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Accuracy of Inhaler Use in COPD Patients and Factors Affecting It

Abstract

Background: Inhaler is a type of dosage form used in the treatment of Chronic Obstructive Pulmonary Disease (COPD). The inhaler has a unique technique for use, however the percentage of accuracy in inhaler use is still low. Whereas proper inhaler use is expected to improve quality of life and decrease the occurrence of exacerbations.

Method: This study was conducted with a cross-sectional design on COPD patients in two different hospitals. Primary data were collected using a questionnaire. Accuracy of inhaler use was assessed using a checklist.

Results: The total number of patients in this study was 110, with an average age of 62 years. Patients were given single inhaler therapy, which included Dry Powder Inhalers (DPI) for up to 34 patients with 70.7% accuracy, Pressurized Metered-Dose Inhalers (pMDI) for up to 9 persons with 45.74% accuracy, and Soft Mist Inhalers (SMI) for one person with 66.67% accuracy. Furthermore, patients who used a combination of pMDI + DPI inhalers had an accuracy value of 68.53%, and pMDI + SMI had an accuracy value of 72.72%. The stage with the lowest level of accuracy in the pMDI type inhaler used alone was exhaling before the inhaler is supplied.

Conclusion: According to the findings, the accuracy of inhaler use in COPD patients is still relatively low. Furthermore, gender and BMI are factors that have a statistically significant relationship with inhaler accuracy.

Introduction

COPD (chronic obstructive pulmonary disease) is one of the three leading causes of death in the world. It is a common respiratory disorder characterized by persistent symptoms and airflow limitation due to exposure to harmful particles or gases (1). Treatment of stable or exacerbated COPD is carried out using an inhaler. Inhalers require specific techniques for

use and are one of the causes of medication noncompliance (2). Although inhalers are one of the best drug delivery devices, and previous research found that only 3% of patients found inhaler use difficult, half of these patients demonstrated incorrect inhaler use (3).

In Indonesia, there are several types of inhalers in circulation with different drug formulations, such as Pressurized metered-dose inhalers (pMDI), Dry Powder Inhalers (DPI), and Soft Mist Inhalers (SMI). All three types of inhalers are widely used by patients with COPD (4). Unfortunately, only 2.86% of patients use the inhaler appropriately for all its stages (5). The Test of Adherence to Inhaler Toolkit has divided the causes of non-compliance of patients using inhalers into 3 categories, which include sporadic (reminders and counseling), deliberate (education and counseling), and unconscious (treatment plan and inhaler use instructions) (6). Inappropriate use of inhalers can lower disease control, increase drug consumption and side effects, increase the frequency of acute attacks or exacerbations, hospitalizations, and drug expenses, and impair treatment success (7). According to one study, providing information on inhaler use method reduced the frequency of moderate to severe yearly exacerbations and hospitalizations (8). The accuracy of each stage of inhaler use in COPD patients was evaluated in this study. We then assessed if any baseline patient characteristic influenced inhaler accuracy.

Method

A cross-sectional study was done to examine the characteristics of COPD patients and to assess the level of accuracy of inhaler use.

Population

Consecutive sampling was conducted on COPD patients who underwent treatment control at Menteng Mitra Afia Hospital in November 2022, and at Grha Permata Ibu Hospital in December 2022. Sampling was terminated when reaching the end of the sampling period. (9) The inclusion criteria were patients diagnosed with COPD by a doctor, receiving at least one therapy administered in the form of an inhaler, and willing to participate in the study as indicated by signing an informed consent. Patients with other chronic lung disorders, such as

tuberculosis and pulmonary fungal infections, as well as those who were blind, deaf, speech challenged, or illiterate, were excluded from this study.

Data collection

Demographic data from each patient was documented using a questionnaire regarding the patient's basic characteristics. Treatment data used was the treatment when the study was taken.

Assessment of the accuracy of inhaler use

A different list was used for each type of inhaler circulated in Indonesia. Proper use of each step was scored in separate points. The checklist is a checklist from the NPS MedicineWise Inhaler Technique: Device-specific checklist that has been adapted and used in the study of Sauriasari, et al (10). The list of steps to be performed is listed in Table 1. The accuracy score of inhaler use is defined as the percentage of correct steps compared to the total number of steps that should be executed. Patients who use combination inhalers demonstrated each inhaler separately.

