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Effectiveness of one-to-one feedback methods of teaching with proper metered-dose inhaler technique and correcting errors in chronic obstructive lung disease patients

Original Article

Çiğdem Gamze Özkan[a,*], Mağfiret Kaşikçi[b]

[a]*Fundamentals of Nursing Department, Health Sciences Faculty, Manisa Celal Bayar University, Manisa 45010, Turkey*
[b]*Fundamentals of Nursing Department, Nursing Faculty, Atatürk University, Erzurum 25100, Turkey*

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Abstract: **Objective:** To determine the most common mistakes made during the use of a metered-dose inhaler (MDI), and the effect of the repeated trainings performed with demonstration method by providing one-to-one feedback on these mistakes.

Methods: This is a quasi-experimental study with a control group. A total of 100 chronic obstructive pulmonary disease (COPD) patients (50 in the control group and 50 in the experimental group) were included in the research. "Patient Information Form (PIF)" (to determine the descriptive characteristics of patients) through the face-to-face interview method, using "MDI Skill Assessment Form" (MDISAF) (it is composed of 10 skill steps about the use of MDI) through observation method was used. Patients in both the groups were asked to use MDI and their abilities regarding use of MDI were assessed. Then in the intervention group, usage of MDI was explained by a nurse via demonstration and placebo MDI. Trainings were repeated on days 1,3, and 5 as from hospitalization of the patient. In the intervention group, three methods were used in this study: "face-to-face training," "one-to-one," and "with feedbacks and repeated." Routine training regarding use of MDI was given by the nurses in the clinic to patients in the control group. The use of an MDI was assessed using MDISAF before training and after the training on the first, third and fifth days of hospitalization. On the seventh day, the last measurement was performed. Percentage, chi square, and mean were used to assess the data.

Results: After repetitive training with one-to-one feedback, several differences between the groups in favor of the experimental group were found in 7 of the 10 skill levels of the MDI. There was a significant difference after "training" between the groups in the third, fourth, fifth, sixth, seventh, eighth and ninth MDI steps in posttest measurement ($P < 0.05$). Evaluating the skills of the groups to use MDI from pretest to posttest, it was determined that while the intervention group made less mistakes in steps in which mistakes were made mostly, the control group continued to make mistakes.

Conclusions: Inhaler technique intervention with repeated, face to face, and one-to-one feedback trainings can significantly enhance the MDI techniques in COPD patients. The patients in the intervention group made less mistakes during MDI application and their application skills improved. It may be asserted that the training provided to the intervention group was effective for using the device correctly, while the training provided in the clinic for the control group was inadequate.

Keywords: *COPD • demonstration • education • metered-dose inhaler technique • one-to-one feedback method • training of patient*

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**Corresponding author.*
E-mail:cigdem.ozkan@cbu.edu.tr (Ç. -G. Özkan).

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1. Introduction

Inhalation is a method of drug administration used for the treatment of chronic obstructive airway diseases such as chronic obstructive lung disease. Specific devices are needed to administer drugs into the lungs. Metered-dose inhalers (MDIs) are most widely used.[1] MDIs, which are among the cornerstones of chronic obstructive pulmonary disease (COPD) treatment, are preferred as they have a rapid effect, are easy to carry, and have multi-doses.[2] However, the use of MDI is difficult as it requires hand–mouth coordination and simultaneous inhalation with the spraying of the drug. In the studies undertaken, it has been determined that almost all the patients administer the drug with wrong techniques.[3–6] It is known that the proper and effective use of inhalers is the main factor in preventing COPD exacerbation[7] and in the control of the disease. The training of the patient is the main factor for the proper use of an inhaler device, which is very important.[8,9] As the method to be used for education of the patient determines the comprehensibility and permanence of the conveyed information, it may be inadequate to provide training only with training leaflets or verbally by learning the MDI application technique.[2,10] In order to establish proper use skill, it is required to show the use of MDI with demonstration devices, perform one-to-one practices with patients, and repeat and control these practices.[11] After the training provided in many studies, it has been shown that patients have corrected the steps that they performed incorrectly and their device use skill has increased positively.[10–12] The fact that the use of MDI is controlled and reinforced by the physician-nurse, the wrong steps are ensured to be recognized by patients by making corrections, and the training is repeated, are important factors to increase the device use success[13] and the effectivity of the treatment.[14] Therefore, health care professionals should use every opportunity to teach and strengthen the correct use of inhaler drugs during health care. The hospitalization duration, in which patients have the most communication with nurses and physicians, should be considered as an opportunity[12] and the patient should acquire the correct technique during this process. The aim of the study conducted based on this idea is to determine the most common mistakes made during the use of MDI and the effect of the repeated trainings performed with demonstration method by providing one-to-one feedback on these mistakes.

