Assessment of Proper Medication Inhaler Technique in Adult Patients

Journal of Pharmacy Technology
2014, Vol. 30(6) 195–200
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sagepub.com/journalsPermissions.nav
DOI: 10.1177/8755122514553987
pharmatech.sagepub.com

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Abstract

Background: Many medications used to manage pulmonary disease are delivered via unique inhalation devices. Proper technique in using these devices is required for effective medication delivery. **Objective:** To assess the degree of proper inhaler technique among adult patients. **Methods:** Patients using inhalers were identified and then interviewed by pharmacy personnel regarding inhaler use. Checklists were used to document the adherence to manufacturers' directions for each respective inhaler, and data were then tabulated and assessed for the number and types of inhalers used, incorrectly performed steps in using the inhalers, as well as demographic information of patients. **Results:** Of the 129 patients that were interviewed, a total of 212 inhalers were used. Twenty-five percent of inhalers (212) were used incorrectly, with the 3 most common errors being improper priming or lack of test sprays, lack of proper exhalation prior to inhaling the medication, and absence or improper cleaning of inhalers. Furthermore, less than 4% of patients reported being instructed by a pharmacist on proper inhaler use. **Conclusion:** Inhaler technique among adult patients is substandard and is a key area for pharmacists to become more proactive in educating patients.

Keywords

COPD, asthma, pulmonary, inhaler, adherence

Introduction

Medication delivery via inhalation is a mainstay for treatment of pulmonary diseases such as asthma and chronic obstructive pulmonary disease (COPD). Drug classes used in the management of these illnesses include β -receptor agonists, anticholinergic agents, and corticosteroids.^{1,2} The clinical benefit of these agents is dependent on adequate delivery to sites of action within the lungs. Manufacturers have been creative in designing delivery systems that serve this function while maintaining a proprietary look and meeting the pharmaceutical needs of the product formulation.

Although adherence in administering inhaled medications at the appropriate time of the day is clearly an important factor in achieving desired clinical outcomes, technique based on the ability to properly handle the inhalation device is equally important. New drugs delivered by these devices require approval from the Food and Drug Administration and evidence must be made available to show that patients benefit from drugs delivered by these unique systems. But once these new systems are approved and made commercially available, the actual degree of correct use of some inhalers, even those that have existed on the market for years, may not meet the intended degree of expertise required for proper disease state control. Improper inhaler technique has been associated with poor disease state outcomes and an increase in emergency room visits.³

The objective of our study was to assess the technique of inhaler use by patients and determine the degree to which patients adhere to the manufacturers' directions for use of individual inhaler products.

Methods

This research project was reviewed and approved by the institution's institutional review board. The medication lists of patients either seen by a health care provider in an outpatient medical clinic or admitted to an inpatient general medicine care unit in a community teaching hospital between November 2012 and April 2013 were reviewed for current use of medications delivered via inhaler devices. Patients were excluded if they were unable to participate in the interview due to an inability to communicate (ie, nonverbal, sedated, did not speak a language in common with the interviewer). One patient, who spoke only Spanish, was able to effectively converse with one of our bilingual interviewers.

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For those patients who had only recently (ie, within 24 hours) been ordered to start using an inhaler but had not received any doses or teaching were also excluded from evaluation. Once identified, patients who gave informed consent were interviewed regarding inhaler use by pharmacy personnel that included students on their advanced pharmacy practice experiential (APPE) rotations and pharmacy practice faculty. Approximately 24 students worked with 2 faculty preceptors to conduct the interviews. Students were provided with an extensive 90-minute orientation of the project that included a background and description of their role, use of data collection sheets, and the opportunity to clarify the use of any inhalers with which they were not familiar. This allowed for a standard approach to providing the interviews and inhaler assessments. Proper inhaler use was assessed by asking patients to demonstrate the use of their inhalers using the actual devices. Individualized checklists for each type of inhaler based on the manufacturers' directions or prescribing information were used to assess proper inhaler technique. The specific methods of cleaning each type of inhaler were also based on manufacturers' recommendations and whether patients cleaned their spacer was asked as just a general question without regard to technique. The use of spacers was only a consideration for those of which it was applicable (ie, metered dose inhalers). Expiration dates of inhalers varied based on the type of inhaler used and could have been a use-by date after opening (such as is the case with Diskus inhalers) or the expiration date printed on the device. Based on the checklists, patients were determined to have followed all directions recommended for optimum benefit from the inhalers or whether they missed or incorrectly performed any steps. If incorrect technique was observed, interviewers explained the corrections and ensured proper use before closing the session by asking the patients to explain the corrections and demonstrate (without giving themselves another dose) how they would now administer their medications. Demographic information such as gender, ethnicity, age, and place of residence (ie, home/apartment vs nursing home) was also gathered. Additional data included type of respiratory condition, duration of condition, and duration of inhaler use. Patients were also asked to identify health care personnel that provided initial or prior instruction on how to use their inhaler(s) (ie, pharmacist, physician, nurse, respiratory therapist, self-taught, etc) and to self-report inhaler adherence, as either missing no scheduled doses or missing some doses, as well as whether they routinely primed any inhalers requiring this action.

