Heliyon 7 (2021) e07870

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

The effect of repeated education using live demonstrations and videos of how to use inhalation drugs on quality of life for COPD patients

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ARTICLE INFO

Keywords:
Inhaler
CAT (COPD Assessment test)
Demonstration video
Repeated education

ABSTRACT

Repeated education regarding the proper use of inhalers can reduce the error rate in inhaler-using patients and improve COPD patients' quality of life. This study investigates the effect of repeated education on the quality of life of COPD patients during the pandemic of COVID-19 from February to June 2020. Repeated education is provided using direct demonstrations to patients through educational media in the form of short videos made by the researchers for each inhaler type. This is a pre-experimental study design which was carried out prospectively at Grha Permata Ibu Hospital, Depok. The quality of life of 22 subjects was examined using the COPD assessment test (CAT) questionnaire. Each patient was given a direct verbal demonstration of the appropriate use of the inhaler. One month later, each patient was provided further education using less than 2 min of video sent to them online via the WhatsApp application. Final quality-of-life examination and assessment of inhaler technique were carried out three months after the initial examination. Assessment of proper inhaler technique was carried out using a specific checklist regarding the use of inhaler translated by the researcher. Before and after delivery of repeated education, the mean CAT score showed a decrease of two points, i.e., 12.8 ± 1.3 and 10.8 ± 2.0, respectively. This indicated that quality of life of the patients had significant improvement. However, as many as 63.6% of patients still made mistakes in using inhaler even though they had been educated. For DPI-type inhalers, mistake mostly happened at step "breath out gently, away from inhaler". For pMDI-type inhalers, mistake mostly happened at step "while holding breath, remove inhaler from mouth". It can be concluded that repeated education regarding proper inhaler technique with direct demonstrations and further maintained by videos can improve the quality of life in COPD patients.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is currently the fourth most common cause of death in the world and is estimated to rise to the third most common by 2030 (WHO, 2020). COPD is a progressive disease associated with an increased inflammatory response in the airways and lungs (Singh et al., 2019). Patients with COPD may suffer from obstructive bronchiolitis (narrowing of the airways or bronchioles due to inflammation and swelling), emphysema (alveolar wall damage), or both (Torpy et al., 2010). The most common risk factor for COPD is exposure to cigarette smoke (Wells et al., 2017). Apart from cigarette smoke, other factors that can cause or worsen COPD include exposure to hazardous substances in the environment, such as heavy exposure to dust while working, chemicals, and air pollution, both indoors and outdoors (including wood smoke and biomass fuel outputs) (Lareau et al., 2019). One of the causes of increased mortality in COPD patients is acute exacerbations or AECOPD (acute exacerbation of chronic obstructive pulmonary disease) (Hillas et al., 2016). AECOPD is an episode of worsening of the patient's respiratory symptoms (dyspnea, cough, and/or sputum production) outside of normal daily variations and requires a change in treatment (Kim and Aaron, 2018). AECOPD is not only considered an acute event characterized by worsening of the patient's respiratory symptoms (Hillas et al., 2016); acute exacerbations are also the most important adverse condition in the progression of COPD. Patients known as "frequent exacerbators" have more severe conditions of COPD and have a worse decline in quality of life compared to "infrequent

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https://doi.org/10.1016/j.heliyon.2021.e07870
Received 29 December 2020; Received in revised form 3 August 2021; Accepted 20 August 2021

exacerbators" (Tomioka et al., 2016). Pharmacologic therapy of AECOPD includes fast-acting bronchodilators (SABA), systemic corticosteroids, and antimicrobials in selected patients. The therapy goals are the prevention of hospitalization or reduction of hospitalization period, prevention of acute respiratory failure and death, resolution of exacerbation symptoms, and return of initial clinical status and quality of life (Dixit et al., 2016).

Long-term bronchodilator inhalation drugs, combinations of beta agonists and/or muscarinic antagonists have been recommended in therapy guidelines to prevent acute exacerbations (GOLD (Global Initiative for Chronic Obstructive Lung Disease), 2020). However, most studies have found that the delivery of these inhaled drugs is often of less-than-optimal efficiency, with one of the main reasons for this being the misuse of inhalers (Price et al., 2018). A higher frequency of exacerbations, poor quality of life, and long duration of hospitalization have also been associated with inappropriate inhalation techniques (Ngo et al., 2019).

