Effect of Pharmacist-Led Training on Adherence and Practice of Inhaler Use: A Pre–Post Interventional Study in Outpatients With Asthma at Hue University Hospital

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Disclosures: The authors have no conflicts of interest to disclose. This research was supported by a Hue University grant.

Contributions: All authors contributed to the concept and design, the drafting, revising, and final approval of the article; all authors except Chi Van Le contributed to the acquisition of data; and Anh Dang Thuc Phan and Thi Kim Cuc Ngo contributed to the interpretation of the data and shared the co-first author responsibilities.

Doi:10.4140/TCP.n.2024.78.

OBJECTIVE: This study aimed to evaluate the impact of a pharmacist-led intervention on improving adherence and practice of inhaler use in outpatients with asthma at a hospital in Vietnam.

METHODS: A pre-post interventional study was conducted at Hue University Hospital. An adapted checklist for both metered-dose inhalers and/or dry powder inhalers was used to evaluate the inhaler technique. Adherence was assessed by using the Test of Adherence to Inhalers questionnaire. The means of interventions comprised "Face-to-face training," "Creating the leaflet for patients," and "Watching guidance video."

RESULTS: The number of participants with complete data was 79. Before the intervention, 54.4% of patients had misused inhalers, especially inappropriate posture when using devices (70.2%) and not exhaling before inhalation (46.8%). Non-adherence accounted for 55.7% of patients, and the erratic pattern was the highest, with 83.5%. The intervention had remarkably raised the number of good practice and good adherence patients after three months ($P < 0.001$).

CONCLUSION: Pharmacist-led intervention has a positive impact on improving the adherence to inhalers and inhalation techniques of patients with asthma.

PRACTICE IMPLICATIONS: The pharmacist-led education model could be considered as an effective and feasible solution for asthma management in outpatients and better medication use.

KEY POINTS: (1) The most frequently observed mistakes in this study were inappropriate posture and inhalation skill when using devices. (2) Pharmacist-led training remarkably improved patients' practice of inhaler use as well as medication adherence.

KEY WORDS: Asthma, Dry powder inhalers, Metered-dose inhalers, Test of Adherence to Inhalers.

ABBREVIATIONS: DPIs = Dry powder inhalers, MDIs = Metered-dose inhalers, TAI = Test of Adherence to Inhalers.

Sr Care Pharm 2024;39:78-86.

Introduction

Asthma, a chronic airway inflammatory condition, is a serious public health problem with a remarkably increasing prevalence worldwide, particularly in developing countries.[1] In Vietnam, approximately 10% of the population have respiratory diseases,[2] with 2-5% of people, especially in rural areas, being affected by asthma because of high exposure to environmental tobacco smoke.[3,4] The burden of asthma has a significant negative impact on people's quality of life as well as on their families and societies' economies.[1,5,6]

Positive asthma outcomes depend on effective medication selection and appropriate use by patients. Though many evidence-based guidelines for asthma treatment have been developed, disease control in patients with asthma remains suboptimal.[7] According to asthma management guidelines,[1,8,9] inhaler devices are frequently recommended and are essential for optimal drug delivery to the lungs. Several studies, however, have found that 50-80% of patients with asthma or chronic obstructive pulmonary disease (COPD) do not use their inhalers correctly, resulting in poor disease control and increased side effects.[7,10,11] Adherence, the degree to which a patient complies with a treatment plan involving medication and lifestyle changes, is also an important cause of uncontrolled asthma and suboptimal disease management.[7,12,13] However, the prevalence of non-adherence in patients with asthma remains high, especially in developing countries, with 86% of patients being non-adherent to inhalers in a study in Bangladesh.[14]

Research has demonstrated the vital role of pharmacists in counseling and educating patients to improve the clinical outcomes of their asthma.[7,15,16] Particularly, several studies have shown the positive effects of pharmacists on inhaler use technique and adherence to medication in patients with asthma.[17-20] Despite the evidence of their importance, few studies have specifically concentrated on the role of pharmacists in counseling and educating patients with asthma in developing countries, including Vietnam. These approaches are not widely used in the Vietnamese health care system, where the pharmacists' primary role is to dispense medications in pharmacies and hospitals.[18] In recent years, few studies have been conducted on this topic in developing countries, including Vietnam.[18,21] Therefore, the aim of this study was to evaluate the impact of a pharmacist-led intervention on improving adherence and practice of inhaler use in outpatients with asthma at Hue University Hospital in the central region of Vietnam.

