Original Article

Impact of a structured workshop on the inhaler technique knowledge and skills of healthcare workers in a tertiary government hospital

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ABSTRACT

Background: Poor inhaler technique is associated with poor disease control. With the advent of newer inhaler devices, this study aimed to evaluate the effectiveness of a structured workshop on the knowledge and skills in inhaler technique of healthcare workers (HCWs) in the Department of Medicine of the Philippine General Hospital.

Methodology: This was a quasi-experimental study which compared the knowledge and skills of HCWs on inhaler technique before and immediately after a structured inhaler workshop. A follow-up evaluation was conducted to measure the effect after a one-month period.

Results: A total of 101 participants comprised of interns, nurses, and residents were included in the final analysis. Participants had low baseline knowledge scores; only 41 participants (40.6%) passed the pre-workshop knowledge assessment. The knowledge scores significantly increased immediately post-workshop ($p < .001$ across HCW groups) which persisted until one month after for the residents but not for the nurses and interns. For all groups, the skill scores in using dry powder inhaler (DPI) significantly improved immediately after the workshop ($p < .001$). After one month, there was a decline in skill scores for all, but scores remained significantly higher than pre-workshop values. The metered-dose inhaler (MDI) skill scores of participants immediately post-workshop showed an improvement from baseline that was sustained on follow-up. For all HCW groups, the single-dose DPI (SDPI) skill scores also improved immediately after the workshop and persisted after one month. At baseline, none of the interns possessed any skill in using soft mist inhaler (SMI) while both nurses and residents had low skill scores. Immediately post-workshop and on one-month follow-up, SMI skill scores improved across all HCW groups.

Conclusions: A structured inhaler workshop improves the knowledge and skills of HCWs on inhaler technique on a short-term basis and at one-month follow-up. Further studies are needed to determine the longevity of the effect.

Keywords: inhaler technique, structured workshop, bronchial asthma, chronic obstructive pulmonary disease, healthcare workers

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INTRODUCTION

Bronchial asthma and chronic obstructive pulmonary disease (COPD) remain global health problems. COPD has a global prevalence of 10.3% and is the fourth leading cause of death worldwide, causing 3.5 million deaths in 2021.[1,2] Bronchial asthma is another major noncommunicable disease afflicting an estimated 262 million people in 2019 and causing 455,000 deaths.[3] Since inhaler therapy is the mainstay of treatment for either disease, poor inhaler technique is associated with poor disease control with increased risk of hospitalizations, emergency room consultations, and the need for oral steroids and antibiotics.[4] All types of inhaler devices are equally efficacious.[5] However, with the advent of newer inhaler devices, healthcare providers and patients may not understand the key features of inhalers and how to operate them.[6,7] An educational program may improve this gap.[8]

Patient education on proper inhaler technique is the responsibility not only of the attending physician, but also of the entire healthcare team. The adequacy of the knowledge and skills of healthcare workers (HCWs) at all levels of patient care in inhaler-related patient education is crucial to impart the full benefit of inhaler therapy. In this study, we determined the impact of an inhaler workshop on the inhaler-related knowledge, skills, and teaching practices of HCWs for different inhaler devices to assess its value as part of healthcare delivery improvement measures.

The study aimed to evaluate the effectiveness of a structured workshop on the knowledge and skills on inhaler technique among residents, medical interns, and nurses in the Department of Medicine of the Philippine General Hospital. Specifically, it aimed to describe their baseline knowledge, skills, and patient teaching practices on inhaler technique; and compare their knowledge and skills at three time points, namely: at baseline, immediately post-workshop, and one month after.

METHODOLOGY

Study design

This was a quasi-experimental study which compared the knowledge, skills, and teaching practices of residents, medical interns, and nurses on inhaler technique, before and after a structured inhaler workshop.

Study setting

The study was conducted at the Department of Medicine of the University of the Philippines—Philippine General Hospital which has a high case burden of patients with airway diseases.

Study population

The study population consisted of HCWs at the Department of

Medicine: residents in all levels of training, nurses assigned to the medical wards regardless of length of appointment to the area, and medical intern rotators during the conduct of the study. Participants were included if they were able to attend a face-to-face inhaler workshop.

Participants who did not consent to join the study were excluded. Participants who chose to withdraw from the study at any time were withdrawn.