In a study conducted by Goris et al. (2013), patient education using direct demonstration and educational videos increased the accuracy of inhaler use by 82.4% in the all-educated group. In addition, the incidence of exacerbations was only found in 5% of patients who were given education in contrast to 50% of patients who were not given an education (Goris et al., 2013).

Health-related quality of life (HRQoL) is a useful indicator in measuring overall health, as it can collect information related to an individual's physical and mental health statuses and their impacts on the individual's quality of life. HRQoL is usually assessed through various self-perceived indicators of health status and indicators of physical and mental function (Yin et al., 2016). The COPD Assessment Test (CAT) questionnaire is a valid instrument for measuring COPD's impact on patient health and complements existing approaches to diagnosing COPD, such as the FEV1 (Forced Expiratory Volume in 1 s) measurement. The CAT questionnaire consists of eight items that reflect the symptoms and activity limitations that are most disturbing to COPD patients: coughing, phlegm, chest heaviness/tightness, shortness of breath when walking uphill or climbing stairs, limitations to activities at home, confidence when leaving home, sleeping, and energy. The CAT score ranges from 0–40, with an increase in the score indicating a deteriorating health status, and decrease in the score indicating an improvement of health status. It is recommended to be carried out every two to three months (Jo et al., 2018). A minimum clinically important difference (MCID) revealed in the CAT assessment, indicating a significant improvement in the quality of life, is shown by a decrease in CAT score of two points (Kon et al., 2014).

Various efforts can be made to improve the accuracy of COPD patients using inhalers. During the COVID-19 pandemic, efforts to improve the accuracy of inhaler use, thus increasing the patients' quality of life, are highly challenging. Given these factors, the researchers wanted to examine the effect of repeated education on the proper use of inhalers in improving the quality of life of patients with COPD using the CAT questionnaire, as well as to investigate other factors that may be involved. The intervention was in the form of education given through two repetitions: a direct demonstration by the researcher and, subsequently, a video made by the researcher regarding the right steps in using an inhaler. This research is expected to improve the accuracy of use of inhaled medication by COPD patients at Grha Permata Ibu Hospital, so that the effectiveness of therapy is optimized and the patient's quality of life can be improved.

2. Methods

This research is a pre-experimental study with prospective pre-test and post-test data collection. The research was conducted at Grha Permata Ibu Depok Hospital. Data were collected from February to June 2020. This study has been approved by Health Research Ethics Commitee - University of Indonesia and Cipto Mangunkusumo Hospital (HREC-FMUI/CMH) No. KET-149/UN2.F1/ETIK/PPM.00.02/2020. The population was outpatient COPD patients who attended Grha Permata Ibu Hospital chosen using a consecutive sampling technique. Consecutive sampling technique is a sampling where the participants are consecutively selected in order of appearance according to their convenient accessibility. The sampling process comes to an end when the total amount of participants (sample saturation) and/or the time limit (time saturation) are reached (Martí nez-Mesa et al., 2016). We used inhaler checklist that was adapted with permission from NPS MedicineWise Inhaler technique: Device-specific checklists (February 2020). To measure patient's quality of life, we used CAT questionnaire with permission from GlaxoSmithKline (GSK). The CAT is a validated, short, and simple patient completed questionnaire, developed for use in routine clinical practice to measure the health status of patients with COPD (Jones et al., 2009). The Indonesian translated version of CAT has been validated previously (Kwon et al., 2013).

The patients had been asked to sign an informed consent prior to their participation in this study. Then, the patients who were eligible based on the inclusion criteria included for the first assessment and the face-by-face intervention. The second education was given via online to all subjects. The inclusion criteria for the subjects included a medical history of COPD at least for 1 month prior to the study, using inhaler regularly at least for 1 month prior to the study, and having an active WhatsApp number for keeping in touch with the researcher. Any patients who undergo treatment for other respiratory disease (tuberculosis, etc) was excluded from this study.

The data used in this study are primary data collected via a questionnaire measuring the quality of life, a questionnaire relating to the study's basic characteristics, and a special checklist on the use of inhalers. Education was repeated twice: the first instance in the form of counseling through direct demonstration regarding the proper use of inhalers for each patient. The second education was delivered using online educational videos detailing proper inhaler technique sent to each patient via the WhatsApp application. The videos were made by the researchers and were reviewed by pharmacists and a pulmonologist. The steps on how to use the inhaler were adjusted to match a special checklist translated by the researcher and reviewed by the pharmacists and the pulmonologist. Proper use of inhaler was defined by not missing or not doing any step incorrectly. Improper use of inhaler was defined as missing or doing at least one step incorrectly.