2. Methods

2.1. Study design

This study was conducted as a pretest–posttest intervention study with the control group.

2.2. Population and sample of the study

The population consisted of stable COPD patients hospitalized and treated in the pulmonology clinics of a Ministry of Health hospital in the Eastern region of Turkey between March and October 2012. The sample size was planned for a total of 76 COPD patients, including 38 in the intervention group and 38 in the control group, as a result of the power analysis performed with a testing power of 95% and a significance level of 0.05 and 0.536 effect size. However, as data may be lost due to reasons such as withdrawal from the study, early discharge, or death of the patients, 31% more than the sample was taken and it was decided to continue the study with a total of 100 patients, 50 of whom were controls and 50 were interventions.

2.3. Ethical considerations

This study was approved by the ethics committee of the University Institute of Health Sciences (IRB Approval No: 2012/2.6). Additionally, patients were informed about the aims and procedures of the study before data collection. The verbal and written consents of the patients to be included in the study were received on a voluntary basis.

2.4. The inclusion and exclusion criteria

The stable COPD patients, who were hospitalized in the chest diseases clinics, were willing to participate in the study; they had used MDI for at least 6 months and would continue to use, and those who used MDI in 2 doses at a time were included. Also included were patients who had communication and hearing–speech problems and physical disorder preventing inhaler use, and whose exacerbation was confirmed by a chest disease specialist.

2.5. Data collection

The data were collected from stable COPD patients, hospitalized in the chest diseases clinics of a hospital between March and October 2012, using “Patient Information Form (PIF)” through the face-to-face interview method, using “MDI Skill Assessment Form” (MDISAF) through observation method.

2.5.1. The data collection tools

PIF: This is aimed to collect the data of the COPD patients in this form prepared based on the literature.[3,15] The form is composed of a total of 18 questions about the sociodemographic characteristics of the patients,

their status of smoking and knowing of the medical diagnosis, the number of hospitalizations per year due to COPD diagnosis, status of going control appointments, the type and period of getting information about MDI use, the person providing information, and the adequacy of the information.

2.5.1.1. MDISAF checklist and scoring of inhaler technique

This is composed of 10 skill steps about the use of MDI.[1,9] In order to make a quantitative evaluation concerning the use of MDI, each step is scored. As all the steps are thought to be crucial to realize optimal drug administration, they have, therefore, an equal weighting and are scored with 1 point in each (Table 1); 1 point is given for the correct steps and 0 point is given for the incorrect steps.[1,9] According to this evaluation, the total score to be obtained from the checklist is obtained by equating the highest score to be obtained from each skill level to 100 points. The direct observation method was used in the assessment of the steps.

2.6. Setting and training description

In order to prevent the study groups from affecting each other, the study was started first with the patients in the control group. After the patients in the control group were completed, the data of the patients in the experimental group began to be collected. In order to prevent the patients in the experimental and control groups from being affected by each other, the patients were hospitalized in different rooms. The patients were invited to the treatment room, where the training would be provided, and their consent was taken again. The PIF was filled out and then placebo (MDI without active ingredient) MDI was administered to the intervention and control group patients. Before starting the study, a pilot application was made regarding the duration, frequency, and repetition of the training to be given to the intervention group. The average treatment period of the patients varies between 7 d and 10 d. In order to use the patient's time efficiently and to create a behavioral change for the patient, the trainings were held 1 d apart. In addition, the trainings were evaluated as a pretest and a posttest on the first, third, and fifth days due to the difficult acquisition of MDI use skills and the easy forgetting of steps.