Results

Overall, 129 adult patients gave consent to be interviewed and assessed regarding inhaler use. The majority of patients were female (52.7%), admitted to a hospital (76.0%), with

Table 1. Demographic Information of Patients Assessed.

Category	n (%)
Gender	
Men	61 (47.3%)
Women	68 (52.7%)
Age	
Mean	65.9 years
Range	23-93 years
Location	
Outpatient	31 (24.0%)
Inpatient	98 (76.0%)
Ethnicity	
American Indian	2 (1.6%)
Black/African American	1 (0.8%)
Hispanic	13 (10.1%)
White/Caucasian	99 (76.7%)
Other	4 (3.1%)
Unknown/undeclared	10 (7.8%)
Home environment	
House/apartment	95 (73.6%)
Nursing home	10 (7.8%)
Assisted living	1 (0.8%)
Other/undeclared	23 (17.8%)
Disease state	
Asthma ^a	44 (34.1%)
COPD ^a	76 (58.9%)
Other/undeclared	11 (8.5%)
Years with condition	
Mean	11.2 years
<1 year	5 (3.9%)
1-4 years	22 (17.1%)
5-10 years	37 (28.7%)
11-15 years	13 (10.1%)
>15 years	27 (20.9%)
Undeclared	25 (19.4%)
Years of inhaler use	
Mean	9.0 years
New	5 (2.4%)
1 month to 1 year	27 (12.7%)
2-4 years	31 (14.6%)
5-10 years	61 (28.8%)
>10 years	41 (19.3%)
Unknown/undeclared	47 (22.2%)

Abbreviation: COPD, chronic obstructive pulmonary disease.

^aTwo patients stated they had both asthma and COPD.

COPD (59%), and a mean age of 66 years old. Demographic information is summarized in Table 1. These patients were prescribed a total of 212 inhalers, the number and type of which are listed in Table 2. Responses to interview questions regarding inhaler use are provided in Table 3.

Of the 212 inhalers that were assessed for proper technique, 158 (74.5%) of them were used correctly by patients when observed by pharmacy personnel. For the remaining

Table 2. Summary of Inhalers Used Improperly and Incorrectly Performed Steps^a.

Inhaler	Total Number Used by Patients	Frequency of Improper Inhaler Use	Incorrectly Performed Steps ^b							
			Breathe Out Before Inhalation	Rinse Mouth Following Use of Inhaled Corticosteroid	Shake Inhaler Prior to Use	Improper Timing of Actuation and Inhalation	Hold Breath Following Inhalation	Improper Position of Inhaler in Mouth	Improper Priming Procedure/ Test Sprays	Absence/ Improper Cleaning
Advair Diskus ^c	55	13 (23.6%)	3	7			2	1		
Advair HFA ^d	5	0 (0.0%)								
Albuterol/Proair ^e /Ventolin ^f	74	22 (29.7%)	1		2	8	4	2	18	13
Combivent MDI ^g	20	8 (40.0%)	4		2		1	1	7	5
Dulera MDI ^h	1	1 (100%)	1		1			1	1	
Flovent HFA ⁱ	9	4 (44.4%)		1			1		3	1
Flovent Diskus ^j	1	0 (0.0%)								
Proventil HFA ^k	1	1 (100%)							1	
Spiriva ^l	38	2 (5.3%)						2		
Symbicort MDI ^m	8	2 (25.0%)	1	1		1			1	1
Total	212	53	10 (10.1%)	9 (9.1%)	5 (5.1%)	9 (9.1%)	8 (8.1%)	7 (7.1%)	31 (31.3%)	20 (20.2%)

Abbreviations: HFA, hydrofluoroalkane; MDI, metered dose inhaler.

^aMultiple errors were made in use of inhalers by individual patients; steps were assessed based on the each inhalers' manufacturers' prescribing directions and use instructions.