Sampling and sample size calculation

This study used a convenience sampling method. The average prevalence of incorrect inhaler technique among HCWs in previous studies was 60%.[9-11] Using Fisher's formula, with a confidence interval of 90% and a margin of error of 10%, the minimum sample size was 35 residents-in-training, 37 nurses, and 24 medical interns, with a total of 96 study participants.

During protocol development (basis for sample computation), the Department of Medicine had 70 residents-in-training, 80 nurses, and 36 interns. At the time of the study, the department had 70 residents-in-training, 54 nurses, and 46 rotating medical interns.

Study procedure

This study adapted the procedures done in a local study with an additional follow-up evaluation of the knowledge and skills after a month of the workshop.[12] The evaluators/facilitators of the study were fellows from the Division of Pulmonary Medicine who received training in inhaler technique from the Philippine College of Chest Physicians.

After consent was secured, participants accomplished a self-administered questionnaire on their demographic characteristics, baseline knowledge of inhaler devices, and their reported practices on inhaler education. To assess their baseline skills in inhaler technique, participants were first asked if they knew how to use each of the four commonly prescribed inhaler devices. A score of 0 was given if the participant answered "no" and no demonstration was requested to avoid the participant figuring out the device pre-workshop. For those who knew how to use the devices, participants were asked to demonstrate their use while reciting the steps, and skills were checked by a trained facilitator against a checklist. For each step of the process, a score of 1 was given for the correct step and 0 for missed or incorrect steps. The facilitators did not give feedback on the skills pre-workshop.

A one-hour structured lecture, developed by one of the investigators who serves as a consultant of the Division of Pulmonary Medicine, was then delivered. It covered the following topics: appropriateness of inhaler device type, recommended frequency of assessment of patients' inhaler technique, steps in the proper use of different inhaler types (metered-dose inhaler [MDI], dry power inhaler [DPI], and soft mist inhaler [SMI]), and the indication for the use of spacers. After the lecture, the plenary was divided into small groups with a maximum of 10 participants with a corresponding facilitator. The facilitators conducted demonstrations of inhaler technique using the different inhaler devices in each small group. The participants were given time to practice and have a return demonstration.

After the workshop, participants answered the same self-administered questionnaire. Each participant then demonstrated the use of MDI, DPI (both single-dose and multi-dose), and SMI. The same facilitator from the pre-workshop skills assessment graded the participant's inhaler technique against the same checklist. The same manner of grading was done. For incorrect steps, facilitators gave verbal feedback and corrected the technique after the post-workshop assessment was completed. Only the first attempt of the post-workshop evaluation of skills was graded. The whole duration of the workshop, including the pre- and post-workshop assessments, was approximately 4 hours.

To evaluate the impact after a one-month period, a follow-up evaluation using the same self-administered questionnaire and skills demonstration was done. The same facilitators evaluated the participants. The average duration of the follow-up assessment was approximately 10 minutes.

Data collection

The self-administered questionnaire consisted of the HCWs' demographics and practices. Questions 1 to 7 reported practices, and questions 8 to 19 were about knowledge on proper inhaler technique. These knowledge questions were adopted from a local study which underwent item analysis (Supplementary Material 1).[12] All questions were in English. The questionnaire was administered at baseline, immediately after the workshop, and one month after. The estimated time to answer the questionnaire was 10 minutes.

Device-specific inhaler checklists provided by the manufacturer of each inhaler type were used to grade the skills of the participants (Supplementary Material 2).

Data analysis

Descriptive statistics was used to summarize the demographic data and practices on inhaler technique patient education. Frequency and proportion were used for categorical variables, median and interquartile range for non-normally distributed continuous variables, and mean and standard deviation for normally-distributed continuous variables. Shapiro-Wilk test was used to test the normality of the continuous variables. Wilcoxon signed-rank test was used to compare pre-workshop and immediately post-workshop scores, and pre-workshop and one-month follow-up scores. The null hypothesis was rejected at 0.05 α level of significance. JASP version 0.17.1.2 was used for data analysis.

Ethical consideration

This study was approved by the University of the Philippines Manila Research Ethics Board (UPM-REB 2023-0689-EX) and was conducted in accordance with the Declaration of Helsinki and the Data Privacy Act of 2012. The proper procedures for obtaining informed consent were duly followed.