The statistical analysis conducted for this study included univariate and bivariate analysis. Univariate analysis was used to identify the basic characteristics studied, and bivariate analysis to reveal the relationship between the existing and dependent variables.

3. Result & discussion

The majority of patients in this study were over 50 years old (81.8%). Regarding gender, 59.1% of the patients in this study were female, and they had a higher CAT score on average than men (from 13.0 ± 2.5 to 12.7 ± 1.7) at pre-intervention. In this study, most patients were over 50 years old (81.8%), reflecting COPD as a disease that worsens with age. Patients under 50 still risk developing COPD, as shown in this study. The results of the 2013 Indonesia Basic Health Research (Riskesdas) showed that the prevalence of COPD patients in the age ranges of 25–34 years, 35–44 years, and 45–54 years was 1.6%, 2.4%, and 3.9%, respectively. The pre-intervention data of the subjects showed in Table 1 below.

Most of the patients were not working (68.2%) and remained at home. Acute exacerbations are a major feature of COPD and are associated with worsening health status, accelerated lung damage, muscle wasting, and decreased survival. They can also lead to a prolonged decrease in physical activity, which tends to have a significant impact on the quality of life of COPD patients (Lee et al., 2018). The risk of exposure to cigarette smoke, vehicle fumes, or other triggers that can cause an acute exacerbation decrease when patients mostly remain at home, and this could be the reason for the lower pre-intervention CAT score in

Table 1. The baseline of subjects at Grha Permata Hospital (n = 22).

Characteristic	Number of subjects (%)
Age (years)	
≤50	4 (18.2)
>50	18 (81.8)
Gender	
Male	9 (40.9)
Female	13 (59.1)
Working status	
Yes	7 (31.8)
No	15 (68.2)
Education level	
Elementary school	3 (13.6)
Middle school	2 (9.1)
Senior high school	9 (40.9)
College/university	8 (36.4)
Smoking status	
Still smoking	1 (4.5)
Passive smoker	6 (27.3)
Has stopped smoking	11 (50)
Never smoked	4 (18.2)
Duration of COPD	
≤ 12 months	14 (63.6)
>12 months	8 (36.4)
Duration of inhaler use	
≤ 12 months	17 (77.3)
>12 months	5 (22.7)
Experience of receiving education from a healthcare professional	
Yes	20 (90.9)
No	2 (9.1)
Number of inhalers	
1 inhaler	9 (40.9)
2 inhalers	13 (59.1)

patients who are not working compared to patients who are still working daily (from 12.4 ± 1.9 to 13.7 ± 2.0).

The 2013 Indonesia Basic Health Research (Riskesdas) stated that COPD prevalence tended to be higher in patients with lower education levels (elementary and middle school). In contrast, it was found in this study that there is a higher prevalence of COPD in patients with higher education levels (high school and college/university). However, the patient group with low education levels had higher pre-intervention CAT scores than patients with higher education.

The 2020 GOLD (Global Initiative for Chronic Obstructive Lung Disease) guidelines show that smoking is the most common risk factor associated with developing COPD. Smoking cessation is one of the recommendations for non-pharmacological therapy for COPD patients. A total of 11 patients (50%) had stopped smoking, and only one (4.5%) still smoked. Despite quitting smoking, patients in this group had the highest pre-intervention CAT scores among the smoking status groups (13.3 ± 1.9). In contrast to patients who had quit, still smoking patients had the lowest CAT score, at only four points. This fact suggests that risk factors other than smoking cannot be ignored as causes of COPD. Exposure to secondhand smoke, also known as environmental tobacco smoke, can also contribute to respiratory symptoms and COPD by generating an inflammatory response with increased macrophage and neutrophil infiltration into the lungs (Chan et al., 2019). Occupational exposure to gases or particles can also cause 10–20% of the symptoms or functional disorders consistent with COPD (GOLD, 2020). As a result, non-pharmacological treatments to reduce disease's impact on a patient's quality of life cannot be based solely on smoking cessation.

Table 2. The effect of the patient's baseline characteristics on the proper use of an inhaler.

