


# Effectiveness of Various Methods of Teaching Proper Inhaler Technique: The Importance of Pharmacist Counseling

Journal of Pharmacy Practice  
1-7  
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sagepub.com/journalsPermissions.nav  
DOI: 10.1177/0897190016628961  
jpp.sagepub.com  


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## Abstract

**Objective:** To compare the effectiveness of 4 different instructional interventions in training proper inhaler technique. **Design:** Randomized, noncrossover trial. **Setting:** Health fair and indigent clinic. **Participants:** Inhaler-naïve adult volunteers who spoke and read English. **Interventions:** Subjects were assigned to complete the following: (1) read a metered dose inhaler (MDI) package insert pamphlet, (2) watch a Centers for Disease Control and Prevention (CDC) video demonstrating MDI technique, (3) watch a YouTube video demonstrating MDI technique, or (4) receive direct instruction of MDI technique from a pharmacist. **Primary Outcome:** Inhaler use competency (completion of all 7 prespecified critical steps). **Results:** Of the 72 subjects, 21 (29.2%) demonstrated competent inhaler technique. A statistically significant difference between pharmacist direct instruction and the remaining interventions, both combined ( $P < .0001$ ) and individually ( $P \leq .03$ ), was evident. No statistically significant difference was detected among the remaining 3 intervention groups. Critical steps most frequently omitted or improperly performed were exhaling before inhalation and holding of breath after inhalation. **Conclusion:** A 2-minute pharmacist counseling session is more effective than other interventions in successfully educating patients on proper inhaler technique. Pharmacists can play a pivotal role in reducing the implications of improper inhaler use.

## Keywords

COPD, inhaler technique, asthma, patient education, pharmacist counseling

## Introduction

In 2012, the results of the Behavioral Risk Factor Surveillance System survey indicated that approximately 21.1 million adults in the United States had been diagnosed with asthma and another 15.3 million had chronic obstructive pulmonary disease (COPD).<sup>1</sup> These findings suggest that millions of Americans are likely candidates for treatment with medications administered as a metered dose inhaler (MDI) or dry powder inhaler (DPI). The effectiveness of drug therapy involving an MDI or DPI is dependent on the technique used by the patient, which ultimately determines whether the prescribed dose of drug is optimally delivered.<sup>2</sup> High inhaler misuse rates have been associated with poor control of asthma and COPD as evidenced by increased emergency department visits, antibiotic use, and systemic steroid use.<sup>3-5</sup> Levy et al reported that patients who presented with uncontrolled asthma were 4 times more likely to demonstrate improper inhaler technique than proper technique, further noting the importance of effectively training patients to properly utilize their inhalers.<sup>4</sup>

## Evidence of Inhaler Technique

As early as 1965, Saunders reported a high prevalence of inhaler misuse.<sup>6</sup> Since then, numerous studies have reported

findings of inhaler misuse, with the prevalence ranging from 15% to 94%.<sup>3-5,7-17</sup> Souza et al found that over 94% of patients performed at least 1 error in their MDI technique.<sup>13</sup> Melani et al reported up to 53% of patients performed at least 1 error in the process of using an MDI inhaler.<sup>7</sup>

Patients may falsely perceive themselves to use proper inhaler technique, although empiric observation suggests otherwise. Giraud and Roche found that of patients who exhibited poor inhaler technique, only 15% were aware of the deficiency.<sup>5</sup> Pinto Pereira et al demonstrated that only 41% of participants were able to display correct MDI technique, yet 92% were confident that their inhaler technique was appropriate.<sup>10</sup> Souza et al reported that although over 98% of the participants claimed to use proper inhaler technique, 94.2% performed at least 1 error when using the inhaler.<sup>13</sup>

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Inappropriate inhaler technique has been demonstrated with all forms of inhalers, but the majority of reports in the literature identify errors associated with MDI use.<sup>8,14</sup> Souza et al showed a statistically significant difference in the number of errors seen with MDI administration versus a DPI.<sup>13</sup> Bryant et al found that patients were more likely to demonstrate good technique with a Turbohaler than with an MDI.<sup>8</sup> Press et al reported a 71% frequency of misuse with a Diskus inhaler, as compared to 86% misuse with an MDI.<sup>14</sup>