RESULTS

A total of 170 healthcare workers from the Department of Medicine were deemed eligible and invited to participate, of whom 115 attended the inhaler workshop (Figure 1). Some participants were unable to complete the inhaler workshop (residents, n = 6; nurses, n = 1, interns n = 5) due to emergency calls and two participants who were lost to follow-up, one was on leave and the other one was not available due to conflict of rotation schedule. A total of 101 participants (residents, n = 47; nurses, n = 29; interns n = 25) were included in the final analysis.

As seen in Table 1, nurses were older compared to residents

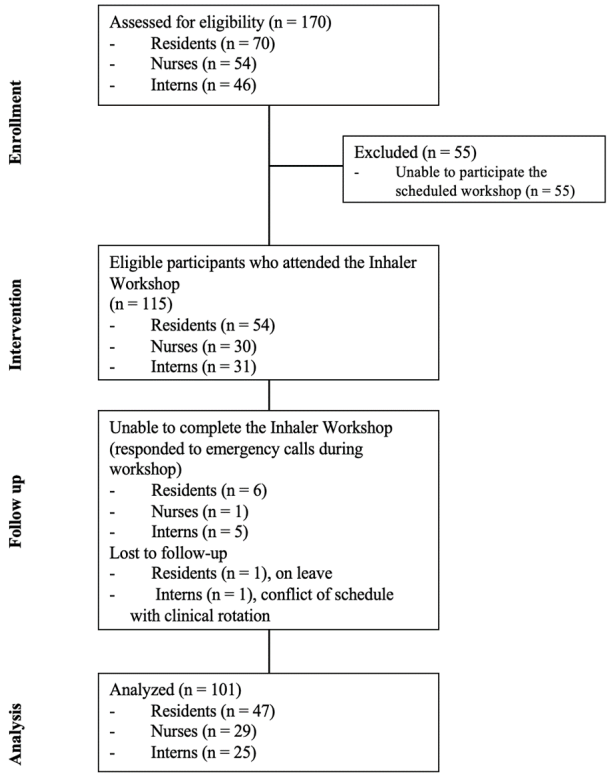

Figure 1. Flow diagram of study participants

and interns (mean age 39.2 ± 10.3 vs 28.1 ± 2.18 and 25.0 ± 1.0 years), and had more years of practice compared to residents (mean 10.2 ± 6.41 vs 2.0 ± 2.0 years). Nurses saw more asthma/COPD patients per week than either interns or residents (median 3.0 [IQR 2.5]). Nurses had a higher proportion of female participants compared to residents and interns (72.4% vs 46.8 and 44%). The majority of residents (55.4%) received hands-on inhaler education, while only one nurse and one intern reported receiving formal instruction on inhaler technique. Among residents who received inhaler education, most (38.5%) obtained it during medical school.

The majority of nurses (89.7%) and residents (93.6%)—but less than half of interns (48%) checked the inhaler technique of patients. Out of those who checked, some assessed the technique at first consult only or if patients had uncontrolled symptoms but there were some who assessed on multiple occasions or every consult regardless of symptoms. The manner of assessing the technique and teaching the proper one to patients varied; most of the assessments were conducted through demonstration, while most of the patient teaching was done via a combination of verbal instruction and video/live demonstration. A higher proportion of nurses compared to residents and interns taught patients on correct inhaler cleaning and proper storage and how to determine if the device was empty.

Results showed that participants had low baseline knowledge scores; there were only 41 participants (40.6%) who passed the pre-workshop knowledge assessment, i.e., having a score of at least 75%. Interns had higher baseline knowledge, with 60% of interns scoring at least 75% compared to only 41.4% for nurses and 29.8% for residents.

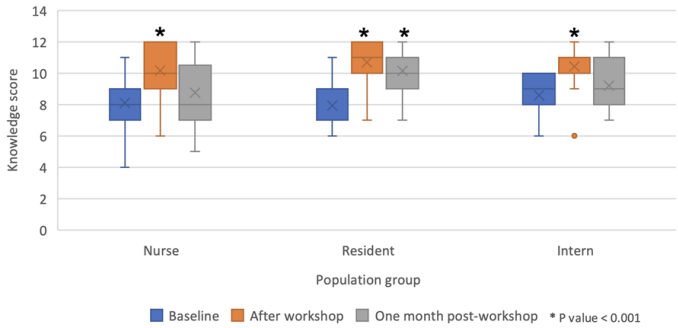

Figure 2. Knowledge scores of the participants at baseline, immediately after workshop, and at one-month follow-up (maximum score of 12)