^bIncorrect steps listed are the incorrect steps observed with the total amount and percentages calculated to determine the most commonly misperformed steps. Total number of observed misperformed steps = 99.

^cAdvair Diskus (fluticasone/salmeterol), GlaxoSmithKline, Research Triangle Park, NC.

^dAdvair HFA (fluticasone/salmeterol), GlaxoSmithKline, Research Triangle Park, NC.

^eProair HFA (albuterol sulfate), Teva Respiratory LLC, Horsham, PA.

^fVentolin (albuterol sulfate), GlaxoSmithKline, Research Triangle Park, NC.

^gCombivent (albuterol/ipratropium), Boehringer Ingelheim Pharmaceuticals, Inc, Ridgefield, CT.

^hDulera (mometasone furoate/formoterol fumarate dehydrate), Merck and Co, Inc, White House Station, NJ.

ⁱFlovent Diskus (fluticasone propionate), GlaxoSmithKline, Research Triangle Park, NC.

^jFlovent HFA (fluticasone propionate), GlaxoSmithKline, Research Triangle Park, NC.

^kProventil (albuterol sulfate), Merck and Co, Inc, White House Station, NJ.

^lSpiriva (tiotropium bromide), Boehringer Ingelheim Pharmaceuticals, Inc, Ridgefield, CT.

^mSymbicort (budesonide and formoterol fumarate dehydrate), Astra Zeneca LP, Wilmington, DE.

Table 3. Patient Responses to Inhaler Use Questions.

Question	Response	n (%)
Who taught patient how to use the inhaler (multiple answers were allowed)	Pharmacist	8 (3.8%)
	Physician	120 (56.6%)
	Nurse	39 (18.4%)
	Respiratory therapist	2 (0.9%)
	Self-taught	23 (10.8%)
	Unknown/undeclared ^a	44 (20.8%)
Patient reported adherence with inhaler	Yes—always adherent	191 (90.1%)
	No—sometimes missed doses	18 (8.5%)
	Not answered	3 (1.4%)
Uses a spacer (n = 118 applicable inhalers)	Yes	29 (24.6%)
	No	85 (75.4%)
Cleans spacer regularly as directed (n = 29 applicable patients)	Yes	23 (79.3%)
	No	5 (20.7%)
Reported performs priming (n = 118 applicable inhalers)	Yes	63 (53.4%)
	No	50 (42.4%)
	Sometimes	5 (4.2%)
Routinely checks or is aware of expiration date of inhalers	Yes	140 (66.0%)
	No	70 (33.0%)
	Undeclared	2 (0.9%)

^aUnknown/undeclared indicates the patients were unable to respond to this question for any reason.

53 inhalers, 99 errors were identified. Of the 118 inhalers for which priming was necessary to ensure proper drug delivery, it was reported by patients to always be performed in 63 of them (53.4%). In addition to the performance of priming reported by patients, the steps that were observed to be performed incorrectly in the respective inhalers were also documented and are summarized in Table 2. The most common type of observed deviation from the manufacturers' directions for inhaler use was improper technique or lack of priming/performing test sprays, which accounted for over 30% of the errors. Absence or improper cleaning (20.2%) and failure to properly exhale prior to inhalation of medication (10.1%) rounded out the top 3 inhaler usage errors.

Discussion

Management of pulmonary conditions such as asthma and COPD with inhaled medications is effective as it quickly delivers drugs to the site of action. Use of inhaled medications, when used at the lowest effective dose, also reduces the risk and severity of systemic side effects associated with medication use.⁴⁻⁶ But the trade-off comes with a price, as drug delivery is dependent on proper use of the inhaler, which could be difficult for some patients to use correctly. COPD is a disease most commonly associated with smoking and is likely to occur in older patients.^{7,8} Although many elderly patients are quite capable of performing the manipulations required for proper inhaler use, there are likely to be patients who have trouble consistently using the drug-delivery systems in the appropriate manner. The development of new systems that look and function differently than traditional metered dose inhalers may also pose a risk of misuse for some patients who have relied upon years of familiarity to ensure adequate administration when their dexterity and cognition begins to fail them.

Many attempts have been made to improve and evaluate the compliance and usability of inhaled medications. Focused teaching efforts,⁹ combining 2 drugs into 1 delivery system,¹⁰⁻¹² use of spacers,^{13,14} active programs in community pharmacies,^{15,16} diaries or electronic monitors,¹⁷ self-management programs,¹⁸ health education methods,¹⁹⁻²² and even interactive voice response systems²³ have all been evaluated to assist patients. Despite these published efforts, few of them are available for most patients, leaving them to rely on themselves, friends, or family for oversight. What is even more striking is that the concern over inhaler nonadherence is nothing new, as evidence of poor use has been known for decades,²⁴ and based on our data, appears to continue.