MDI using steps	Points
Step 1: Removing cap	1
Step 2: Shaking MDI well	1
Step 3: Hold the inhaler with the mouth in line with the jaw, up right, and with the index finger on the drug tube	1
Step 4: Exhaling before using MDI	1
Step 5: Placing the lips between the lips of the MDI and closing the lips	1
Step 6: Pressing the device and inhaling simultaneously	1
Step 7: Holding breath for 3–10 s	1
Step 8: Exhaling slowly after administering the drug and waiting for 1 min before the second dosage	1
Step 9: Shaking the inhaler before the second dose	1
Step 10: Closing the cover of the MDI	1

Note: MDI, metered-dose inhaler.

Table 1. Rubric and using steps for inhaler technique scoring.

2.7. Pilot application for experimental group training plan

The training was provided as one patient to one nurse through the face-to-face method. The patients displayed their inhaler technique on placebo MDI under supervision of the nurse in the intervention group. When the patient made a mistake, the nurse corrected it and clarified why the missing step(s) were significant. The nurse then showed verbally and physically each inhaler step to the patient through the placebo MDI. The patients were asked to implement the technique again until they could show all the steps. The training was continued until there was a change in all the MDI steps. In this study, training and feedback were provided 3 times a day, the patients used MDI 3 times, and this process lasted for a total of 30 min. All the observations and trainings were performed by the nurse working as a specialist for 5 years in the chest diseases clinic and being experienced in the use of MDI.

2.8. Application process of study

2.8.1. Training plan of intervention group

The nurse evaluated the MDI use of the patients in the intervention group on the first day of their hospitalization with MDISAF (pretest) and then evaluated the right and wrong steps and gave education to the patients. Training, practice, and feedback were repeated on the third and fifth days. The study was completed with the evaluation (posttest) of the patient's use of MDI on the seventh day.

2.8.2. Training plan of control group

Patients in the control group were not intervened and were given routine clinical training by clinical nurses, including demonstration/explanation of placebo MDI use. Routine education includes demonstrating the use of MDI to the patients on the first day of hospitalization

by the pulmonology service nurse, which is applied by the patient. The nurse evaluated the use of MDI by MDISAF (pretest) on the first day of hospitalization of the patients in the control group. After informing the patient about the steps that she used incorrectly in the use of MDI, the nurse asked the patient to apply the MDI again and ended the training by correcting the wrong steps again. After this training, patients were not given repetitive training on the use of MDI.

The study was completed with evaluation (posttest) of the patient's use of MDI with MSIDAF on the seventh day.

Characteristics	Intervention group			Control group			χ^2	t	*P*
	X ± SD	n	%	X ± SD	n	%			
Year of disease	13.38 ± 5.89			12.24 ± 5.02				1.083	0.301
Age (years)	63.20 ± 8.56			66.06 ± 8.73				1.654	0.101
Time of receiving information (min)	3.76 ± 2.83			4.32 ± 2.54				1.402	0.3
Sociodemographic characteristics									
Gender							0.043		0.836
Male		32	64		31	62			
Female		18	36		19	38			
Education level							1.208		0.547
Not literate		18	36		16	32			
Primary school		23	46		28	56			
Secondary school/high school		9	18		6	12			
Number of hospitalizations per year							3.938		0.414
No		3	6		6	12			
1		6	12		11	22			
2		5	10		6	12			
3		12	24		10	20			
>4		24	48		17	34			
Examine status/keep an appointment									
Yes		50	100		50	100			
No									
Type of information							3.754		0.153
Question–answer		6	12		11	22			
Method of expression		26	52		17	34			
Demonstration		18	36		22	44			
Informative person							3.499		0.174
Nurse		24	48		22	44			
Doctor		18	36		25	50			
Pharmacist		8	16		3	6			
Total		50	100		50	100			

Note: COPD, chronic obstructive pulmonary disease.

Table 2. Comparison of the descriptive characteristics of COPD patients in the intervention and control groups.