Table 1. Stages of inhaler use

Inhaler Type	No	Stages of Use
Diskus	1	Open the cap of the inhalation medication using your thumb.
	2	Hold the inhalation medication horizontally, set the dose by sliding the lever until it clicks
	3	Exhale slowly and as fully as possible, away from the inhalation medication
	4	Place the mouthpiece of the inhalation medication between the teeth without biting and close the lips. Do not block the air outlet
	5	Breathe in continuously and deeply
	6	Hold breath for 5 seconds or as long as possible (maximum 10 seconds)

	7	When holding your breath, remove the inhalation medication from the mouth
	8	Exhale slowly, away from the inhalation medication
	9	Close the inhalation medication after use
	10	If the inhalation medication contains steroids, rinse your mouth with clean water after using the inhalation medication, and do not swallow the remaining water.
Turbuhaler	1	Twist and remove the inhalation cap
	2	Keep the inhalation medication in an upright position while turning the grip (red color) to the right.
	3	Turn the grip back the other way (towards the left) until it clicks.
	4	Exhale slowly, away from the inhalation medication
	5	Place the inhalation mouthpiece between the teeth without biting and close the lips. Do not block the air outlet
	6	Breathe in strongly and deeply
	7	Hold breath for 5 seconds or as long as possible (maximum 10 seconds)
	8	When holding your breath, remove the inhalation medication from the mouth
	9	Exhale slowly, keeping away from the inhalation medication
	10	Close the inhalation medication after use
	11	If the inhalation medication contains steroids, rinse your mouth with clean water after using the inhalation medication, and do not swallow the rinse.
	12	Exhale slowly, keep away from the inhalation medication.
	13	Close the inhalation medication after use
	14	If the inhalation medication contains steroids, please rinse your mouth with clean water after using the inhalation medication, and do not swallow the rinse.
PMDI	1	Unscrew the cap of the inhalation medication
	2	Hold the inhalation medication in an upright position and shake it well
	3	Exhale slowly, away from the inhalation medication

	4	Place the inhalation medication between the teeth without biting and keep the lips together
	5	Inhale slowly from the mouth, and at the same time, press the canister firmly
	6	Continue to breathe in slowly and deeply
	7	Then hold breath for 5 seconds or as long as possible (maximum 10 seconds)
	8	While holding the breath, remove the inhalation medication from the mouth
	9	Exhale slowly, away from the inhalation medication.
	10	Close the inhalation medication after use
	11	If the inhalation medication contains steroids, you should rinse your mouth with clean water after using the inhalation medication, and do not swallow the remaining rinse water.
Breezhaler	1	Open the cap of the inhalation medication
	2	Open the mouthpiece of the inhalation medication
	3	Remove the capsule from the blister and place it in the capsule holder.
	4	Close the mouthpiece of the inhalation medication until it clicks.
	5	Press the right and left side buttons of the inhalation medication simultaneously and release (do not shake)
	6	Exhale one breath at a time
	7	Place the mouthpiece of the inhalation medication between the teeth without biting and keep the lips together.
	8	Breathe in strongly and deeply
	9	Hold breath for 5 seconds or as long as possible (maximum 10 seconds)
	10	While holding the breath, remove the inhalation medication from the mouth
	11	Exhale slowly, away from the inhalation medication
	12	Open the mouthpiece of the inhalation medication and take out the capsule. Check if it is empty
	13	Close the inhalation medication after use

	14	If the inhalation medication contains steroids, rinse your mouth with clean water after using the inhalation medication, and do not swallow the remaining rinse water.
Respimat	1	Hold the inhalation medication upright with the cap closed.
	2	Slide the bottom of the inhalation medication to the right (in the direction of the arrow) until it clicks (half a turn).
	3	Open the cap of the inhalation medication completely
	4	Exhale slowly, away from the inhalation medication
	5	Place the inhalation mouthpiece between the teeth without biting and keep the lips together. Do not block the air outlet
	6	Inhale slowly and deeply through the mouth, and at the same time, press the dose button
	7	Continue to breathe in slowly and deeply
	8	Hold the breath for 5 seconds or as long as possible (maximum 10 seconds)
	9	While holding the breath, remove the inhalation medication from the mouth
	10	Exhale slowly, away from the inhalation medication
	11	Close the inhalation medication after use
	12	If the inhalation medication contains steroids, rinse your mouth with clean water after using the inhalation medication, and do not swallow the remaining rinse water.

Statistical Analysis

Descriptive statistics were assessed with frequencies and percentages for qualitative variables and averages for quantitative variables. To see the correlation between two variables, the ANOVA test and Pearson test were used. All analyses were performed using SPSS version 23. A P value of <0,05 was considered significant.