### **Educating Patients on Inhaler Technique**

The inability to use an inhaler properly is most commonly associated with poor knowledge about asthma, a lack of inhaler training, advanced age, and lower levels of reading or education.<sup>3,7,10,15</sup> Effective inhaler education is unquestionably a critical component.<sup>11</sup> All patients should be effectively counseled about proper technique when they receive an inhaler, although the findings of several studies provide contrary results. Reports suggest that 33% to 94% of patients do not receive training on proper technique when they are first given an inhaler.<sup>3,10,16</sup>

The widespread use of inhalers, combined with the well-documented prevalence of improper technique among patient populations with asthma and COPD, suggests that new strategies are warranted to improve the techniques of patients who rely on inhaler therapy. However, there is a paucity of data comparing different educational approaches for providing instruction to patients on the proper use of inhalers. Some studies have been conducted to compare single educational interventions to control groups, whereas others have compared multimedia to written material. To date, there are no reports in the literature of head-to-head comparisons of multiple educational interventions.

### **Objective**

The purpose of this study is to compare the effectiveness of 4 different instructional interventions in training inhaler-naïve adult subjects to properly use an inhaler. The 4 educational methods include print information in the form of an MDI package insert pamphlet, a Centers for Disease Control and Prevention (CDC) video MDI demonstration, a YouTube video MDI demonstration, and direct instruction from a pharmacist or fourth-year professional division (4-year professional degree program) pharmacy student participating in a 4-week clinical advanced practice ambulatory care rotation.<sup>17-19</sup>

### **Methods**

#### **Study Population**

Healthy study subjects were recruited for enrollment between October 2013 and April 2014 by advertising at a local health fair and inquiring regarding participation willingness of patients during visits to an indigent care clinic in West Palm Beach, Florida. Inclusion was restricted to candidates without a diagnosis of asthma or COPD, lacking previous experience of

using an inhaler, who were able to speak and read English, and were at least 18 years of age. All participants signed informed consent. Approval to conduct the study was granted by the Institution Review Board at Palm Beach Atlantic University.

### **Study Design**

A total of 72 subjects were enrolled in this prospective trial. At baseline, each subject completed a questionnaire to capture age, ethnicity, education level, English fluency (verbal and written), prior experience with an inhaler, and general knowledge of asthma. The subjects were also administered the Rapid Estimate of Adult Literacy in Medicine short form (REALMS-SF) to determine health literacy level. This validated tool was selected as previous studies have shown a correlation between improper inhaler technique and low literacy.<sup>15</sup> This validated tool allowed a timely assessment of participants' health literacy through a minimal question burden and correlated with a reading grade level that was noted as well.

These inhaler-naïve subjects were randomly assigned to 1 of the 4 interventions using a dice randomization process: (1) reading a manufacturer-published MDI package insert pamphlet, (2) watching a CDC video demonstrating MDI technique, (3) watching a general popular YouTube video demonstrating MDI technique, or (4) receiving direct instruction of MDI technique from a pharmacist or fourth-year pharmacy student.<sup>17-19</sup> Eighteen participants were assigned to each type of intervention. Utilizing a timer, all interventions were limited to 2 minutes. Although previous studies suggest that successful health care counseling sessions may require approximately 6 to 20 minutes, the allocation of 2 minutes was considered to be more in line with the amount of time that a community pharmacist may routinely be able to devote to inhaler instruction.<sup>11,16</sup> Furthermore, if effectiveness can be demonstrated by such a brief period of instruction, more health care providers might be willing to engage in the activity. Additionally, the 2-minute limit was also consistent with the length of the video interventions, and for uniformity purposes, it was further applied to the package insert arm.