Characteristic	Group A (n = 8)	Group B (n = 14)	*p*
Age* *n* (%)			
28–64.5 years	7 (87.5)	4 (28.6)	0.001
64.6–82 years	1 (12.5)	10 (71.4)	
Gender *n* (%)			
Male	3 (37.5)	10 (71.4)	0.135
Female	5 (62.5)	4 (28.6)	
Education level *n* (%)			
Elementary school	1 (12.5)	2 (14.3)	0.262
Middle school	2 (25)	0 (0)	
Senior high school	3 (37.5)	6 (42.9)	
College/university	2 (25)	6 (42.9)	
Duration of COPD* *n* (%)			
1–8 months	5 (62.5)	6 (42.9)	0.330
9–60 months	3 (37.5)	8 (57.1)	
Duration of using inhaler* *n* (%)			
1–6 months	6 (75)	6 (42.9)	0.156
7–60 months	2 (25)	8 (57.1)	
Number of inhalers *n* (%)			
1 inhaler	5 (62.5)	4 (28.6)	0.135
2 inhalers	3 (37.5)	10 (71.4)	

* division of groups based on the median value; p = significant difference using chi-squared test; Group A: patients correctly using the inhaler; Group B: patients incorrectly using the inhaler.

Most of the patients involved in this study (63.6%) had been diagnosed with COPD for less than one year. The preponderance of patients in this group could be because patients in the other group, those who had had COPD for more than one year, did not come back to the hospital for check-ups of their condition with their pulmonologist. COPD patients with mild, moderate, and severe disease (grades 1–3) are recommended to visit their doctor every year, while patients with very severe disease (grade 4) are recommended to visit at least twice a year (National Institute for Health and Care Excellence (NICE), 2018). As many as 77.3% of patients had used inhalers for less than a year.

The duration of COPD was seen to influence the decreased quality of life, with the CAT score before intervention being higher in patients with more than 12 months (14.9 ± 2.7 vs 11.6 ± 1.5 for those diagnosed for less than one year). These results are consistent with research conducted by Okutan, Demirer, and Kartaloglu in 2013 that showed an increase in CAT score with increasing disease duration. COPD is a respiratory disease that is not completely reversible and can worsen with increasing disease duration and age. This study shows that patients with a longer duration of inhaler use had a poorer quality of life than other patient groups (15.0 ± 4.3 vs 12.2 ± 1.4 for those who used an inhaler for less than one year). This finding is also in line with the results in Okutan et al.'s (2013) research, which shows that the patient's quality of life decreases with increasing duration of management of their COPD.

As many as 9.1% of patients had never received direct education about the use of inhaled drugs from a healthcare professional; this could be the cause of the high CAT score in this group. Healthcare professionals play an important role in educating patients about the use of inhalers. Direct education by healthcare professionals can increase the correct use of inhalers, which can increase the effectiveness of treatment in COPD patients and lead to improvements in their quality of life. Patients who have been taught how to use inhalers have been educated directly by doctors and nurses in hospitals and pharmacists in hospital pharmacy departments and local pharmacies.

After being provided with repeated education in this study, 14 patients (63.6%) still made mistakes in their inhaler use. Table 2 showed

Table 3. Effect of inhaler type with proper technique of inhaler use.

Characteristic	Group A ($n = 8$)	Group B ($n = 14$)	p
Type of inhaler n (%)			
DPI ($n = 23$)	13 (56.5)	10 (43.5)	0.992
pMDI ($n = 12$)	6 (50)	6 (50)	
Name of the inhaler n (%)			
Discus ($n = 12$)	7 (58.3)	5 (41.7)	0.781
Brezhaler ($n = 1$)	0 (0)	1 (100)	
Turbuhaler ($n = 6$)	4 (66.7)	2 (33.3)	
Respimat ($n = 4$)	2 (50)	2 (50)	
pMDI ($n = 12$)	6 (50)	6 (50)	

p = significant difference using chi-square test; Group A: patients correctly using the inhaler; Group B: patients incorrectly using the inhaler.

that age is the only factor which can be associated with proper inhaler use. Table 3 showed that in this study, the type of inhaler is not associated with proper inhaler use. In this study DPI-type inhaler is the type that is most used improperly (62.5%). Several steps when using the inhalers were not performed by subjects (Figures 1, 2, 3, 4, and 5). For DPI-type inhalers, mistake mostly happened at step "breath out gently, away from inhaler". For pMDI-type inhalers, mistake mostly happened at step 8 "while holding breath, remove inhaler from mouth".

Although education had been given, patients were still unable to use inhalation drugs properly. Studies have shown that patients can still make mistakes despite prior education. In a study conducted by Song et al. (2005), patients still misused inhalers even though they had used them every day for years. This study is also in line with Baba et al. (2020), which found that as many as 48.8% of patients still made mistakes in using inhalers even though they had been educated twice.