Materials And Methods

Study Design and Participants

The study was designed as a pre-post interventional study conducted at Hue University Hospital, a tertiary care teaching hospital with more than 700 beds, from March 2022 to August 2022.

The eligibility criteria for the study were as follows: (1) outpatients with asthma 18 years of age and older, and (2) being prescribed at least one inhaler including metered-dose inhalers (MDI) and/or dry powder inhalers (DPI) for asthma treatment for at least four weeks before participating in the study. Asthma was considered to be present in any person who was taking asthma medications or was diagnosed with asthma by a physician. Exclusion criteria included: (1) inability to self-administer an inhaler, (2) use of an inhaler in parallel with other devices (eg, nasal nebulizer), and (3) severe visual, hearing, and communication problems, as well as cognitive impairment. All participants signed consent forms before enrolling in the study.

Assessment of inhaler technique

A 9-step checklist for both MDI and DPI techniques was used in this study. This checklist was adapted from the standard guideline of the Vietnamese Ministry of Health[22] and previous studies.[18,19,23] Every step was scored on this checklist. Because all steps were deemed important for optimal medication delivery, they were given equal weights and scores for each correct step. The total score for each patient was converted into a percentage score and subsequently into a binary category. Scores of ≥ 75% and < 75% indicated "good" and "poor" practices, respectively.

Assessment of adherence to inhaler

To measure patient adherence to inhaler devices, this study applied the Test of Adherence to Inhalers (TAI) questionnaire, which was developed and validated by Plaza and colleagues[24] and is widely used in different countries.[25-28] The TAI has two versions: 10-item and 12-item TAI. Each question of the 10-item TAI is rated by patients on a five-point Likert scale ranging from 1 (worst compliance) to 5 (best compliance), which gives a total score of 10 (minimum) to 50 (maximum). The 10-item TAI is used to identify non-adherent

patterns and levels of non-adherence. Patients who scored 50, 46-49, or ≤45 were classified as having good, intermediate, or poor adherence, respectively. In this study, poor adherence (TAI score≤45) was considered non-adherence, whereas good and intermediate adherence was considered adherence. Two additional questions were added to the 10-item TAI to create the 12-item TAI. These two questions are evaluated by the health care staff, scoring as 1 (poor knowledge of the regimen) or 2 (good knowledge). The 12-item TAI was also used to identify non-adherence behavior patterns. The types of non-compliance were categorized as follows[24]: items 1-5 score ≤ 24: "erratic non-adherence," items 6-10 score ≤ 24: "deliberate non-adherence," and items 11-12 score ≤ 3: "unwitting non-adherence." The 12-item TAI was used in the present study.

Setting and Intervention Description

A patient leaflet and guidance video of inhaler technique were designed by the research team as educational materials prior to the training. The contents of the leaflet and video included relevant information about asthma symptoms, risk factors, treatment and inhaler technique step-by-step. The leaflet and video were prepared using the official guideline for inhaler use by the Vietnamese Ministry of Health[22] and were approved by the clinical pharmacists and physicians at the Internal Medicine Department of Hue University Hospital. Patients were screened for eligible criteria by a pharmacist after their medical consultations and receiving medicines from the hospital pharmacy. Those who satisfied the inclusion criteria were invited to join the study and referred to clinical pharmacists for the counseling. During this process, socio-demographics (eg, age, gender, education level, occupation) and medical backgrounds (eg, comorbidities, history of allergy, duration of disease, type of inhaler) were collected.

Three clinical pharmacists, who had received training in counseling skills, carried out the training. Face-to-face training was then performed one-on-one with the patient. Regarding adherence to inhalers, the pharmacist explained the importance of adherence in optimizing clinical outcomes and minimizing side effects. In terms of inhaler technique, patients were asked to demonstrate their inhaler technique in front of the pharmacist using placebo inhaler devices (the same type prescribed by their physicians). If patients made any mistake, the pharmacist corrected it and explained why the missing step(s) was critical. The pharmacist then used the placebo inhaler to simulate each inhaler step. Patients were asked to repeat the technique until they could demonstrate all steps correctly. The leaflet and guidance video were then given to patients for reviewing at home.