2.9. Data analysis

The distribution of the descriptive characteristics of the patients was assessed with mean, percentage, and chi-square test. Comparison of the descriptive characteristics of COPD patients in the intervention and control groups were assessed with the chi-square test. The comparison of MDI use steps in the pretest and post-test measurements of COPD patients in the intervention and control groups according to the incorrect application cases were assessed with the chi-square test.

3. Results

It was observed that the patients in the intervention and control groups were similar in terms of their descriptive characteristics. The result also show that in the clinical trials the control and intervention groups are not similar in terms of the individual characteristics, and receiving information about MDI that may affect the result of study, is important to prevent bias in the study[16] (Table 2).

Figure 1 shows the steps in which patients in the intervention and control groups made mistakes in the pretest, while Figure 2 shows the steps in which the patients in the intervention and control groups made mistakes in the posttest. In the pretest, it was observed that the patients in both groups made mistakes in similar steps (Figure 1). In the posttest, the patients in the intervention group made fewer mistakes than the patients in the control group (Figure 2). The patients in the intervention group made progress in all the steps where they made a mistake in the posttest compared with the pretest (Table 3), and the patients in the control group continued to make mistakes in the posttest at all the steps where they made a mistake in the pretest.

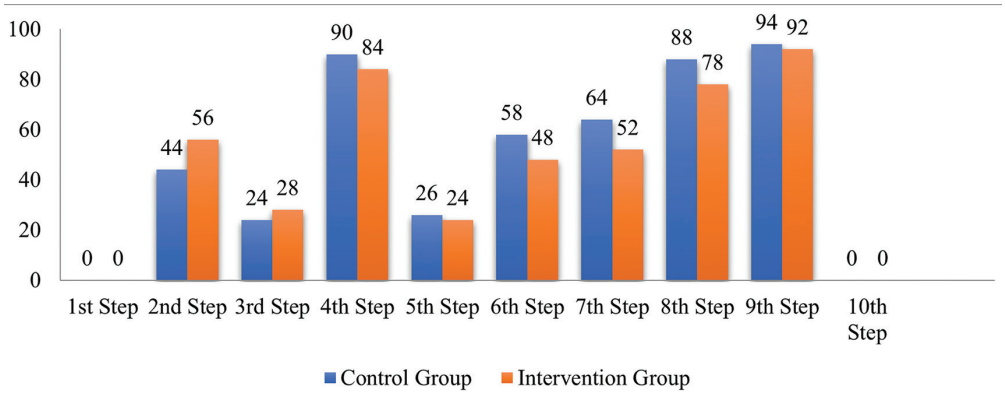


Figure 1. Evaluation of the steps in which intervention and control group patients made mistakes in the pretest.

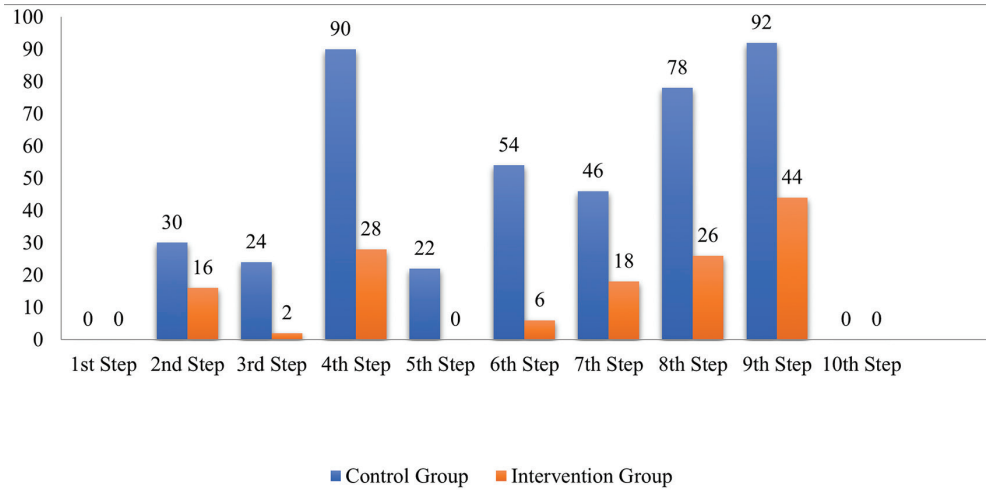


Figure 2. Evaluation of the steps in which intervention and control group patients made mistakes in the posttest.