The reasons behind the occurrence of errors in using inhalers identified in this study include the low frequency of direct verbal education, which is an obstacle in the pandemic situation. In general, patients prefer face-to-face direct demonstrations because they are considered easier to remember and ask questions directly from healthcare professionals. Other studies have shown a significant difference in the correct rate of using pMDI-type inhalers between patients who are given interventions in the form of direct pharmacist instructions and patients who only watch videos or read pamphlets (Axtell et al., 2017).

In addition, research has suggested that healthcare professionals should provide education at least three times for each patient (Takaku et al., 2017). The intervention was only carried out twice in this study, with direct verbal demonstrations at the first intervention and the second intervention via online video. Repeated education is needed because studies have shown that healthcare professionals' education effectiveness can decrease or even be lost over time and that repeated education can increase the correct use of inhalers in patients on an ongoing basis (Morton et al., 2020). Effective management of COPD therapy consists of 90% education and 10% medication (Xin et al., 2016).

Mistakes in the use of inhalers that occur in the majority of patients can cause low drug release and low drug deposition in the lungs (Sulaiman et al., 2017). Drug deposition in the lungs via inhaler ranges from 10–50% (Thorsson, 1995). Reduced lung deposition of drugs due to misuse of inhalers can reduce therapeutic effects, leading to poor control of symptoms and reduced treatment management effectiveness in COPD patients.

Despite the abovementioned limitation, our study showed that after repeated interventions in the form of a direct face-to-face demonstration and an online video, there was a clinically important improvement in the patients' quality of life indicated by a decrease of two points in mean CAT score, even if not statistically significant. A total of 15 patients (68.2%) experienced an increase in quality of life. There were no differences between patient baseline characteristics and the decrease in CAT score ($p > 0.05$). Table 4 also showed that there were no significant differences in mean CAT score before and after intervention between correct inhaler-use group with the incorrect inhaler-use group. The small sample size in this research (n = 22) can be the reason behind this result.

Quality-of-life assessment with CAT scores can be carried out every 2–3 months. Every two-point decrease indicates a significant improvement in the quality of life in COPD patients. In this study, the researchers failed to show a significant result ($p = 0.490$).

The mean CAT score of patients who used their inhalers correctly after being given repeated education was 7.5 ± 2.3 compared to the pre-intervention score of 10.4 ± 1.8. This result is clinically important compared to patients who still incorrectly used their inhaler, who had an average post-intervention CAT score of 12.7 ± 2.9. The decrease in CAT

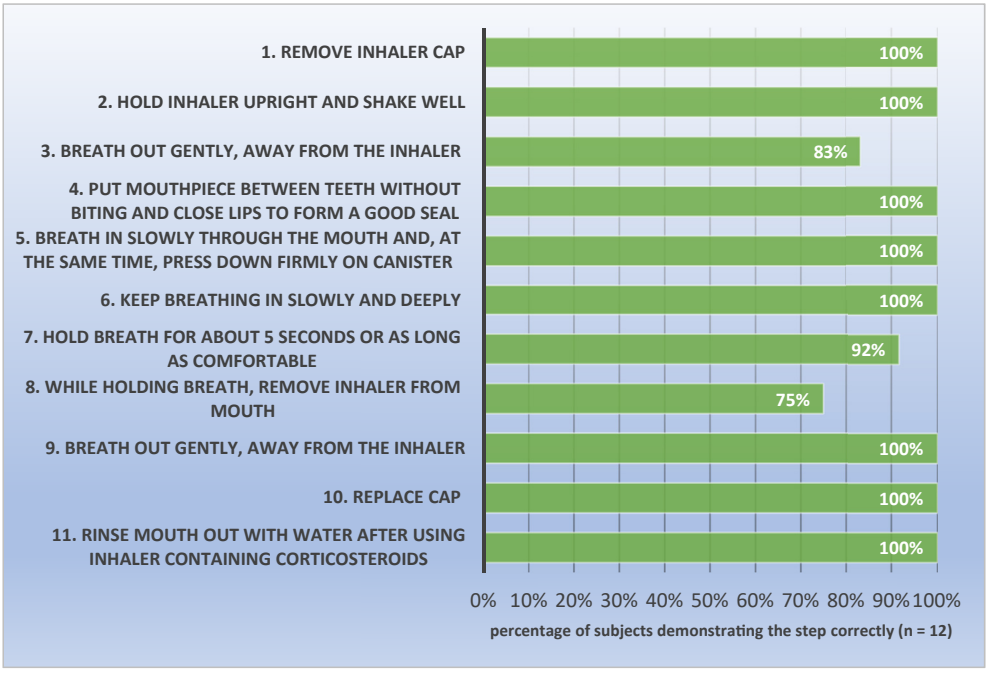

Figure 1. Percentage of subjects demonstrating each steps of using pMDI correctly.