Baseline inhaler technique scores were also low across all device types. Interns had lower skill scores across all types of inhalers (DPI 1.16 ± 2.81; MDI 5.80 ± 3.63; SDPI 0.52 ± 2.60; SMI 0) compared to either nurses or residents. Residents had higher baseline scores compared to nurses for all inhaler types except SDPI (DPI 4.49 ± 4.49 vs 1.21 ± 2.56; MDI 7.89 ± 3.86 vs 7.38 ± 2.96; SMI 4.21 ± 5.47 vs 0.79 ± 2.14). All groups had more or less similar skills score for MDI (interns 5.80 ± 3.63; nurses 7.38 ± 2.96; residents 7.89 ± 3.86).

The knowledge scores of the residents improved from baseline and persisted until one-month follow-up (p <.001) while the knowledge scores of both interns and nurses improved immediately post-workshop but were no longer statistically significant compared to pre-workshop values at one month (Figure 2).

For all groups, the skill scores in using DPI significantly improved immediately after the workshop (p <.001). After one month, there was a decline in skill scores for all, but scores remained significantly higher than pre-workshop values (Figure 3).

Compared to other inhalers, the mean MDI skill score at baseline was higher for all HCW groups (Table 1). Post-workshop scores improved and were sustained at one-month follow-up (Figure 4).

Interns had a lower baseline mean SDPI skill score compared to nurses and residents with a statistically significant increase

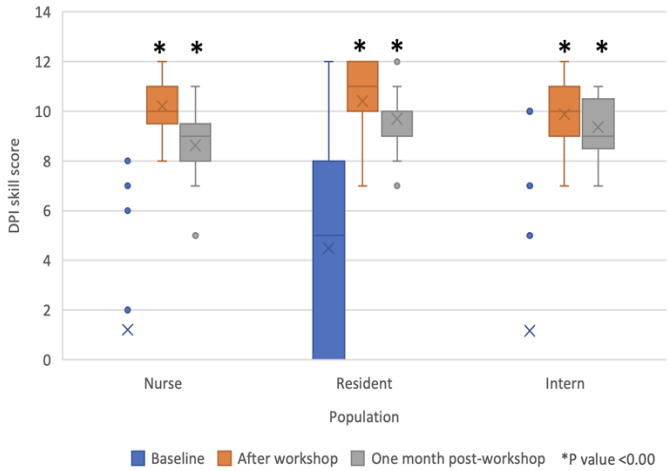

Figure 3. DPI skill scores of the participants at baseline, immediately after workshop, and at one-month follow-up (maximum score of 12). DPI, dry powder inhaler

Table 1. Characteristics of study participants

	Interns (n=25)	Nurses (n=29)	Residents (n=47)	p-value
Age in years, mean (SD)	25.0 (1.0)	39.2 (10.3)	28.1 (2.18)	<0.001
Years of practice, mean (SD)	NA	10.2 (6.41)	2.0 (2.0)	<0.001
Number of asthma/COPD patients/week, median (IQR)	1.0 (0.25)	3.0 (2.5)	2.0 (IQR 1.75)	0.006
Sex				
Female	11 (44.0)	21 (72.4)	22 (46.8)	0.052
Male	14 (56.0)	8 (27.6)	25 (53.2)	
Had hands-on inhaler education	1 (4.0)	1 (3.4)	26 (55.3)	<0.001
Timing of hands-on inhaler education,[1]				
Medical school	1/1 (100.0)	0	10/26 (38.5)	
Unspecified time	0	1/1 (100.0)	8/26 (30.8)	
Residency	0	0	4/26 (15.4)	
Workshop	0	0	2/26 (7.7)	
Pharmacy school	0	0	2/26 (7.7)	
Checked inhaler technique	12 (48)	26 (89.7)	44 (93.6)	<0.001
Frequency of checking inhaler technique[1]				
First consult				
Every consult	7/12 (58.3)	17/26 (65.4)	31/44 (70.5)	
If uncontrolled	5/12 (41.7)	8/26 (30.8)	12/44 (27.3)	
Other	2/12 (16.7)	0	27/44 (61.4)	
Manner of checking inhaler technique[1]				
Verbal	1/12 (8.3)	9/26 (34.6)	9/44 (20.5)	0.097
Demonstration	6/12 (50.0)	13/26 (50.0)	29/44 (65.9)	
Both	5/12 (41.7)	4/26 (15.4)	6/44 (13.6)	
Taught patients correct inhaler technique	14 (56.0)	27 (93.1)	44 (93.6)	<0.001
Manner of teaching inhaler technique				
Verbal				
Video demonstration	1/14 (7.1)	7/27 (25.9)	10/44 (22.7)	0.077
Live demonstration	3/14 (21.4)	0	7/44 (15.9)	
Combination	2/14 (14.3)	8/27 (29.6)	6/44 (13.6)	
Taught patients correct inhaler cleaning and storage	2 (8.0)	19 (65.5)	2 (4.3)	<0.001
Taught patients to determine if device is empty	7 (28.0)	18 (62.1)	1 (2.1)	<0.001
Baseline knowledge score (max: 12), mean (SD)	8.60 (1.29)	8.10 (1.52)	7.94 (1.55)	0.197
Baseline knowledge score at least 75%, mean (SD)	15 (60.0)	12 (41.4)	14 (29.8)	0.045
Baseline skill score, mean (SD)				
DPI (max: 12)				
MDI (max: 13)	1.16 (2.81)	1.21 (2.56)	4.49 (4.49)	<0.001
SDPI (max: 14)	5.80 (3.63)	7.38 (2.96)	7.89 (3.86)	0.063
SMI (max: 14)	0.52 (2.60)	7.07 (4.78)	6.36 (5.95)	<0.001