Measurement	Pretest		χ^2	*P*	Posttest		χ^2	*P*
	I	C			I	C		
	Incorrect				Incorrect			
MDI Using steps	%	%			%	%		
1st Step	-	-	-	-	-	-	-	-
2nd Step	56	44	1.440	$P > 0.05$	16	30	2.767	$P > 0.05$
3rd Step	28	24	0.208	$P > 0.05$	2	24	10.698	$P < 0.05$*
4th Step	84	90	0.796	$P > 0.05$	28	90	39.727	$P < 0.05$*
5th Step	24	26	1.336	$P > 0.05$	-	22	12.360	$P < 0.05$*
6th Step	48	58	1.406	$P > 0.05$	6	54	27.429	$P < 0.05$*
7th Step	52	64	1.478	$P > 0.05$	18	46	9.007	$P < 0.05$*
8th Step	78	88	1.772	$P > 0.05$	26	78	27.083	$P < 0.05$*
9th Step	92	94	0.154	$P > 0.05$	44	92	26.471	$P < 0.05$*
10th Step	-	-	-	-	-	-	-	-

Note: *There is statistically significant differences.
I, Intervention group; C, Control group; MDI, metered-dose inhaler.

Table 3. Comparison of the erroneous MDI use steps performed by the intervention and control group patients in the pretest and posttest.

When the patients in the intervention and control groups were compared according to the results of the first measurement, it was found that all of the patients in both groups applied the first (removing cap) and tenth (closing the cover of the MDI) steps correctly and there was no significant difference between the groups. More than half of the intervention group patients were in the second (shaking MDI well) and seventh (holding breath for 3–10 s) steps, almost all of the control group patients were in the fourth (exhaling before using MDI), eighth (exhaling slowly after administering the drug and waiting for 1 min. It was determined that more than half of them made mistakes in the minute before the second dosage), and ninth (Shaking the inhaler before the second dose) steps, and more than half of them made mistakes in the sixth (pressing the device and inhaling simultaneously) step. It was found that the other steps in which the intervention and control group patients made mistakes were similar to each other and the incorrect application of all steps was statistically insignificant ($P > 0.05$). When the intervention and control groups were evaluated according to the seventh measurement results, the first (removing cap) and tenth (closing the cover of the MDI) steps were performed correctly in all the intervention and control group patients, and no significant difference was detected between the groups. The intervention group patients learned to apply the fifth step (placing the lips between the lips of the MDI and closing the lips), the third (hold the inhaler with the mouth in line with the jaw, up right and with the index finger on the drug tube) and the sixth steps (pressing the device and inhaling simultaneously) were corrected by almost all of the patients, the second (shaking MDI well) and seventh (holding breath for 3–10 s) steps were incorrectly performed by less than 25%, and in the fourth (exhaling before using MDI)), eight (exhaling slowly after administering the drug and wait for 1 min before the second dosage), and ninth (shaking the inhaler before the second dose) steps, the error rate was found to be over 25%.

On the other hand, the patients in the control group improved compared with the first measurement, especially in the second (shaking MDI well), fifth (placing the lips between the lips of the MDI and closing the lips), sixth (pressing the device and inhaling simultaneously), and seventh steps (holding breath for). It was determined that there was no statistically significant improvement in MDI application skill at 3–10 s) in the eighth (exhaling slowly after administering the drug and waiting for 1 min before the second dosage) and ninth steps (shaking the inhaler before the second dose). As a result, the intervention group patients showed statistically significant progress in all the steps where they made a mistake in the use of MDI, but they continued to make mistakes, albeit slightly, in the third to ninth steps; the intervention group patients were more likely than the control group. It was determined that the patients in the control group made mistakes in the first measurement and continued to make mistakes in all steps, and the difference between the groups was statistically significant ($P < 0.05$).