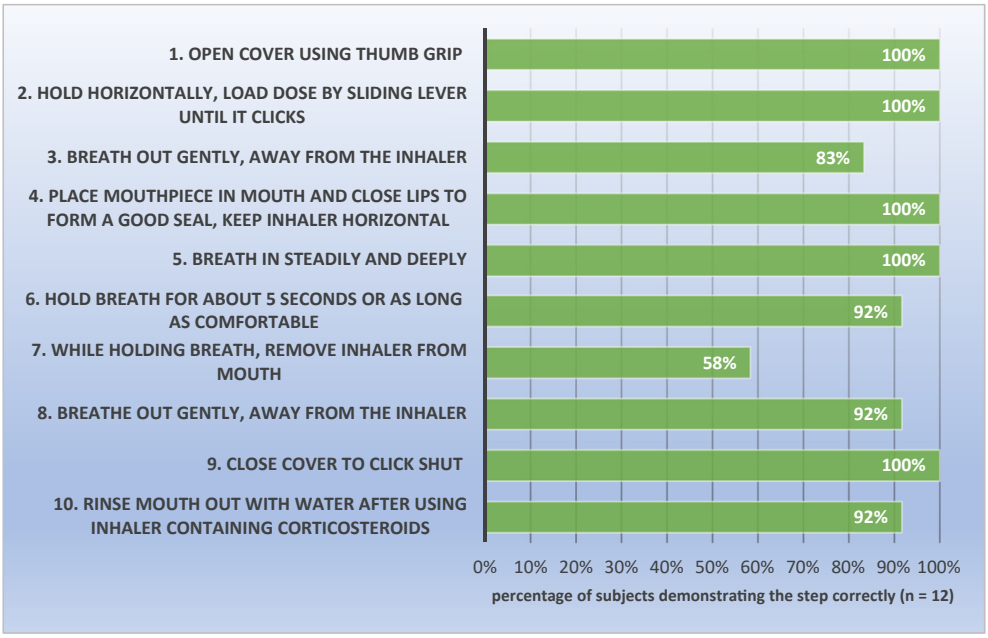

Figure 2. Percentage of subjects demonstrating each steps of using Discus correctly.

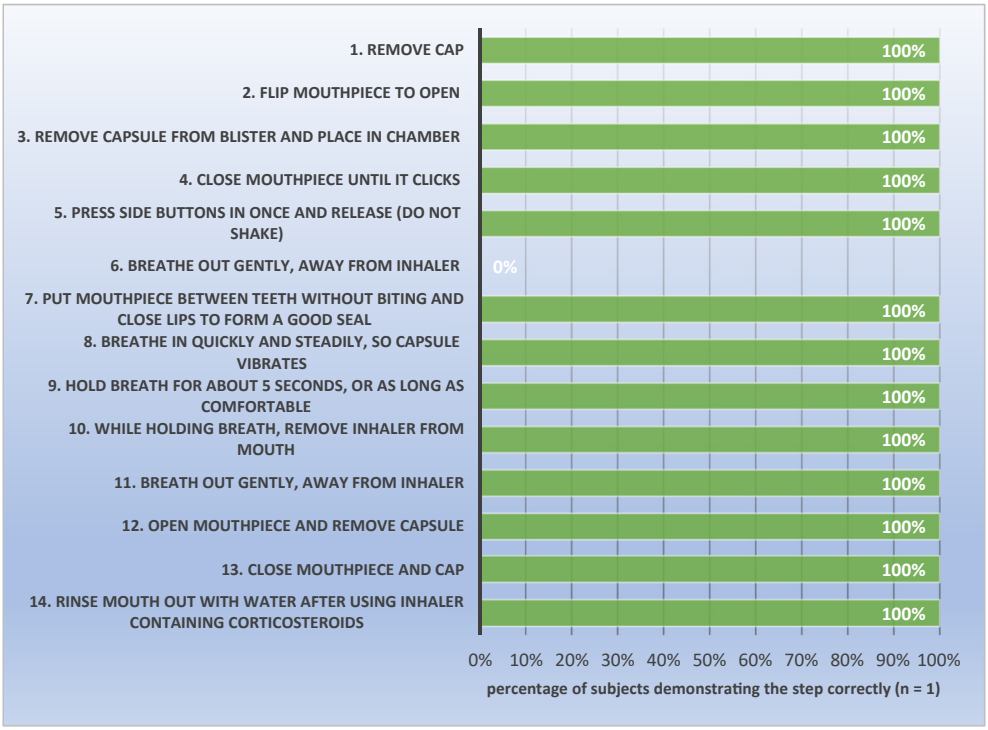

Figure 3. Percentage of subjects demonstrating each steps of using Breezhaler correctly.

