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ORIGINAL ARTICLE – OPEN ACCESS

A Home Education Technique for Inhaler Devices Used by Patients with Obstructive Lung Disease

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ABSTRACT

Objective: Feedback from multiple international centers has revealed inhaler device handling errors in obstructive lung disease patients over several years. This study evaluates the effectiveness of an easy-to-apply and continuous inhaler device education method that may be implemented in a hospital setting and continued at home.

Materials and Methods: A total of 60 patients with Chronic Obstructive Pulmonary Disease (COPD) who had >2/10 critical errors in using their inhaler devices were included in the study. They received training on how to use their inhalers, and were then divided into two equal groups. Group 1 consisted of control patients who did not receive any additional education. Group 2 patients had the steps for inhaler administration recorded as voice commands on their mobile phones, and also received reminders for medication administration time. All patients were followed for six months to evaluate the outcome of the training.

Results: Among the patients, 86.7% were unaware that they were misusing their inhaler devices. In Group 1, the success rate was 56.7% after the first education session in the clinic. However, after six months, none of the patients in Group were successful. On the other hand, in Group 2, the success rate was 46.7% at the end of the first education session, and this was maintained at the sixth-month follow-up.

Conclusion: Patients may not be aware of their mistakes in handling inhaler devices, and may forget the correct steps over time. This study supports the use of phone applications for providing continuous education, which may help to increase the success of inhaler treatment. Such applications could be adapted for use in clinical settings.

Keywords: Obstructive lung disease, inhalation therapies, inhaler device handling errors, inhaler device education via phone, continuous inhaler education

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INTRODUCTION

Inhaler drugs are commonly used for bronchodilation and anti-inflammatory purposes in obstructive respiratory tract diseases (1, 2). This drug delivery method enables the drugs to directly reach the lungs. Therefore, with lower doses, drugs cause earlier effects and fewer side effects than systemically applied drugs. It is well-known that various types of inhaler devices are currently being used, and each device is associated with specific features to ensure optimal inhalation. Choosing the appropriate inhaler device for each patient is as important as the correct diagnosis and determination of the beneficial treatment (1–3).

In addition to individual characteristics such as the patient's age, cognitive and emotional state, and hand coordination skills, the patient's training on the device is also as important as the right device selection (4). It is well-known that patients make various errors while using inhaler drugs (5). This can minimize treatment benefits and diminish full control of the disease (1, 2). Face-to-face training is the most commonly used method in the training of inhaler device handling. It has been observed that physical training methods are more successful than written information for the patient to follow the correct step sequence (6). It is observed that the intervention of the lecturer face-to-face, via video clips, or the Internet has become a necessity (6).

In the context of verbal, written, physical education, video, and internet-mediated education, some studies were found in the literature (6–8). However, these studies were incomplete, as uniform training was assessed, and there was no comparative group with any other training method (7). Additionally, when the use of drugs is continuous, and continuity in education is not maintained, the patient's knowledge of the correct use of the device disappears after a while, and the problem of compliance with drug use restarts. In this study, a continuous device training method that can be started in the clinic and continued at home by creating an easy registration method on the phone was used. Thus, the patient's awareness of the correct treatment steps was kept active during each drug use. The aim of the study is to measure the effect of an easily sustainable education with a phone application on device usage errors in Chronic Obstructive Pulmonary Disease (COPD) patients.

MATERIALS and METHODS

Study Duration and Setting

The study is a prospective study conducted with COPD patients at the Near East University Chest Diseases Outpatient Clinic. The study was carried out between August 2020 and December 2021, and the patients who formed the study population were collected within three months. Each patient was followed for six months in relation to this study.

Study Design

This study was conducted with patients diagnosed with COPD who were using an inhaler device. Patients demonstrating incorrect use of their inhaler devices were selected for the study. The devices used by the patients were not changed, and the study was done with the devices they were using. All patients were given device usage training in the clinic, and then the patients were divided into two different groups for the study. Group 1 patients were not given any further training, while Group 2 patients were included in an inhaler device usage program that they could use continuously at home with a mobile phone application.

Patient Selection

The patients who formed the study population were collected within three months, and care was taken to ensure that they were not experiencing a COPD exacerbation during patient selection. In addition, attention was paid to the fact that they had no more than two comorbid diseases and did not have visual and auditory problems or dementia. Efforts were made to ensure that the demographic data of the patients included in the study were similar in terms of age and education.

Device Selection

Each device has a different usage technique, and since device training was the main purpose of this study, device diversity would affect the results. Therefore, the study was not performed with all devices. Among the devices used by the patients who applied to the outpatient clinic, the four most commonly used devices were selected for the study. These devices are Discair, Capsair, Discus, and Turbohaler.