In 2010, Over 700 000 hospital discharges were related to COPD, with a national burden of approximately \$49.9 billion in the United States.²⁵ In 2011, it was estimated that approximately 25.9 million Americans have asthma, with

over two thirds of these patients being adults.²⁶ Over 2 million emergency room visits occurred in 2008 and 14 million days of work were estimated to be lost in 2009 due to the condition, contributing to an annual burden of over \$50 billion dollars.²⁶ It is difficult to ascertain, but it is likely that a portion of these admissions and subsequent patient demise could be averted through routine evaluation of patient inhaler technique. According to Drugs.com, 7 of the top 100 prescribed medications in the United States represent inhalers, accounting for over 100 million total units in 2013 alone.²⁷ Therefore, it would make sense for pharmacists to make the extra effort to not only ask if patients know how to properly use their inhalers but also to visually assess patients' inhaler use and make any necessary corrections.

The improper use of inhalers is not a new phenomenon. But what is concerning is the limited efforts by pharmacists to ensure that patients are using their inhalers correctly. In our study, we found that most patients learned how to use their inhalers from the physicians who prescribed them. This makes perfect sense as the physician is often the first point of contact. However, most of these patients then visited the pharmacy in order to fill the initial prescription and subsequent refills and yet less than 4% of patients reported that a pharmacist had provided instructions on how to use the inhaler. This is quite concerning for our profession, especially since 25% of inhalers were observed to be used incorrectly in our study. If pharmacists made the effort to assess inhaler use, especially in at-risk populations, such as the elderly, and provide instruction on appropriate use, the benefits observed could be significant. Fewer hospital admissions, less visits to physician offices or emergency rooms, and prolonged survival may be possible. Barriers to effective counseling do exist and include lack of time, lack of patients' interest, lack of placebo inhaler devices, inadequate staffing, and lack of support by administrators and other health care personnel, among others.^{28,29} It could also be suggested that some pharmacists make a conscious choice not to counsel patients on inhaler use and instead focus on other areas of their job. But the opportunity to counsel should not be overlooked, and methods to facilitate meeting this need include providing adequate and appropriate resources for patient education, limiting the technical duties of pharmacists, providing adequate staffing levels, and establishing a well-designed counseling program.²⁹ Although excuses for not counseling can easily be offered, the responsibility remains and the effort to counsel should be made in the interest of caring for our patients. Therefore, we suggest that all pharmacists, regardless of their practice environment, make a conscious effort to ensure that patients prescribed inhalers are using them correctly.

Our evaluation was conducted in a small population at only 2 patient care sites. Evaluation of a broader patient base would make it possible to identify technical manipulation issues with use of other inhalers that we did not observe being used in our population. A larger population evaluated could

also help further identify error trends, such as poor priming adherence, to help health care personnel focus on particular inhaler steps that are most likely to be performed incorrectly. Most of the inhaler assessments in this project were performed by pharmacy students on APPE rotations. Although training was provided to students to standardize the process, it is possible that some variation occurred between data collectors. Since over 2 dozen people were involved with the project, it is possible that some data collectors were more crisp in their evaluations than others. Our orientation of students to the project was a verbal presentation of the task and explanation of the forms used. Use of a video or voiceover slide presentation would have been useful in standardizing the orientation procedure. Although students had the opportunity to ask questions before they spoke with real patients, giving a mock interview may have been helpful to refine their skills as well. Furthermore, a closer look at some keenly specific inhaler use actions, such as speed of inhalation, would have been valuable, but was not assessed in this study. All these factors provide the potential for an overestimation of the percentage of patients that properly use their inhalers due to the variations and lack of evaluative experience by our students. It should also be noted that the Combivent metered dose inhalers, of which 20 were observed to be used by patients in our study, are no longer available, as the Combivent Respimat version (Boehringer Ingelheim Pharmaceuticals, Inc, Ridgefield, CT) has replaced it.

Conclusion

There are many types of inhalers used by patients. Multiple steps required to adequately use the variety of inhalers available create the opportunity for patients to misuse their inhalers and limit the health benefits they could receive from them. Proactive efforts by health care personnel, especially pharmacists, should be offered to help patients learn proper inhaler technique when first prescribed these medications, and then routine assessment should occur thereafter, especially in elderly patients, to ensure that proper use continues.

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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