4. Discussion

The treatment success of the inhaler drugs increases with the correct use of the inhaler devices.[17] The main steps to be performed for the optimum effect before the use of MDI are exhalation and inhalation simultaneously with pressing the device. However, studies have revealed that as well as these steps,[15,18] the steps of shaking MDI and adequate breathholding after the inhaler drug intake are performed incorrectly.[5,8] When the steps in which the patients in the control and intervention groups (I/C%) made mistakes mostly in pretest were examined in the present study, it was observed that these steps were step 9 (92/94%), step 4 (84/90%), step 8 (78/88%), step 2 (56/44%), step 7 (52/64%), and step 6 (48/58%) (Figure 1). This result is compatible with the results of previous studies.

The main factor in the achievement of inhaler device use and decreasing mistakes is the training of the patient. For effective training, the training method and duration, repetition of training, and the assessment of device use with certain intervals are important.[11,19,20] The physical demonstration has more effects on improvement of pressurized metered-dose inhaler (pMDI) technique compared with the written and verbal instructions alone.[10] It has been determined that the trainings performed face-to-face, one-to-one, practically, and with feedback are more effective.[11] In the study by Press et al.[21] a group was provided training with teach-to-goal technique and another group was provided training with brief instruction about MDI use in a hospital. In the control made in the patients' houses 90 d later, the teach-to-goal (TTG) group performed more steps correctly compared with the brief group. The duration of training and the number of repetitions are also important for acquiring the skill to use. After the training was provided 3 times consecutively for the patients using the inhaler device for the first time, 90% of the patients used MDI correctly.[22]

Training can enable to correct inhaler technique but skills decrease rapidly if training is not repeated.[23] In their study, Ruud et al.[24] determined that after training with pharmacists, the rate of patients to perform the technique correctly increased from 31% to 86% for MDI. The rate of patients having the correct technique decreased from 86% to 75% 3 months later. Although the training was repeated on every other day, it was observed that the patients forgot these steps and that repetition of the training was important. In this study, when the skill of using MDI in pretest and posttest measurements was evaluated on a step-by-step basis after the trainings performed by a nurse, in the intervention group, there was a significant difference in all the steps except for the first, second and tenth steps (Table 3). All of the patients in the intervention group performed correctly the fifth step and almost all of them performed correctly the third (98%) and sixth (94%) steps. This result may indicate that training has a positive effect on the correct application. The first and the tenth steps may be performed correctly as they require motor skills. The second step was the step requiring the shaking of the inhaler for homogenization of the drug before using MDI and for taking MDI in the proper dose.[25] The success of the intervention group increased from 44% (pretest) to 84% (posttest) and the success of the control group increased from 56% (pretest) to 70% (posttest). This result may suggest that both groups made progress, training was effective in the intervention group, the patients in the control group learned MDI use from nurses and physicians, or they had awareness during the use of another patient. The third and fifth steps were learned easier as they required motor skills and they did not require complex maneuvers. The sixth and seventh steps [26] were mostly performed incorrectly, while a statistically significant improvement was recorded in these steps by the repeated trainings provided for the intervention group (Table 3).

When the effect of the training was assessed in the steps that were mostly performed incorrectly; a significant difference was found between the pretest–posttest results of the intervention and control groups (Table 3). Although the "shaking the inhaler before the second dose" step (ninth step) was not among the steps that are mostly performed incorrectly in the literature, it was the top one step performed incorrectly. In the study by Shah and Gupta,[10] the status of the correct application of this step after training increased from 57% to 87%, and in the study group by Şahin et al.[27] it increased from 0% to 50%. In the present study, the incorrect application of the intervention group was 92% in the pretest measurement and decreased to 44% in the posttest measurement (Table 3). The fact that this step was performed incorrectly at the rate of 44% even after training in the present study may be associated with the fact that the second dose was not regarded as a separate drug dose by the patients or the drug shaking rate was low (56%) in the pretest (Table 3). Also, when comparing with the mentioned studies, it may be asserted that the success status was at the same rate and the training was effective in the correct application of this step.

