inhaled therapy. Plaza *et al.* [6] also recorded that 14.6% of the respondents had adequate inhaled therapy knowledge.

On comparing pulmonologists and nonpulmonologists with regard to the concept of inhalation therapy, there were significant differences in the level of prescription of inhalation therapy, type of device prescribed, and in assessing patient skills regarding the use of inhalation therapy. These differences can be explained by the significantly higher level of knowledge among chest doctors. Regarding the level of knowledge, pulmonologists showed significantly higher scores

(66.6%) than other specialties (14.6%). These are consistent with previous studies [6,27]. The higher level of knowledge among pulmonologists can be attributed in part to their higher level of training and differences in the source of knowledge between chest and nonchest doctors, where a large percentage of pulmonologists depend on meetings, courses, and workshops as their primary source of knowledge regarding inhalation therapy.

When level knowledge was compared between different positions, consultants showed significantly better scores than other positions.

### Limitations

- (1) Although we did our best to explain to the physicians that what we are looking for is their real practice, some of them tried to answer in the ideal way and not based on actual practice. Sometimes, we noticed that some of them used the web to find the right answers!
- (2) Sometimes, we noticed group answering of the questioners, and many of them were excluded.
- (3) The method used is another limitation: the data were based only on the results of a survey on self-perceived knowledge and may not reflect respondents' behavior in actual clinical practice.

### Conclusion

Asthma and COPD are two diseases that are not only managed by pulmonologists but also by nonpulmonologists. Prescription of inhaler medications varies among doctors of different specialties who deal with patients with these problems. Poor prescription of inhalers was found among GPs and was not optimal for other specialties including pulmonologists. The main reason for not prescribing inhalation therapy was patient refusal. The present study identified poor knowledge among healthcare professionals regarding the correct use of inhalers. It would be beneficial to have periodic educational programs for healthcare professionals regarding inhaler medication use. Different strategies to improve general inhalation therapy knowledge during residency training should be provided. In addition, scientific societies and pharmaceutical industries should develop and launch a series of educational activities (meetings, postgraduate courses, workshops, and documents) supported by scientific societies addressing physicians (pulmonologists and nonpulmonologists) who are dealing with patients with either asthma or COPD to improve their knowledge on inhalation therapy. Patient



education about the nature of the disease and the advantages of inhalation therapy to avoid refusal of using such valuable treatment modes is of utmost importance.

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### Conflicts of interest

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## Appendix

Table 1A Questionnaire administered to the studied sample

<b>1- Age:</b> ..... years			
<b>2- Sex:</b>	1- Male	2- Female	
<b>3- Specialty:</b>	1- Primary care	2- Pediatrician	
	3- Internist	4- Pulmonologist	
<b>4- Position:</b>	1- Primary care	2- Resident	3- Specialist 4- Consultant
<b>5- How often do you see patients with pulmonary problems?</b>			
	1- Few times	2- Sometimes	3- Many times
<b>6-For non –pulmonologists, What do you do when you see, patients with pulmonary problems?</b>			
	1- Manage by yourself	2-Refer to Pulmonologist.	
<b>7-For patients with asthma or COPD how often do you prescribe inhaled medications:</b>			
	1- Most of the times	2- Sometimes	3- Never
<b>8-Main reasons for never or little prescription of inhalers?</b>			
	1. Patients refuse to use inhalers		
	2. You think that patients cannot use the inhalers in the correct way		
	3. You do not trust the effectiveness of the inhalers		
	4. You do not have enough information about the inhalers		
<b>9-From where does your knowledge concerning the usage of Inhalation devices comes from?</b>			
	1. Attendance of scientific meetings & workshops		
	2. Reading books specialized in this topic		
	3. Reading the pamphlets included with the inhaler devices		
	4. Directly from personal clinical experience and common sense		
<b>10-Who is responsible for the training of your patients concerning the technique of usage of the inhalation devices?</b>			
	1. You, personally		
	2. Nurses(trained/untrained)		
	3. Either the nurse or you, it depends		
	4. I provide written information		
	5. I don't give any training		
<b>11-Which device do you prefer?</b>			
	1- pMDI	2- pMDI with spacer	3- Turbuhaler
	4- Diskus	5- Aerolizer	
<b>12-Why do you prefer this device?</b>			
	1- Easy to use	2- Cheap	3- More effective
<b>13-Which of the following variables do you consider most important when you prescribe an inhalation device?</b>			
	1- The patient's preferences	2- The patient's age	
	3-The patient's previous experience using a specific inhaler		
	4-The patient's cultural level	5- Cost	
<b>14-Do you assess the patient's skill with inhaler use?</b>			
	1- Always	2- Sometimes	3- Hardly ever
<b>15-The most important step for correct pMDI inhalation is:</b>			
	1. Shake the device before inhalation		
	2. Exhale deeply before inhalation		
	3. Firing the device after beginning inspiration		
	4. Inhale deeply and forcefully		
	5. Continue deep, slow inspiration		
<b>16-The most important step for correct DPI inhalation is:</b>			
	1. Shake the device before inhalation		
	2. Exhale deeply before inhalation		
	3. Firing the device after beginning inspiration		
	4. Inhale deeply and forcefully		
	5. Continue deep and slow inspiration		

Many times, if you usually (>75% of your days) see asthmatic or chronic obstructive pulmonary disease patients during practice.

Sometimes, if you see asthmatic or chronic obstructive pulmonary disease patients (50% of your days) during practice.

A few times, if occasionally (<20% of your days) you see asthmatic or chronic obstructive pulmonary disease patients.