Data presented as n (%) unless otherwise stated. Denominators are the column totals (interns, n = 25; nurses, n = 29; residents, n = 47) unless otherwise stated.
[1]Participants could select more than one option.
COPD: chronic obstructive pulmonary disease; DPI: dry power inhaler; MDI: metered-dose inhaler; SDPI: single-dose DPI; SMI: soft mist inhaler

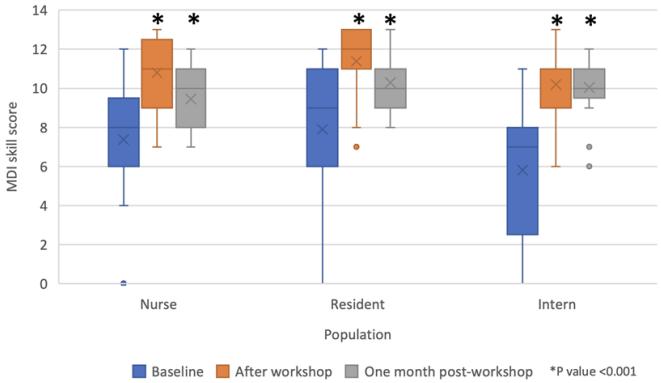

Figure 4. MDI skill scores of the participants at baseline, immediately after workshop, and at one-month follow-up (maximum score of 13). MDI, metered-dose inhaler

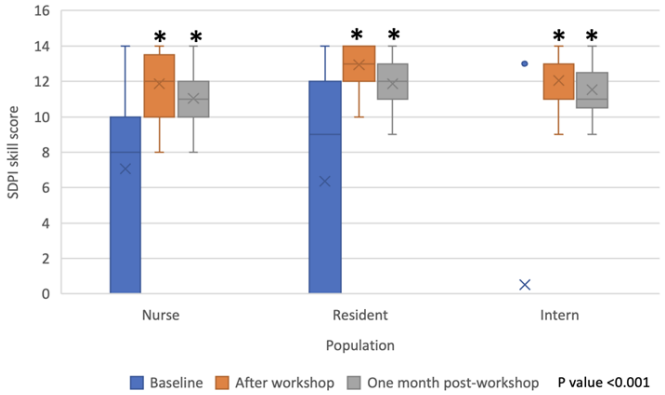

Figure 5. SDPI skill scores of the participants at baseline, immediately after workshop, and at one-month follow-up (maximum score of 14). SDPI, single-dose DPI

immediately after the workshop and on one-month follow-up (Figure 5). The SDPI scores of both nurses and residents improved immediately after the workshop as well and persisted on one-month follow-up.

At baseline, none of the interns possessed any skill in using soft mist inhaler (SMI) while both nurses and residents had low skill scores. Immediately post-workshop and on one-month follow-up, SMI skill scores improved across all HCW groups (Figure 6).