Random Assignment of Patients

In order for the patients to be randomly assigned to the groups, only the inhaler devices they used were considered, and an equal number of patients using the same device were included in both groups. While distributing the patients to the groups, the disease stages and demographic characteristics were not taken into consideration.

Outcome Measurements

For each device, the ten process steps determined in its own manual and recommended to be implemented were used for evaluation, and critical errors are indicated in bold (Appendix 1). The patients were asked to use their current inhaler devices under the supervision of the physician conducting the study, and the critical errors they made were noted from ten handling steps determined for each device. Device handling skill scores were formed by giving one point to each correct usage. Making more than two critical errors for these devices prevents patients from benefiting adequately from the drug and results in treatment failure. For this reason, patients who made more than two critical errors were selected for the study. During the study, the device usage skill assessment of the patients was made by the same doctor using the same scale.

Table 1. Comparison of demographic and device characteristics of the groups

	Group 1		Group 2		p
	n	%	n	%	
Gender					0.091
Female	12	40.0	6	20.0	
Male	18	60.0	24	80.0	
Age					0.774
Below 55	8	26.7	9	30.0	
55 and above	22	73.3	21	70.0	
Education					0.184
High school	16	53.3	21	70.0	
University	14	46.7	9	30.0	
Inhaler device					0.985
Discair	10	33.3	10	30.0	
Capsair	6	20.0	7	23.3	
Discus	7	23.3	6	20.0	
Turbohaler	7	23.3	7	23.3	

Interventions for Groups

All patients were given inhaler device usage training in the clinic, and a written report of the critical errors they made during the initial evaluation was provided to them. Group 1 patients did not receive any educational intervention other than in-clinic education.

Group 2 patients received a device training program that they could use at home. The device usage steps of these patients were recorded as voice commands by the doctor on their mobile phones. Attention was paid to sufficient waiting time for each application step, and an alarm was added to remind these patients to take their medication every day. These 30 patients were asked to use the devices by following the recorded command on the phone application at the reminder time every day.

All patients were called for follow-up visits three times (after one month, three months, and six months), and their drug handling skills were scored again by the same doctor. The success of the training was evaluated by comparing the device usage skill scores of these two groups of patients after one month, three months, and six months.

Statistical Analysis

The data is represented using descriptive statistics. For qualitative variables, frequency and percentage were calculates, and for quantitative variables, the arithmetic mean, standard deviation, median, minimum, and maximum values were calculated. Data distributions in groups were tested for normality using Shapiro-Wilk test of normality, and Q-Q plots and skewness-kurtosis were also evaluated. Nonparametric tests were applied accordingly. At each evaluation

Table 2. Comparison of device handling skill scores of the groups

	Group 1 (n=30)		Group 2 (n=30)		p
	Mean±SD	Median (Min–Max)	Mean±SD	Median (Min–Max)	
Initial evaluation	6.87±0.78	7.00 (6.00–8.00)	7.00±0.64	7.00 (6.00–8.00)	0.439
After clinical training	9.57±0.50	10.00 (9.00–10.00)	9.43±0.57	9.00 (8.00–10.00)	0.383
1st month	8.80±0.66	9.00 (8.00–10.00)	9.63±0.49	10.00 (9.00–10.00)	**<0.001**
3rd month	7.67±0.84	8.00 (6.00–9.00)	9.50±0.51	9.50 (9.00–10.00)	**<0.001**
6th month	7.13±0.73	7.00 (6.00–9.00)	9.43±0.57	9.00 (8.00–10.00)	**<0.001**

SD: Standard deviation; Min: Minimum; Max: Maximum. Skill scores are calculates by awarding one point for each correct step in the inhaler handling process, as outlined in Appendix 1

time, the two independent study groups were compared using the Mann-Whitney U test. Demographic variables and the use of different inhaler devices were compared using the Pearson Chi-Square test. All statistical analyses were performed using SPSS (Demo Version 26.0 for Mac). Graphical visualization was done using GraphPad Prism (Demo Version 9.0 for Mac).

Ethics Approval

All study procedures were approved by the Near East University Institutional Review Board (approval no. YDU/2021/88-1287) and were conducted in accordance with the 1964 Declaration of Helsinki. Written informed consent was obtained from each patient.

RESULTS

A total of 60 patients participated in the study, and the mean age of all patients was 58.70±5.20 years. This group of 60 patients was then equally divided into two groups. The demographic characteristics of the groups and the devices used are presented in Table 1. While forming the groups, an equal variety of inhaler devices was chosen for both groups (p>0.05) (Table 1).