score in patients who were still wrongly using their inhalation drugs was less than two points, which means that the improvement in this group's quality of life was not significant compared to patients who used the inhaler appropriately.

Previous studies have shown that patients who receive repeated education regarding proper inhaler technique have a better quality of life than patients who do not (Takemura et al., 2011). The repeated education given needs to be re-evaluated to have a significant effect and be applied in the long term. Previous research has shown that repeated education with direct verbal demonstrations can improve disease control and patient quality of life (Ilic et al., 2016). Repeated education through teleconferences also shows promising results regarding proper inhaler techniques and improving the quality of life in COPD patients (Thomas et al., 2017).

Proper inhaler technique is not the only factor that can improve patients' quality of life. Other factors can influence the quality of life in COPD patients, such as the severity of the disease (Irianti et al., 2018), the presence of comorbidities (Galal et al. 2018; Kwon and Kim, 2016), the patient's lifestyle (Savchenko and Kaidashev, 2018), the patient's mental condition (Ekici et al., 2015; Kwon and Kim, 2016), body mass

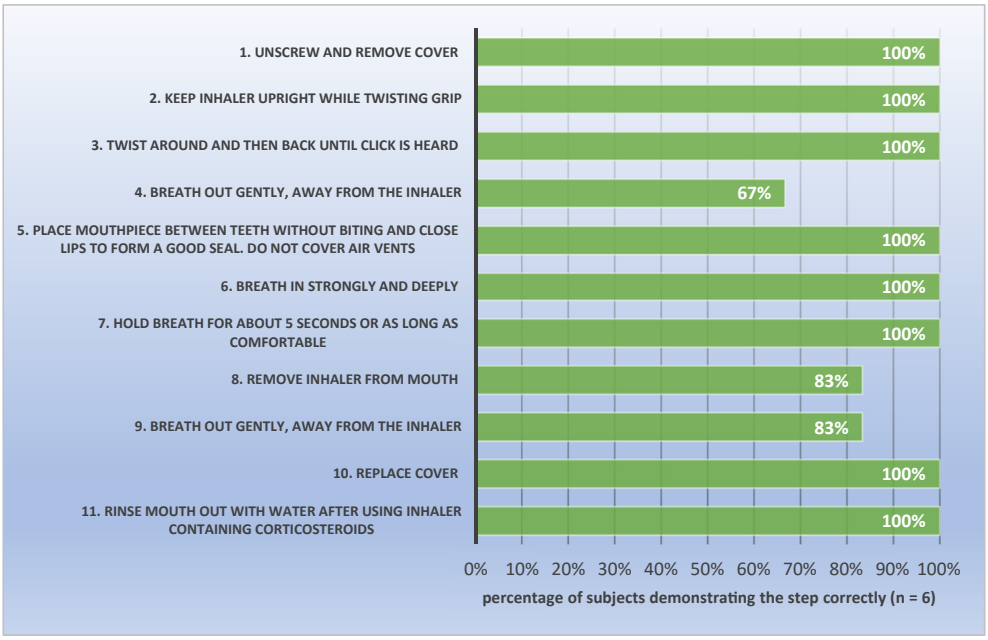

Figure 4. Percentage of subjects demonstrating each steps of using Turbuhaler correctly.