Pharmacists assessed the patient adherence to inhalers using TAI questionnaires and inhaler technique using the developed checklist prior to training (T0) and then reassessed the patients' inhaler technique and adherence 3 months (T3) after baseline evaluation.

Statistical analyses

Descriptive statistics were expressed as frequency, percentage or mean ± standard deviation, where appropriate. Comparisons between subgroups were performed using Chi-square tests for categorical variables. In the pre-post intervention study, McNemar's tests were used to determine the differences between two groups in dichotomous dependent variables. Statistical significance was set at *P*-value of ≤ 0.05 (two-tailed). All data were analyzed using SPSS version 20.0 (IBM Corporation, Armonk, NY, USA).

Ethics approval

The study was approved by the Scientific and Ethics Committee of Hue University of Medicine and Pharmacy (Document Number: H2022/497).

Results

Sociodemographic Characteristics and Disease Profile of Participants

A total of 102 outpatients with asthma were enrolled in the study at baseline (T0). During the 3-month follow-up period, 23 patients (22.5%) dropped out of the study because of missed appointments. As a result, the number of participants with complete data was 79. Most of the remaining participants were 18-59 years of age (58.2%), with a mean age of 55.4 (± 14.4 years). The male-to-female ratio was approximately 1.5:1. Regarding educational level, only 27.8% had educational levels higher than high school. Half of the participants were unemployed or retired (48.1%), and most of them had at least one comorbidity (62%). In addition, approximately 41.8% of patients had a family history of asthma. The majority of respondents had asthma for ≥ 5 years (79.8%) with common symptoms such as cough (68.4%), wheezing (77.2%), shortness of breath (77.2%), and chest tightness

Table 1. Baseline Demographic and Clinical Information of Participants (N = 79)

Characteristics	n (%)
Age (year)	
18-59	46 (58.2)
≥ 60	33 (41.8)
Mean ± SD	55.4 ± 14.4
Gender	
Male	49 (62.0)
Female	30 (38.0)
Educational level	
High school or lower	57 (72.2)
University or higher	22 (27.8)
Active occupation	
Yes	41 (51.9)
No	38 (48.1)
Comorbidity	
Yes	49 (62.0)
No	30 (38.0)
Allergy history	
Yes	20 (25.3)
No	59 (74.7)
Family history of asthma	
Yes	33 (41.8)
No	46 (58.2)
Asthma Profile	
Asthma duration (years)	
< 5	16 (20.2)
≥ 5	63 (79.8)
Common symptoms	
Cough	54 (68.4)
Wheeze	61 (77.2)
Shortness of breath	61 (77.2)
Chest tightness	64 (81.0)
Prior hospitalization resulting from asthma attack(s)	
Yes	11 (13.9)
No	68 (86.1)
Inhaler used	
MDI	18 (22.8)
DPI	32 (40.5)
MDI and DPI	29 (36.7)
Treatment regimen	
Inhaler and oral medications	19 (24.1)
Inhaler only	60 (75.9)

Abbreviations: DP = Dry powder inhaler, MDI = Metered-dose inhaler, SD = Standard deviation.

(81%). The prevalence of participants having prior hospital admissions because of asthma attacks was high (13.9%). Regarding asthma treatment, the most frequent inhaler device being used was DPI (40.5%), followed by a combination of MDI and DPI (36.7%) or MDI only (22.8%) (Table 1).

Inhaler Technique Before and After the Intervention

Of the 79 participants who were using inhalers, 47 patients were using MDI and 61 patients were using DPI. Regarding the specific steps, as shown in Table 2 (pre-intervention), no mistakes were observed in Step 2 and 9, but mistakes occurred in every other step. The most incorrectly performed step was the fifth, followed by the sixth and fourth step. These steps were significantly improved after the pharmacist intervention ($P < 0.05$) (Table 2). In addition, the percentage of patients performing good inhalation technique increased considerably from 45.6% at baseline to 91.2% after training ($P < 0.001$) (Table 3). The data suggest that the pharmacist intervention probably made a positive impact on patients' inhaler technique.