The correct application of the steps for using the inhaler devices was evaluated in the patients, and a score was given. One point was given for each correct step application in the evaluation. Optimal inhalation steps for each device are attached at the end of the article (Appendix 1). Among the patients, 86.7% thought that they used their devices correctly in accordance with the instructions, and only 13.3% of them were aware that they could not use their device correctly. Breathing and hand-breathing coordination steps were noted as the most common mistakes in device handling.

Within Group 1, 90.0% of the patients thought that they used their prescribed device correctly. However, 36.7% of participants made four critical mistakes, 40.0% percent of participants made three critical mistakes, and 23.3% of participants made two critical mistakes in the initial skill scoring. Evaluations after the initial clinic training and in the follow-up months are presented in Table 2.

Among Group 2 patients, 73.3% thought that they used their prescribed device correctly. However, 20.0% of the patients made four critical errors, 60.0% of the patients made three critical errors, and 20.0% of the patients made two critical errors. Evaluation scores after the first training in the clinic and in the months of follow-up are presented in Table 2.

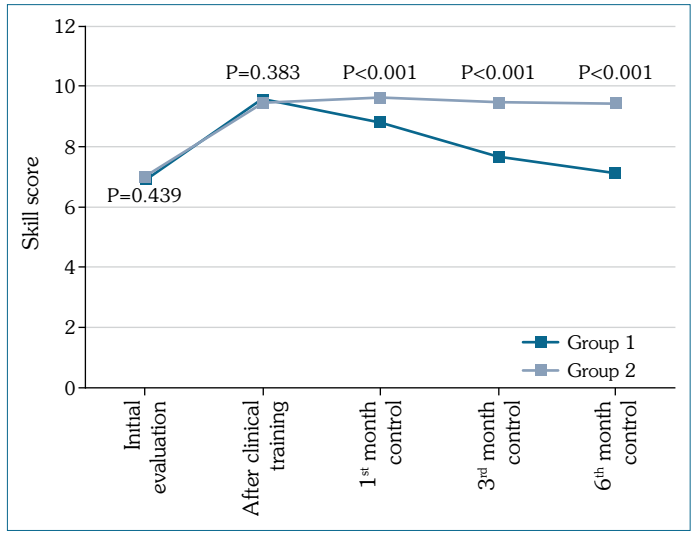

Figure 1. Success comparison of Group 1 and Group 2. The figure shows the mean scores of the groups at each evaluation

While the rate of error-free handling increased from zero to about 50.0% after clinical training in both patient groups, this rate was zero once again after three months in Group 1 patients. However, the error-free handling rate, which was noted as 46.7% in the initial education in Group 2, continued after six months (p<0.05) (Fig. 1). In Group 1, the device usage score average was 6.87±0.78 in the first evaluation, while it was 7.00±0.64 in Group 2 (p=0.439). After training in the clinic, this rate was 9.57±0.50 in Group 1 and 9.43±0.57 in Group 2 (p=0.383). In the evaluation one month later, the mean of Group 1 was 8.80±0.66, and the mean of Group 2 was 9.63±0.49 (p<0.001*). In the evaluation after three months, the mean of Group 1 was found to be 7.67±0.84, and the mean of Group 2 was 9.50±0.51 (p<0.001*). In the evaluation after six months, the mean of Group 1 was found to be 7.13±0.73, and the mean of Group 2 was 9.43±0.57 (p<0.001*) (Fig. 1).

DISCUSSION

In this study, it was observed that the majority of obstructive airway patients made mistakes while using their inhaler drugs. As a result of the study, 86.7% of participants thought that they used their devices correctly in accordance with the instructions, and only 13.3% of them were aware that they could not use their device correctly. It has been

observed that errors in similar steps are made in different device applications. These errors are critical errors that prevent optimal benefit from the drug. There are many feedbacks about inhaler drug handling errors in the literature (6, 7, 9). This situation prevents the beneficial treatment of the disease and causes unnecessary drug side effects, wasted drug treatment costs, preventable attacks, rapid disease progression, hospitalizations, and even causes premature deaths. In addition, since patients do not benefit from the medication, they show treatment incompatibility and avoid routine follow-ups. Recently, the Aerosol Drug Management Improvement Team (ADMIT) published a series of articles focusing on the necessity of improving inhalation technique in Europe (ADMIT 2016). In addition to choosing the most appropriate device option according to the treatment success, the patient's clinical condition, dexterity, perception, and learning status also require personalized device training materials.