DISCUSSION

Inhaled delivery of bronchodilators and corticosteroids is the cornerstone of management of obstructive airway diseases, such as bronchial asthma and COPD.[13,14] This mode is preferred over systemic administration because it involves direct deposition of medication to airway receptor sites, has a rapid onset of action, and carries fewer systemic side effects.[15] These medications are delivered via nebulizers and inhalers, including MDIs, DPIs and SMIs.[13,16]

Although randomized controlled studies have demonstrated that there is no significant difference between devices in terms of efficacy, they usually exclude patients with poor inhaler technique, thus, overestimating real-world experience. Up to 90% of patients commit critical errors when using an inhaler, or those errors that likely significantly impair delivery of adequate medication to the lungs.[17] Age, educational status, previous inhaler instruction, comorbidities, and socioeconomic

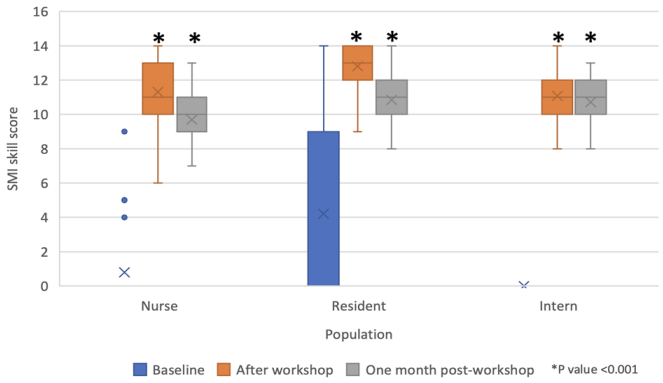

Figure 6. SMI skill scores of the participants at baseline, immediately after workshop, and at one-month follow-up (maximum score of 14). SMI, soft mist inhaler

status are factors associated with high inhaler error frequency.[14]

Healthcare providers play a vital role in ensuring proper inhaler technique among patients. According to a multicenter, cross-sectional, observational study, the provision of patient education instructions by healthcare workers is the only modifiable factor in reducing inhaler misuse.[7] This finding supports the thrust of clinical practice guidelines for both asthma and COPD to train healthcare providers, as they are the ones who instruct and educate patients on proper inhaler therapy.[18-19] Unfortunately, only 15-69% of healthcare professionals can correctly demonstrate correct inhaler use.[13-15] This prevalence is comparable with the findings of this study wherein only 60% of interns, 41.4% of nurses and 29.8% of residents had baseline knowledge scores of at least 75%, suggesting poor knowledge. Of note, despite high baseline knowledge of interns, they were noted to have poor baseline inhaler skills across all types of inhalers used in the study. This could be attributed to a very low prevalence of hands-on inhaler education among interns (4%). This finding is consistent with a cross-sectional survey in the United Kingdom which showed that 88% of medical students perceived that they need further training on inhaler technique.[20]

Educational workshops on inhaler technique have been demonstrated to improve knowledge and skills among healthcare practitioners. A study on residents-in-training showed that a single didactic session and workshop improved knowledge and skills during a short-term assessment.[21] The same result was observed in a small study among emergency department personnel which showed that a short educational session on proper MDI technique improved their ability in using the device.[22] An improvement in inhaler skills after a workshop was also noted in a study among several healthcare practitioners—specialists, general practitioners, pharmacists, pharmacist assistants, nurses, and respiratory therapists, not only during the immediate assessment but even after a four-month period.[23] These findings are consistent with the results of this study, which noted significant improvement in the knowledge scores and inhaler skills scores of not only the residents but also the interns and nurses, immediately after the workshop and at one-month follow-up.

As a limitation, this study demonstrated the knowledge and skills of healthcare workers as evaluated based on the questionnaire and against a checklist. The actual health education of patients and real-world outcomes were not

examined. Thus, it is recommended to evaluate these healthcare workers in their actual clinical practice. A longer follow-up period is also recommended to document the long-term effect of such interventions in the local setting. Lastly, it is recommended to conduct studies that evaluate whether the proper inhaler technique taught by healthcare workers translates to better clinical outcomes.

CONCLUSION

A structured inhaler workshop improves the knowledge and skills of healthcare workers on inhaler technique on a short-term basis and at one-month follow-up. Further studies are needed to determine the longevity of the effect.

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Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Authors' Disclosure

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