Patient Adherence to Inhalers Before and After the Intervention

TAI questionnaire comprised two main domains: patient-related (items 1-10) and health care professionals-related (items 11-12) domains. The mean scores of the first 10 items (patient domain) after intervention were higher (47.2 ± 3.3 vs 44.0 ± 4.8) and statistically significant ($P < 0.001$). Compared with pre-intervention, the percentage of non-adherent patients dramatically decreased (55.7% to 24.1%; $P < 0.001$) (Table 4). Of interest is that when applying the 12-item TAI, the proportions of erratic, deliberate, and unwitting non-adherence behavior patterns were substantially reduced from 83.5%, 62.0%, and 49.3% to 67.1%, 20.3%, and 20.3%, respectively ($P < 0.001$), after the intervention (Table 5). These results suggest that the pharmacist intervention had a positive effect on patient adherence to inhalers.

Factors Associated With Good Practice and Good Adherence at Baseline

The analysis of factors associated with good practice and good adherence results is summarized in Table 6. A higher percentage of patients who were admitted to the hospital as a result of asthma attacks showed

Table 2. Participants' Performance of Each Step Before and After the Intervention

Steps	MDI (n = 47)		DPI (n = 61)	
	Pre-intervention n (%)	Post-intervention n (%)	Pre-intervention n (%)	Post-intervention n (%)
1. Hold inhaler vertically	44 (93.6)	46 (97.9) *P* = 0.5	42 (68.9)	57 (93.4) *P* < 0.001
2. Remove the cap	47 (100)	47 (100)	61 (100)	61 (100)
3. Shake inhaler well (MDI) or turn the red wheel one way and back the other way until the "click" is heard. (DPI)	35 (74.5)	46 (97.9) *P* = 0.001	57 (93.4)	60 (98.4) *P* = 0.25
4. Stand or sit straight	28 (59.6)	35 (74.5) *P* = 0.016	33 (54.1)	45 (73.8) *P* = 0.002
5. Neck slightly tilt back	14 (29.8)	26 (55.3) *P* = 0.002	15 (24.6)	35 (57.4) *P* < 0.001
6. Breath out gently through the mouth	25 (53.2)	44 (93.6) *P* < 0.001	34 (55.7)	55 (90.2) *P* < 0.001
7. Place the mouth-piece between teeth and close lips, then breathe in strongly and deeply	38 (80.9)	45 (95.7) *P* = 0.016	58 (95.1)	57 (93.4) *P* = 0.25
8. Hold breath for 10s and breath out gently	35 (74.5)	45 (95.7) *P* = 0.002	45 (73.8)	61 (100) *P* < 0.001
9. Close the cap	47 (100)	47 (100)	61 (100)	61 (100)

Table 3. Percentage of Patients Who Showed Improvement in Inhalation Technique

		Post-intervention		Total	*P*-value[a]
		Good practice n (%)	Poor practice n (%)		
Pre-intervention	Good practice (n, %)	36 (45.6)	0 (0.0)	36 (45.6)	**< 0.001**
	Poor practice (n, %)	36 (45.6)	7 (8.8)	43 (54.4)	
Total		72 (91.2)	7 (8.8)	79 (100)	

[a] MacNemar's test.

Table 4. Adherence Improvement Oriented With the 10-Item TAI

Adherence Levels	Pre-intervention n (%)	Post-intervention n (%)	*P*-value
Non-adherence (≤ 45)	44 (55.7)	19 (24.1)	
Intermediate adherence (46-49)	25 (31.6)	34 (43.0)	**< 0.001**[a]
Good adherence (50)	10 (12.7)	26 (32.9)	
Mean score ± SD	44.0 ± 4.8	47.2 ± 3.3	**< 0.001**[b]

[a] MacNemar's test.
[b] Paired *T*-test.