Participants assigned to the package insert arm were asked to review written information regarding the MDI technique within this 2-minute period. The material was determined to have a Flesch-Kincaid reading grade level of 5.8, meaning an average student in the fifth grade is able to read the text.<sup>20</sup> Those assigned to the CDC and YouTube video arms were asked to view the respective video. A standard government-issued inhaler instructional video from CDC was utilized because it is readily available to health professionals and consumers. The YouTube video was selected since it was the first video listed when conducting a Google Internet search using the term "how to use an inhaler." Subjects assigned to pharmacist's direct instruction participated in a one-on-one counseling session with either a pharmacist or fourth-year pharmacy student who received training in how to execute the study protocol. The content was loosely scripted with proper inhaler technique listed. This ensured consistency of the message while

**Table 1.** Number of Subjects Demonstrating Proper Technique for Each of the 7 Critical Steps.

7 critical steps of inhaler technique	All interventions (n = 72)	CDC video (n = 18)	YouTube (n = 18)	Inhaler pamphlet (n = 18)	Pharmacist counseling session (n = 18)
1. Remove cap	66 (91.7%)	15 (83.3%)	16 (88.9%)	18 (100%)	17 (94.4%)
2. Hold inhaler upright	56 (77.8%)	14 (77.8%)	15 (83.3%)	11 (61.1%)	16 (88.9%)
3. Shake inhaler	60 (83.3%)	14 (77.8%)	14 (77.8%)	15 (83.3%)	17 (94.4%)
4. Exhale completely	40 (55.6%)	8 (44.4%)	6 (33.3%)	10 (55.6%)	16 (88.9%)
5. Place inhaler in mouth and seal lips	72 (100%)	18 (100%)	18 (100%)	18 (100%)	18 (100%)
6. Breathe in slowly while pressing down inhaler	63 (87.5%)	13 (72.2%)	17 (94.4%)	15 (83.3%)	18 (100%)
7. Hold breath as long as possible (up to 10 seconds)	43 (59.7%)	6 (33.3%)	13 (72.2%)	9 (50%)	15 (83.3%)
Overall performance on all 7 steps	21 (29.2%)	3 (16.7%)	2 (11.1%)	3 (16.7%)	13 (72.2%)

Abbreviation: CDC, Centers for Disease Control and Prevention.

allowing for flexibility in communication. During the 2-minute session, the trainer explained proper inhaler technique and demonstrated the proper use of the device. Subjects were also given the opportunity to ask questions if time permitted in order to simulate an authentic patient counseling session.

Immediately following each of the 4 types of intervention, subjects were asked to demonstrate proper inhaler technique using a placebo MDI. Investigators, including those conducting direct instruction sessions, observed all subjects' performance and rated their competency utilizing a standardized checklist of the 7 critical steps of proper inhaler technique that are listed in Table 1. In order to minimize possible bias when assessing participants, subjects either completed these steps correctly or incorrectly, partial credit was not awarded. In addition, there was no prompting or corrections made during the assessment in order to allow results that mimic real-life scenarios. The selection of the 7 critical steps was based on a review of the literature to identify the step-wise inhaler techniques consistent with previous studies.<sup>10-11,16,21-26</sup> Consideration was also given to the instructions listed in the manufacturer's MDI package insert.<sup>17</sup> Subjects who omitted or failed to properly perform any of the 7 critical steps were determined to lack competency in inhaler technique. The frequency with which each of the 7 critical steps had been performed properly was also documented. Both the percentage of proper performance on each of the critical steps and the percentage of overall competency for all steps were analyzed for comparison between the 4 types of interventions.

The primary outcome of this study was to determine whether there were significant differences in the proportion of subjects in each group who successfully demonstrated competent inhaler technique, defined as properly executing all of the 7 critical steps listed in Table 1. A secondary outcome was the proportion of subjects who successfully demonstrated proper execution of each critical step. Results of inhaler technique competency were correlated with subject age, ethnicity, education level, REALMS-SF score, reading grade level, and familiarity with asthma, as well as to the 4 types of educational intervention.