Table 2. Distribution of disease status and treatment-related factors in patients using different devices

Characteristic	Inhaler					Total
	DPI	PMDI	PMDI + DPI	PMDI + SMI	SMI	
Gender						
Male	18 (23.07)	7 (8.97)	50 (64.1)	2 (2.56)	1 (1.28)	78 (100)
Female	16 (50)	2 (6.25)	13 (40.625)	1 (3.125)	0 (0)	32 (100)
Age	60.17	63.67	62.7	70.67	77	
Age range						
19 – 44	1 (25)	0 (0)	3 (75)	0 (0)	0 (0)	4 (100)
45 – 49	9 (39.13)	0 (0)	14 (60.86)	0 (0)	0 (0)	23 (100)
>60	24 (28.91)	9 (10.84)	46 (55.42)	3 (3.61)	1 (1.2)	83 (100)
Education						
Elementary School	9 (36)	1 (4)	14 (56)	1 (4)	0 (0)	25 (100)
Middle School	5 (26.31)	2 (10.52)	11 (57.89)	1 (5.26)	0 (0)	19 (100)
High School	13 (29.54)	6 (13.63)	25 (56.81)	0 (0)	0 (0)	44 (100)
College/University	7 (31.81)	0 (0)	13 (59.09)	1 (4.54)	1 (4.54)	22 (100)
Working						
Employe	11 (34.37)	1 (3.125)	18 (56.25)	2 (6.25)	0 (0)	32 (100)
Unemploye	23 (29.48)	8 (10.25)	45 (57.69)	1 (1.28)	1 (1.28)	78 (100)
Smoking						
Non Smoker	5 (38.46)	0 (0)	8 (61.53)	0 (0)	0 (0)	13 (100)
Pasive Smoker	5 (71.42)	1 (14.28)	1 (14.28)	0 (0)	0 (0)	7 (100)
Exsmoker	23 (27.38)	6 (7.14)	51 (60.71)	3 (3.571)	1 (1.19)	84 (100)
Current smoker	1 (16.67)	2 (33.33)	3 (50)	0 (0)	0 (0)	6 (100)
Comorbid						
With comorbid	21 (32.81)	6 (9.3)	34 (53.12)	2 (3.125)	1 (1.56)	64 (100)
No comorbid	13 (28.26)	3 (6.52)	29 (63.04)	1 (2.17)	0 (0)	46 (100)
Therapy						
Reliever	2 (50)	2 (50)	0 (0)	0 (0)	0 (0)	4 (100)
Controler	32 (91.42)	2 (5.71)	0 (0)	0 (0)	1 (2.85)	35 (100)
Reliever and controller	0 (0)	5 (7.04)	63 (88.73)	3 (4.22)	0 (0)	71 (100)
No. of inhaler						
1	31 (88.57)	3 (8.57)	0 (0)	0 (0)	1 (2.85)	35 (100)
2	3 (4.34)	6 (8.69)	57 (82.6)	3 (4.34)	0 (0)	69 (100)
3	0 (0)	0 (0)	6 (100)	0 (0)	0 (0)	6 (100)
Education history						
Literate	21 (26.92)	5 (6.41)	48 (61.53)	3 (3.84)	1 (1.28)	78 (100)
Illiterate	13 (40.62)	4 (12.5)	15 (46.87)	0 (0)	0 (0)	32 (100)

Results

Patient

This study included 110 patients, with a mean age of 62 years and 32 female and 78 male patients. Only 20% (n=22) had a diploma or a university degree. The majority, 40% (n=44), had completed high school. 76% (n=84) had a smoking history and had quit, but 11.82% (n=13) claimed to continue smoking. Table 1 shows detailed patient features.

Inhaler devices

35 patients were given only one type of inhaler, with four receiving only the relief form of pMDI and 31 receiving both DPI and SMI controls. Twelve patients utilized a turbuhaler, sixteen used a disc form, two used a breezhaler, and one used a Respimat. A total of 75 individuals received more than one inhaler, with 72 receiving a combination of pMDI and DPI and three receiving a combination of pMDI and SMI. Table 1 contains more complete information.

Table 3. Relationship between each variable and the percentage of accuracy of inhaler use

	% Accuracy (n)	P
Gender		
Male	64.87 (78)	0.046
Female	73.38 (32)	
BMI		
<18.5	62.5 (24)	0.013
18.6-24.9	64.33 (46)	
25-29.9	74.85 (27)	
>30	71.38 (13)	
Age range		
19 – 44	67 (4)	0.499
45 – 49	71.04 (23)	
>60	66.34 (83)	
Smoking		
Current Smoker	63.83 (6)	0.159
Exsmoker	. 65.94 (84)	
Pasive Smoker	83.57 (7)	
Non Smoker	69.31 (13)	
Education		
Elementary School	62.88 (25)	0.075
Middle School	70.58 (19)	
High School	64.05 (44)	

College/University	76.23 (22)	
Therapy		
Reliever	50 (4)	0.713
Controler	70.4 (35)	
Reliever and controller	66.82 (71)	
No. of inhaler		
1	69.77 (35)	0.62
2	65.3 (69)	
3	76.67 (6)	

Inhaler use technique

There were 5 patients who utilized the inhaler correctly at all stages. The highest percentage of inhaler accuracy was 79% in patients using Breezhaler type inhalers, followed by 69.15% in patients using Diskus type inhalers. Figure 1 depicts specific problems in inhaler use techniques. Table 1 contains information on the checklist used in this study.