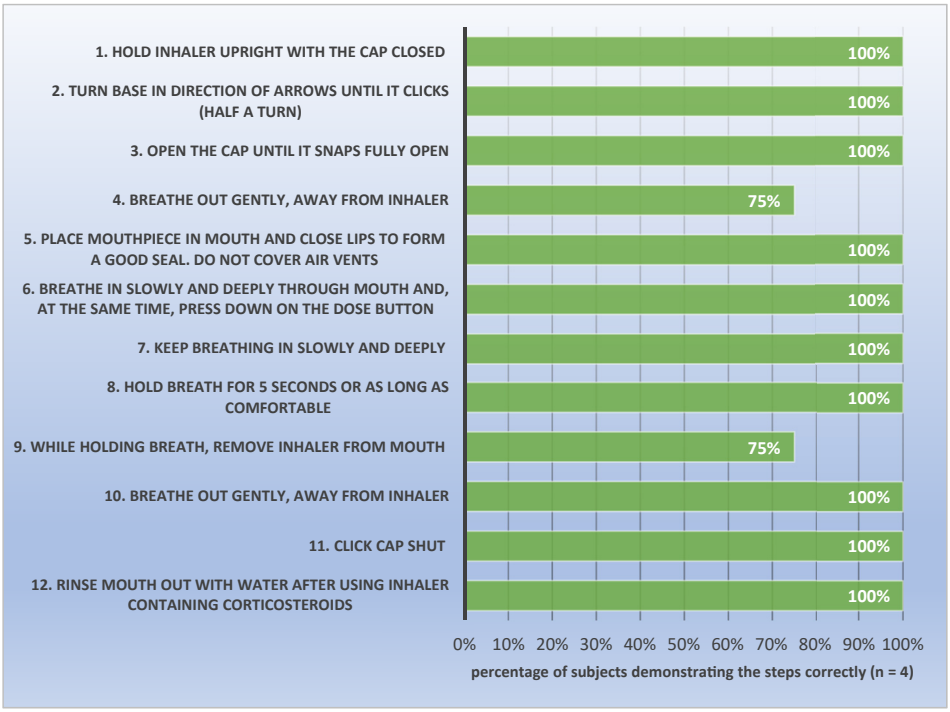

Figure 5. Percentage of subjects demonstrating each steps of using Respimat correctly.

Table 4. Changes in CAT score based on the proper technique of inhaler use.

The technique of using an inhaler	Mean of CAT score before intervention	Mean of CAT score after intervention	*p*	Mean of differences in CAT score before and after intervention	*p*	Percentage of patients with improved QoL	Percentage of patients with not improved QoL	*p*
Correct ($n = 8$)	10.4 ± 1.8	7.5 ± 2.3	p^a: 0.217	2.9 ± 2.1	p^c: 0.716	27%	9%	p^d: 0.490
Incorrect ($n = 14$)	14.2 ± 1.9	12.7 ± 2.9	p^b: 0.278	1.5 ± 2.5		41%	23%	

Data are expressed in mean ± SEM; SEM = standard error of mean; p = significant difference. p^a = significant difference before and after intervention in correct group using Paired T-Test; p^b = significant difference before and after intervention in incorrect group using Wilcoxon Signed Rank Test; p^c = significant difference in delta CAT score between groups using Independent T-Test. p^d = significant difference of proportion between the patients with improved QoL and patients with not improved QoL related to the technique of using inhaler correctly, tested using Chi-Square Test.

index (Esteban et al., 2020), and adherence to treatment regimens (Takemura et al., 2011); these factors were not examined in this study. Despite these limitations, our study gives preliminary data that counseling through direct demonstration and subsequently maintained by online short educational videos made by the researchers for each inhaler type showed promising results in improving the proper inhaler technique and patients' quality of life.

4. Conclusions

The mean CAT score of respondents before and after giving repeated education showed a two-point decrease (12.8 ± 1.3 vs. 10.8 ± 2.0), indicating an improvement in the quality of life, and 68.2% of respondents showed a decrease in CAT score of two points or more. There were no significant differences in mean CAT score before intervention and after intervention between correct inhaler-use group with the incorrect inhaler-use group. It can be concluded that repeated education regarding proper inhaler technique with direct demonstrations and further maintained by videos can improve the quality of life in COPD patients.

5. Author's note

To improve proper inhaler technique for COPD patients, we plan to get a larger sample size to represent the population of COPD sufferers at Grha Permata Ibu Depok Hospital and use more effective educational methods and a greater frequency of educational intervention.

Declarations

Author contribution statement

Rani Sauriasari: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Raiza Aulia Madani: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Anna Rozaliyani, Dodi Sudiana: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement

This work was supported by Directorate of Research and Development Universitas Indonesia through PUTI Q1 Grant (NKB-1275/UN2.RST/HKP.05.00/2020).

Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Acknowledgements

We acknowledge NPS MedicineWise who gave us permission to adapt NPS MedicineWise Inhaler technique: Device-specific checklists (February 2020) and GlaxoSmithKline (GSK) for permission to use the language version of CAT questionnaire for academic research purpose. We also thank to the Director of Grha Permata Ibu Hospital, all the nurses and healthcare professionals for helping us during the research.

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