### Statistical Analysis

Data analysis was conducted using IBM SPSS version 21.0 software. An omnibus test was used to determine whether there

were overall differences in the proportion of patients successfully demonstrating proper inhaler technique, as well as successful completion of each critical step. Results for the pharmacist direct instruction cohort were subsequently compared to the other 3 intervention cohorts collectively, and each type of intervention was individually compared to the others using a series of post hoc  $\chi^2$  tests. To assess for statistical significance in the omnibus test results, the computed *P* value was compared to a Bonferroni-corrected alpha level of .007. Correlation analyses were then conducted between inhaler technique competency and subject age, ethnicity, REALMS-SF score, reading grade level, familiarity with asthma, and education level. For the primary outcome, a total calculated sample size of 72 subjects was needed in order to detect a 35% difference between intervention groups (alpha = .05, power = 0.80).

### Results

The baseline characteristics between the 4 intervention arms were similar, with the exception of subject age (Table 2). Of the 72 study participants, 21 (29.2%) were able to demonstrate competent inhaler technique by successfully executing all 7 of the critical steps. Figure 1 indicates the subjects who successfully demonstrated inhaler competency for each type of intervention. Overall, there was a statistically significant difference in competence of inhaler technique between pharmacist direct instruction and the remaining 3 types of intervention combined ( $P < .0001$ ). In comparing the individual interventions to one another, statistically significant differences were found between pharmacist direct instruction and the CDC video ( $P = .001$ ), pharmacist direct instruction and the YouTube video ( $P = .03$ ), and pharmacist direct instruction and the inhaler pamphlet ( $P = .01$ ; Table 3). No statistically significant differences were identified when comparing the CDC video, YouTube video, and inhaler pamphlet treatment arms.

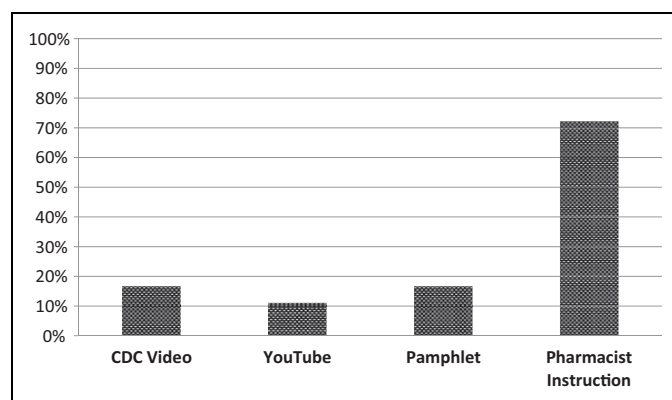
Table 1 indicates the number of study participants who properly demonstrated each of the 7 critical steps per treatment arm. For the subjects who lacked overall competence of inhaler technique, the critical steps most frequently omitted or improperly performed were exhaling before inhalation and holding of breath for as long as possible up to 10 seconds. Regarding the steps with the most positive outcomes, the coordination of

**Table 2.** Demographics of the Study Population for Each Type of Intervention.

	CDC video (n = 18)	YouTube (n = 18)	Inhaler pamphlet (n = 18)	Pharmacist counseling session (n = 18)
Males	7 (38.9%)	10 (55.6%)	4 (22.2%)	7 (38.9%)
Age 18-45 years <sup>a</sup>	10 (55.6%)	13 (72.2%)	16 (88.9%)	16 (88.9%)
Earned an associate's degree or above	12 (66.7%)	12 (66.7%)	11 (61.1%)	12 (66.7%)
English is primary spoken language	14 (77.8%)	17 (94.4%)	14 (77.8%)	17 (94.4%)
English primary language in home	17 (94.4%)	17 (94.4%)	16 (88.9%)	17 (94.4%)
English primary written language	14 (77.8%)	17 (94.4%)	15 (83.3%)	17 (94.4%)
Answered asthma question correctly	13 (72.2%)	17 (94.4%)	18 (100%)	17 (94.4%)
REALMS-SF score of $\geq 5$	15 (83.3%)	17 (94.4%)	18 (100%)	18 (100%)
$\geq$ Seventh Grade Reading Level	15 (83.3%)	17 (94.4%)	18 (100%)	18 (100%)

Abbreviations: CDC, Centers for Disease Control and Prevention; REALMS-SF, Rapid Estimate of Adult Literacy in Medicine short form.

<sup>a</sup>Statistically significant difference,  $P = .009$ .