Discussion

This study evaluated the accuracy of inhaler use and the factors that influence it. This is important because identifying and characterizing incorrect inhaler use is the first step to determining the next intervention to improve inhaler use techniques (11).

Table 4. Percentage of accuracy of inhaler use for each inhaler combination

Inhaler	%Accuracy(n)
DPI	70.7 (34)
PMDI	45.74 (9)
PMDI + DPI	68.35 (63)
PMDI + SMI	72.72 (3)
SMI	66.67 (1)
Total	**68.54 (110)**

In this study, the overall accuracy rate of inhaler use reached 68.54%, close to previous studies which stated that the error rate of inhaler use reached 25.3% (12). Based on the combination of inhalers used by each patient, a more detailed level of accuracy can be shown. Table 4 shows the accuracy value for each combination of inhalers used, with the lowest accuracy value occurring in patients who use a single pMDI type inhaler, with an

accuracy level of only 45.74%. This is consistent with prior research, which found that the level of inaccuracy in the usage of pMDI type inhalers was 38.9% and pMDI combined with a spacer was 42.3% (5). Similar to diskus and respimat type inhalers, the lowest percentage appears in the stage of slowly exhaling before administering the inhaler, which was 36% in the pMDI type, 44% in the Diskus type inhaler, and 20% in the Respimat type inhaler. The stage of holding one's breath after spraying the inhaler had the second lowest accuracy rate in pMDI, Turbuhaler, and Respimat type inhalers, with 42.67%, 39%, and 40%, respectively. Both stages are crucial in the use of pMDI, which has a consistently low percentage of accuracy (13)(14). According to another study, the most common errors were not exhaling before using the inhaler, breathing through the nose, and not retaining the breath (12). Breathing is typically more difficult to coordinate than other processes such as opening the cap or rotating the inhaler, especially in individuals with cough or dyspnea(15). Furthermore, if the inhalation medication contained steroids, the gargling step in Diskus, Turbuhaler, Breezhaler, and Respimat type inhalers was frequently overlooked. Patients did not rinse their mouth after using steroid-containing inhalers because they were unaware of the benefits and significance of this step, which was consistent with previous research (16). Each type of inhaler has stages that are risk factors for errors in its use(17). Details of the accuracy for each stage of inhaler use can be seen in Figure 1.