Interventions for improving inhaler handling techniques are generally divided into three categories: technological interventions, training of healthcare providers, and training of patients or caregivers (10–13). These trainings can be presented through face-to-face, physical, written, visual, or Internet-based video demonstrations. Education of healthcare professionals on the correct use of the device is essential (14). However, healthcare providers usually do not have enough time for individual education of patients (6). Inhalers can be developed to be easier to use. The wide range of existing interventions to improve inhaler technique means that no single mechanism has been identified to benefit clinical outcomes (6, 9).

The correct technique for inhaler handling should be understandable, time saving, and accessible through widespread technology. However, even after successful interventions, the literature shows that many patients return to misuse in a short time (6, 7, 13). This prospective study demonstrates that even after face-to-face, verbal, visual, and written training, inhaler handling techniques are not adequately learned in the clinic (Table 2; skill scores after initial clinical training). In this study, all patients in Group 1 returned to misuse after three months (Table 2).

Patients tend to forget the trainings given in the clinic after a while. Written and visual information brochures on device handling are often insufficiently understood by patients (9). Although YouTube videos are easily accessible resources for patients (15), this study has shown that patients are unaware of whether they use their devices correctly or not, and thus, do not seek such sources to correct their errors. Therefore training methods should be continuous, maintain active treatment awareness, and not occupy the time of healthcare personnel. In this study, each patient was given face-to-face, physical, visual, and written education in a clinic setting. To ensure continuity and eliminate the need for re-education, long-term training was provided with the help of a mobile phone recording system that reminded patients of their dosage and correct application steps at home. With this application, it was observed that the success of using the right medication was maintained for six months.

Limitations

This study has some limitations. Firstly, the study was unable to achieve a 100% success rate in education, as appropriate inhaler devices could not be choses for each patient. Instead, the study continued with the inhaler device that each patient was already using. However, switching to the appropriate inhaler option after the initial training in the clinic could achieve close to a 100% success rate. Secondly, the distribution of cases to the two groups did not have an exact division of gender, age, and education levels between the groups. Additionally, many variables such as not having COPD exacerbations, not having more than two comorbid diseases, not having dementia, hearing or vision problems, were taken into consideration as they were thought to affect education. This variance did not permit a full one-to-one equality comparison in each variable. However, as the main subject of investigation is device training, device equality was given priority.

CONCLUSION

Phone applications can be adapted to the clinical environment to increase the success of treatment and may be a good option for the treatment of COPD patients. This method can be further developed and applied to more patient groups. These applications can be standardized and prescribed with the device, leading to increased treatment success, reduced hospitalizations, and lower treatment costs.

Ethics Committee Approval: The Near East University Clinical Research Ethics Committee granted approval for this study (date: 30.07.2020, number: YDU/2021/88-1287).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The author have no conflict of interest to declare.

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Appendix 1. Handling steps of inhaler devices

Discair	**Capsair**
1) Check whether appropriate dose appears in the device	1) Pull of the aerolizer cover
2) Press the grove	2) Lift up the mouthpiece
3) Remove the protective cover	3) Place the capsule in and close the cover
4) Ensure it placed in the groove	**4) Press the button and click the capsule**
5) Breathe out completely	5) Breathe out
6) Hold the device in the right position	6) Hold the device in the right position
7) Place the mouthpiece of the inhaler between your teeth and seal your lips tightly around it	7) Place the mouthpiece of the inhaler between your teeth and seal your lips tightly around it
8) Breathe in quickly and deeply through your mouth	**8) Breathe in quickly and deeply through your mouth**
9) Remove the device from your mouth after breathing out	9) Remove the device from your mouth after breathing out
10) Hold your breath for 8–10 seconds	10) Hold your breath for 8–10 seconds
Turbuhaler	**Discus**
1) Remove the protective cover	1) Check whether appropriate dose appears in the device
2) Check whether appropriate dose appears in the device	**2) Place the thump to the thump grip and twist protective cover**
3) Twist	3) Push your thumb away from you until the device clicks
4) Click	**4) Hold the device level and slide the lever away from you until the device clicks. This will load the medication**
5) Breathe out	5) Breathe out
6) Hold the device in the right position	6) Hold the device in the right position
7) Place the mouthpiece of the inhaler between your teeth and seal your lips tightly around it	7) Place the mouthpiece of the inhaler between your teeth and seal your lips tightly around it
8) Breathe in quickly and deeply through your mouth	**8) Breathe in quickly and deeply through your mouth**
9) Remove the device from your mouth after breathing out	9) Remove the device from the mouth after breathing out
10) Hold your breath for 8–10 seconds	10) Hold your breath for 8–10 seconds

The guidelines of each inhaler device have been used in accordance with the instructions as suggested. Critical steps has been shown by bold letters