**Figure 1.** Percentage of overall competence in inhaler technique for each intervention cohort.

breathing in slowly and not removing the cap were executed properly by about 90% of the subjects, and 100% properly placed the inhaler in their mouths and sealed their lips (Table 1).

No correlation was found between baseline demographics and the demonstration of proper inhaler technique, with the exception of the reading grade level, which showed a weak, but statistically significant correlation ( $r = .245$ ,  $P = .038$ ).

## Discussion

Studies of inhaler technique that have been published to date focused on assessing either the effectiveness of a single

**Table 3.** Comparison of Overall Inhaler Competence Between Types of Intervention.

Sample 1 Versus Sample 2	Test statistic	Standard error	P
CDC video versus inhaler pamphlet	-4.61	6.76	1.00
CDC video versus YouTube video	-7.11	6.76	1.00
CDC video versus pharmacist counseling session <sup>a</sup>	-25.83	6.76	.001
Inhaler pamphlet versus YouTube video	2.5	6.76	1.00
Inhaler pamphlet versus pharmacist counseling session <sup>a</sup>	-21.22	6.76	.01
YouTube video versus pharmacist counseling session <sup>a</sup>	-18.72	6.76	.03

Abbreviation: CDC, Centers for Disease Control and Prevention.

<sup>a</sup>Statistically significant difference between the types of intervention.

educational intervention or the comparative effectiveness between 2 different interventions.<sup>21-23</sup> This study appears to be the first comprehensive comparison of multiple training methods, consisting specifically of printed information, video presentation, and direct instruction.

This study demonstrated a statistically significant difference when comparing direct pharmacist instruction on proper inhaler technique to having subjects watch a video or read an inhaler pamphlet. These findings are consistent with previous reports of pharmacists effectively educating patients on proper inhaler technique.<sup>11,24-26</sup> For example, Giraud et al showed that approximately 6 minutes of pharmacist counseling significantly improved inhaler technique competency from a baseline of 24% to 79%.<sup>16</sup> In addition, Shrestha et al discovered that an average 8-minute counseling session with a health care provider (physician, respiratory therapist, or medical student) produced a 100% success rate in inhaler technique competency.<sup>11</sup> Other studies have demonstrated that pharmacist interventions significantly impact patients' asthma control, knowledge, adherence, management, inhaler technique, and disease severity.<sup>24-26</sup>

The current study's findings suggest that a brief 2-minute counseling session conducted by a pharmacist can significantly improve a patient's MDI inhaler technique. With this being found, it is important to note that literature reports indicate that some patients who use inhalers have never received instruction on proper technique from a health care provider.<sup>3,10,16</sup> Some barriers, such as limited time and/or lack of knowledge, may deter pharmacists and other health practitioners from providing inhaler instruction to patients.<sup>2,27-30</sup> The importance of instructing patients on proper inhaler technique is unequivocal and should not be overlooked.

There is also evidence to suggest that the inhaler training provided in this study should be a repetitive, ongoing process.<sup>31</sup> Guidelines support the recommendation that inhaler technique be assessed recurrently.<sup>32</sup> Although this may not always be feasible in the community pharmacy setting, every effort should be made to instruct first-time inhaler recipients on proper technique. In addition, patients who present for a refill



of an inhaler should be counseled as well to confirm proper technique and enhance the likelihood of adherence with the prescribed therapeutic regimen.

In the future, a study utilizing a teach-back method can be compared to other counseling modalities in order to determine the most effective patient counseling method as the National Asthma Education and Prevention Program guidelines recommend utilizing a teach-back method. This method entails that the health care provider demonstrates to the patient and has the patient demonstrate back, when instructing a patient about any important technique, such as properly using an inhaler.<sup>32</sup> Dantic conducted a systematic literature review that identified 9 studies showing statistically significant outcomes of proper inhaler use when patients were instructed via a “teach-back” method.<sup>33</sup> Patients who demonstrated their inhaler technique to a health care provider were found to have superior inhaler technique, improved asthma control, and greater adherence when compared to patients who had either received no education or watched a demonstration given by their health care provider.<sup>16</sup>

This study also revealed that when instructing patients on proper inhaler technique, certain steps in the process warrant extra emphasis. The steps most frequently overlooked or poorly performed were exhaling before medication inhalation and holding one’s breath after inhalation. These findings coincide with previous studies.<sup>8,34</sup> Other studies found that patients had difficulty coordinating slow inhalation while activating the inhaler.<sup>8</sup> By particularly focusing on these specific actions, the likelihood of improper inhaler technique can be reduced significantly.