Table 5. Non-adherence Behavior Patterns According to the 12-Item TAI

Non-adherence Patterns	Pre-intervention n (%)	Post-intervention n (%)	*P*-value
Erratic	66 (83.5)	53 (67.1)	
Deliberate	49 (62.0)	16 (20.3)	**< 0.001**
Unwitting	39 (49.3)	16 (20.3)	

Table 6. Factors Associated With Good Knowledge, Good Practice, and Good Adherence at Baseline

Independent Variables	n	Good Practice	Good Adherence
Age (years)		*P* = 0.63	*P* = 0.526
18-59	46	22 (47.8)	19 (41.3)
≥ 60	33	14 (42.4)	16 (48.5)
Gender		*P* = 0.44	*P* = 0.892
Male	49	24 (49.0)	22 (44.9)
Female	30	12 (33.3)	13 (43.3)
Educational level		*P* = 0.32	*P* = 0.058
High school and lower	57	24 (42.1)	29 (50.9)
Graduate and higher	22	12 (54.5)	6 (27.3)
Employed		*P* = 0.76	*P* = 0.059
Yes	41	18 (43.9)	14 (34.1)
No	38	18 (47.4)	21 (55.3)
Comorbidity		*P* = 0.76	*P* = 0.285
Yes	49	23 (46.9)	24 (49.0)
No	30	13 (43.3)	11 (36.7)
Allergy history		*P* = 0.33	*P* = 0.553
Yes	20	11 (55.0)	10 (50.0)
No	59	25 (42.4)	25 (42.4)
Family history of asthma		*P* = 0.07	*P* = 0.274
Yes	33	19 (57.6)	17 (51.5)
No	46	17 (37.0)	18 (39.1)
Duration of suffering from asthma		*P* = 0.52	*P* = 0.666
≤ 10 years	43	21 (48.8)	20 (46.5)
> 10 years	36	15 (41.7)	15 (41.7)
Hospitalization resulting from asthma attack		*P* = 0.51	*P* = 0.041
Yes	11	4 (36.4)	8 (72.7)
No	68	32 (47.1)	27 (39.7)
Number of inhalers used		*P* = 0.71	*P* = 0.588
1 inhaler	50	22 (44.0)	21 (42.0)
2 inhalers	29	14 (48.3)	14 (48.3)
Treatment regimen		*P* = 0.86	*P* = 0.200
Inhaler and oral medications	19	9 (47.4)	6 (31.6)
Inhaler only	60	27 (45.0)	29 (48.3)

better adherence with inhaler treatment (P = 0.041). Other factors such as age, gender, educational level, occupation, comorbidity, allergy history, family history of asthma, and treatment regimen had no impact on the results.

Discussion

Pharmacists can help patients avoid drug-related problems and achieve the best results from drug therapies, particularly for chronic diseases.[29] To the best of our knowledge, this is the first interventional study that shows the value of pharmacist-led training in improving inhalation technique and patient adherence to inhalers in a developing country. Findings from this study highlight the importance of patient education by pharmacists in developing countries, especially in Vietnam.

Results revealed that pharmacist-led training remarkably improved patients' practice of inhaler use as well as medication adherence, which are both core elements of effective asthma management. This is consistent with previous studies, which also reported similar effects of pharmacist intervention on patients with asthma or COPD.[18,19,29-32] In this study, 54.4% of the patients used inhaler devices incorrectly at baseline, which is in accordance with findings from Al Jahdali and colleagues.[33] Since there has been evidence about the association between poor practice of inhaler technique and poor asthma control,[34] health care staff should give attention to this major problem in asthma outpatients.

The most frequently observed mistakes in this study were inappropriate posture (failure to lean the head slightly back or sit straight) and not exhaling before inhalation when using devices. This outcome is different from those of Yadav and colleagues (2019) and Hammelein (2011), who found the most regularly performed errors in inhalation technique was "hold breath for 10s," which is not the case in this study. As shown in the data, holding breath after inhalation was correctly performed by more than 70% of the participants. Appropriate posture and exhaling before inhalation are important steps to ensure that the drug molecules deposit deeper into the airways[18]; however, these were the most incorrectly performed steps in this research cohort. These errors indicate that the patients were unaware of the proper technique when using inhalers.[11,19] Hence, these steps should be emphasized during the counseling by health care professionals.