In the present study and in previous studies,[20] it was determined that the second step that was mostly performed incorrectly by the patients was "exhaling before using MDI (fourth step)." Effective exhaling is required for good particle storing. The rate of incorrect performance of this step decreased from 84% (pretest) to 28% (posttest) after the training (Table 3). In another study, it was determined that this rate was 24% before the training and 63.8% after the training.[11] It may be considered

that training with video as well as demonstration may be effective for the successful performance of this step.

While administering MDI, the drug is expected to reach deeper airways with the second dose inhalation; 78% (pretest) of the study group patient performing the step in which "to exhale slowly after administering the drug and wait for 1 min before second dosage" (eighth step) incorrectly were ranked as the third place and after the repeated training, the rate of incorrect performance decreased to 25% (posttest) (Table 3). In Şahin et al.'s[27] study, all of the patients performed this step incorrectly, and this rate decreased to 40% after the training. This could be associated with the fact that the age of the patients in the present study was lower compared with this study.

It was provided that the drug was absorbed by reaching the airways by "holding breath for an adequate period of 3–10 s (seventh step)" after the use of MDI. In the present study, in this step that was performed incorrectly in the fourth place, the error rate of the patients in the intervention group decreased from 52% (posttest) to 18% (pretest) (Table 3). In the study by Shah and Gupta,[10] the rate of incorrect performance in this step decreased from 83% to 23%. That the age average (48.8) in this study was lower compared with the age average in the present study, although the incorrect performance status was high, may be the reason for the success of the training performed with video.

One of the steps that was performed incorrectly mostly during MDI administration and was found difficult to learn was "pressing the device and inhaling simultaneously (sixth step)."[9,28] This step, which was performed incorrectly in the fifth place, was performed incorrectly by 48% (pretest) of the patients in the intervention group; whereas, this rate decreased to 6% (posttest) after training (Table 3). In a review,[29] this step was determined as the first step that was performed incorrectly in 19 of 25 studies. The rates of incorrect performance in this step may be a result of the inadequate device use training provided by the pharmacists and the inadequate evaluation of inhalation technique by doctors and nurses.[5] In the study by Nguyen et al.,[11] the same step was performed wrongly in the pretest at the rate of 49% and in the posttest at the rate of 6.5% of the patients. It may be asserted that face-to-face and one-to-one training provided by giving feedback were effective for the improvement of this step. The results of the study are compatible with the literature.

5. Conclusions

Although MDIs have been the most widely used inhalation devices for many years, because they are more effective in the treatment of respiratory tract diseases and have less side effects, they are the devices with the most application errors. The correct use of the device becomes difficult because their use requires complex maneuvers and hand–mouth coordination of the patient. For this reason, the importance of training to be given to the patients is great, as it will ensure the correct use of the device. It can be stated that the repetitive, one-to-one training given to the intervention group is effective for performing the MDI steps correctly and the practice skills of the patients are improved. After training, patients made fewer mistakes during the MDI application; in other words, the patients' misapplication of the MDI procedure steps decreased. On the other hand, the training given to the control group patients in the clinic was not effective in changing their ability to use MDI, and the patients continued to make mistakes in the steps they made.

Given the high cost of COPD management, strategies should continue to be developed to optimize the benefits of inhaled drugs. There is a need to better understand the conceptual link between fit and technique, especially with regard to fit and inhaler technique skill. A more holistic health care system with an integrated approach is needed to optimize inhaled therapy and compliance. Understanding the patterns of behavioral commitment in a subpopulation of patients (e.g., children, adults) and at different stages of the disease will help develop more specific and effective interventions. The hospitalization duration of COPD patients should be considered as an opportunity and in this period, repeated training should be provided to patients with demonstration devices and MDI use skill may be acquired until discharge of patients. However, the small sample size limits the external validity of these results and suggests the need for further studies.

Ethics approval

The study had approval (No. 2012/2.6) of the Institute of Health Sciences University Ethics Committee. Written permission from the management of the hospital was obtained. Additionally, patients were informed about the aims and procedures of the study before data collection and their questions were answered before written consent was obtained.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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