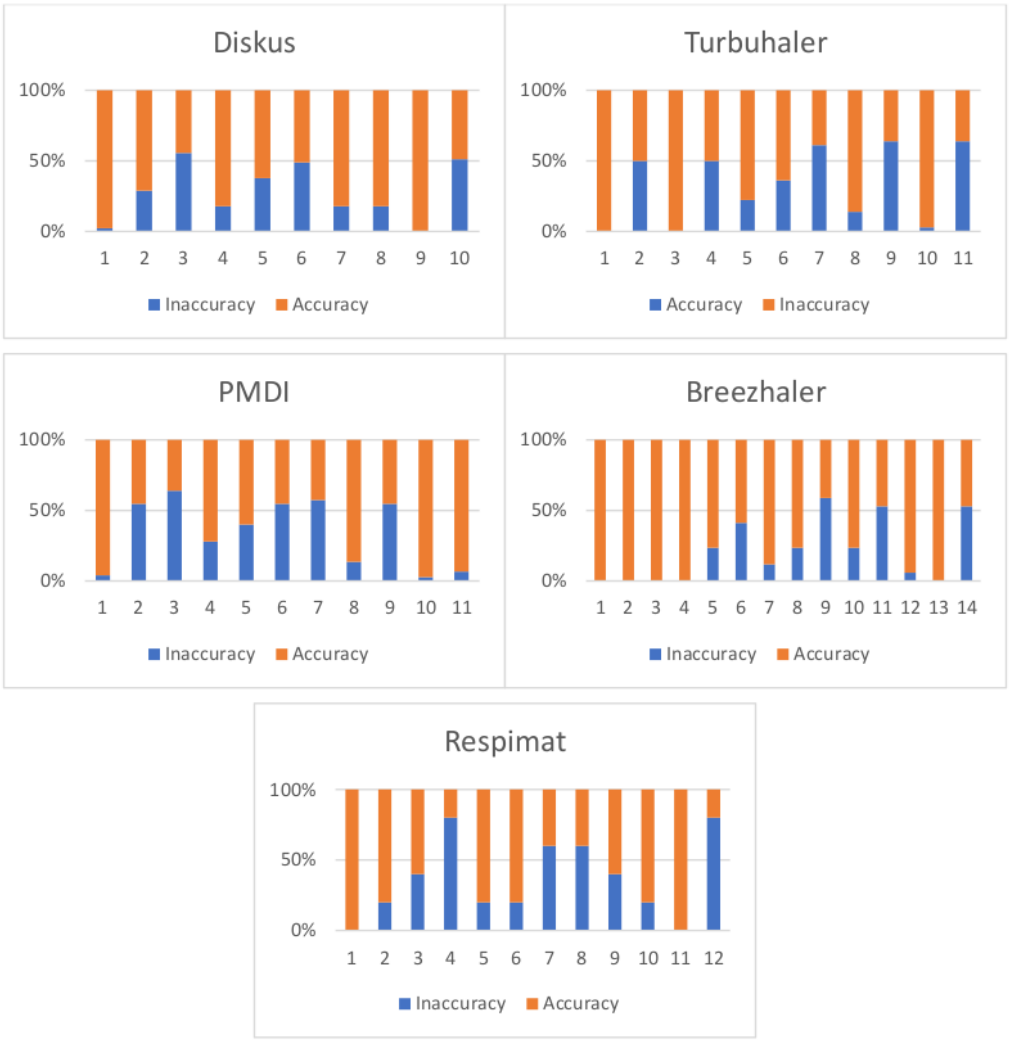

Figure 1. Percentage of inaccuracies committed by patients for each inhaler use

In addition to analyzing inhaler accuracy, this study looked at the presence or absence of basic patient characteristics that influence inhaler accuracy. Table 3 shows that age, smoking history, education history, type of therapy, and the quantity of inhalers used do not have a statistically significant link with inhaler accuracy. Furthermore, there was a statistically significant relationship between gender and BMI and inhaler accuracy. Inconsistent findings have been found in studies on the relationship between gender and

inhaler accuracy(18). Similar to other studies, this study showed that the accuracy of inhaler use in men was lower than in women(13). However, some studies say otherwise (15)(19), and other studies say there is no significant relationship between gender and the accuracy of inhaler use(5). In addition, this study showed that the group with lower BMI had lower accuracy of inhaler use. However, other studies have suggested that BMI is closely related to COPD risk factors (20).

GOLD 2022 stated that smoking habits, adherence levels, and inhaler use techniques are influential in COPD management (1). There were six patients in this study who still smoked. Although there was no statistically significant relationship between smoking habits and inhaler accuracy, the group that still smoked had the lowest inhaler accuracy of the other groups, at 63.83%. Furthermore, smoking is linked to risk factors and clinical conditions because it raises oxidative stress levels in the body, which are highly reactive with inflammatory cells(21) (22). Therefore, smoking can cause exacerbations in COPD patients. (22).

This study did not show a statistically significant relationship between the accuracy of inhaler use and education level. However, in another study, it was mentioned that patients with higher basic education will have a better understanding of the disease and the therapy(23). It was found that the level of education affects the patient's level of understanding in each stage of inhaler use. In addition, patients with lower levels of education tended to make mistakes at stages that were critical points in the use of inhalers(14).

The correct use of inhalers is an important point in COPD therapy, because it will affect the number of doses administered, and the effectiveness of treatment. Health workers need to understand the types of inhalers that can be used well by individual patients and emphasize important steps in their use(16). Repeated demonstrations of inhaler use through various supporting media will be highly effective in reducing incorrect inhaler use, which will manifest in treatment effectiveness(24)(15) .

Limitation

There are a number of limitations to this study. First, there was no information on how long the patient used the inhaler, so the correlation with inhaler accuracy could not be determined.

Second, we did not gather data on the incidence of exacerbations, thus we cannot determine whether inhaler misuse affects the incidence of exacerbations.

Conclusion

The study found that inhaler accuracy in COPD patients was still relatively low, with a total accuracy of only 68.54%. Furthermore, this study found that gender and BMI are factors that have a statistically significant relationship with inhaler accuracy. However, more research is required. Knowing the sort of inhaler that can be used appropriately for each patient, offering instruction on inhaler use procedures, and validating the patient's abilities are all key aspects of treatment.

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