After receiving training from the pharmacist, considerable improvement in practice skill related to inhalation technique was observed in participants. The percentage of patients evaluated as "poor practice" were reduced from 54.4% to 8.8% after the intervention (P < 0.001). Of greater importance is that patients made fewer mistakes in steps 4, 5, and 6, which were the most mishandled steps before the intervention. These findings are supported by other published literature.[17,19,30] A possible explanation for the positive outcome might come from a combination of varied interventions, including pharmacists' training as well as providing patient information leaflet and guidance video. Patient information leaflet is considered useful for health-promotion media, especially for adult participants.[35]

Besides inhalation technique, effective asthma management depends on patient adherence to the prescribed control medication.[30] Though adherence is crucial to maximize therapeutic efficacy, the percentage of patients with optimal adherence (TAI score = 50), in this study, were only 12.7%, whereas the percentage of non-adherent patients (TAI score ≤ 45) was 55.7% (almost fourfold). This is in line with previous studies in Spain (58.1%)[28] and China (49.4%)[27] but significantly higher than that in Ethiopia (18.3%).[25] This suggests that improving patient adherence to inhaler therapy is still a critical and challenging issue for rational clinical drug use in Vietnam, and must be discussed and resolved urgently. Regarding the non-adherence patterns, the prevalence of erratic non-adherence was the most frequent (83.5%), followed by deliberate (62.0%) and unwitting non-adherence (49.3%), which were substantially higher than those of the study by Zhang (2020), who reported 39.4%, 54.6%, and 26.4% of participants with erratic, deliberate, and unwitting non-adherence behavior, respectively.[27] According to Plaza and colleagues,[24] erratic and unwitting patterns can be seen as unintentional non-adherence, whereas deliberate behavior is referred to as intentional non-adherence. The reasons were suggested by Ngo and colleagues that unwitting non-adherence came from the lack of knowledge related to asthma disease, while erratic non-adherence might be because of the better feeling or absence of clinical symptoms; in terms of deliberate pattern, it was possibly a result of the financial burden of medications.[26]

There was a dramatic decrease in the proportion of non-adherent patients by 30% (from 55.7% to 24.1%; $P < 0.001$) after the pharmacist intervention. Of greater interest is that pharmacist intervention reduced both intentional and unintentional non-adherence patterns ($P < 0.001$). Since unintentional non-adherence mainly arises from a lack of knowledge, erratic and unwitting non-adherence behavior can be improved by educating patients or simplifying medication regimens. In contrast, it is challenging to deal with patients with intentional non-adherence who frequently struggle to follow evidence-based recommendations or have personal beliefs that conflict with health guidance.[36] A close relationship between health care staff, particularly pharmacists, and patients would play an important role in collecting patients' information, perspectives, and beliefs that help counsel the patients effectively.

As the last health professional to come into contact with the patient before the use of the medication, pharmacists play a vital role in patient education on medicine use. Pharmacist-led counseling has been demonstrated to be more effective than other methods, such as watching guidance videos.[18] Nevertheless, in developing countries, including Vietnam, pharmacists' primary role is underestimated and mainly related to supplying and dispensing medications in hospitals or pharmacies; thus, pharmacists do not seem to contribute to the treatment process or get involved in the health care team. The findings from this study, as a result, highlight pharmacists' significant contribution to improving inhalation technique and adherence in asthma patients.

This study had several limitations. First, pharmacists did not repeat training at various points of time because of limited human resources and the impact of the COVID-19 pandemic during the study period. A single intervention might not be sufficient for all patients to remember how to perform error-free inhalation technique. Yadav and colleagues (2019) suggested that repeated training and demonstration can benefit patients through regular assessment of their technique with feedback to ensure their adherence and adequate drug delivery.[19] Even though the data showed a good improvement in inhalers' practice skills after a 3-month period, additional follow-up instructions and exercises would increase the number of patients who inhale their medication without making mistakes. Second, this study collected data that mainly relied on self-reporting, which might have recall bias or underestimation of medication use. This is, however, a simple and rapid assessment with acceptable results playing a critical role in disease management during the treatment process. Continued efforts are needed to design different accessible interventions for new and returning patients; different interventions may be required for patients with asthma of varying severity. Future studies may be needed to evaluate the long-term effect of training to find the best period of time for maintaining proper inhalation technique and patient adherence between training and retraining.

Conclusion

The findings of this study showed that a pharmacist-led intervention could remarkably improve the adherence to inhalers and inhalation technique of patients with asthma. This pharmacist-led education model could be considered as an effective and feasible solution for asthma management in outpatients and better medication use, especially in developing countries with limited human resources, such as Vietnam.

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