No correlation was found between the various demographics of the study population and competence in the use of the inhaler in this study, with the exception of reading grade level. However, the correlation, despite being statistically significant, was of insufficient magnitude to warrant a definitive conclusion as to the relevance of this finding.

### Limitations

Study participants were not actually being treated for a condition that required the use of an inhaler. This was to ensure that they did not already have experience in using an inhaler. However, the subjects might not have been as motivated to learn proper inhaler technique as would a patient who is aware of the fact that the inhaler is a critical element in treating their asthma or COPD. On the other hand, the potential lack of motivation would exist equally across the 4 intervention cohorts, thus eliminating any bias in the comparative analysis of the types of intervention.

A portion of the subjects’ inhaler competency was assessed by the same investigator who conducted direct pharmacist instruction, thus introducing an element of bias when evaluating the performance of this small subset of subjects falling into this category. To minimize the potential for bias or subjectivity, a standard assessment checklist was used for all study

participants, and the rating for each of the 7 steps of inhaler technique provided only 2 options: competent or not competent.

Although the 2-minute time limit for treatment arms was placed into effect in order to keep uniformity among all treatment arms, one may view this as a limitation as some participants may require more than 2 minutes.

Despite efforts to randomize subjects via dice method as they were assigned to a type of intervention, a statistically significant difference in age was observed between the 4 cohorts. Nevertheless, no correlation was found between the age of subjects and competent inhaler technique. Age differences do not appear to have impacted the results.

The size of the population studied constitutes another limitation. Due to the small number of subjects in each of the 4 cohorts, it was not possible to determine whether a correlation exists between the type of intervention, inhaler competency, and demographic characteristics. Although the total number of subjects provided adequate statistical power, numbers were not sufficient to make statistical comparisons between the specific demographic categories within the individual interventions.

Because the interventions and assessments of technique were conducted exclusively with MDI inhalers, the findings of this study might not be applicable to other types of inhalers.

Lastly, this study evaluated participants’ short-term recall, as continued access to study population postintervention was limited. This study was conducted as an initial step in assisting clinicians to address frequent misuse of inhaler devices, which requires continual reinforcement.

### Conclusion

Direct instruction of inhaler technique by a pharmacist was shown to be significantly more effective at enabling subjects to demonstrate competence in all 7 critical steps of technique than either professionally produced multimedia videos or manufacturer-prepared instructional inhaler pamphlets. These findings suggest that pharmacist time spent explaining and demonstrating proper inhaler technique, as well as observing the patient’s technique, is justifiable. Inhaler counseling is likely to be more effective when conducted repetitively on multiple occasions over a period of time. Moreover, when instructing patients, special emphasis should be placed on specific steps, such as exhaling before inhaling the medication and then holding one’s breath.

Pharmacists are uniquely positioned as readily accessible health care practitioners who are often the last providers to encounter patients before they initiate a medication treatment regimen. Such convenient and direct access affords pharmacists the opportunity to engage in proactive intervention in order to optimize the potential of achieving a successful therapeutic outcome. Pharmacist initiatives to ensure proper inhaler technique can play a pivotal role in preventing the complications of poorly treated asthma or COPD and reducing avoidable emergency visits or hospitalizations—thus minimizing the spiraling costs associated with such adverse outcomes.

Further study is warranted to quantify the cost-benefit ratio of inhaler technique instruction and to better define the full pharmacoeconomic impact. Nevertheless, results of this study and many others clearly indicate that from a qualitative perspective, the benefit is unequivocal.

### Authors' Note

A report of this research was previously presented at a poster session of the 2014 Midyear Clinical Meeting of the American Society of Health-System Pharmacists, Orlando, Florida.

### Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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