Problems With Inhaler Use: A Call for Improved Clinician and Patient Education

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Patient education is a critical factor in the use and misuse of medication inhalers. Inhalers represent advanced technology that is considered so easy to use that many patients and clinicians do not receive adequate training in their use. Between 28% and 68% of patients do not use metered-dose inhalers or powder inhalers well enough to benefit from the prescribed medication, and 39–67% of nurses, doctors, and respiratory therapists are unable to adequately describe or perform critical steps for using inhalers. Of an estimated $25 billion spent for inhalers annually, $5–7 billion is wasted because of inhaler misuse. Reimbursement and teaching strategies to improve patient education could substantially reduce these wasted resources. Problems with inhaler use, the cost of inhalers, and myths associated with inhalers are reviewed, with recommendations for strategies and techniques to better educate patients in inhaler use. *Key words: metered-dose inhaler, MDI, dry powder inhaler, DPI, patient education, clinician education.* [Respir Care 2005;50(10):1360–1374. © 2005 Daedalus Enterprises]

Introduction

Education is a critical component of disease management. In contrast to other mammals, humans require many years, from infancy to adulthood, to learn to perform essential activities of daily living. Once learned, these become the day-to-day routines that we seldom think about. With the introduction of disease, there may be the need to learn and adopt new behaviors, sometimes rather complex, in a relatively short period of time. These can be as simple

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as taking a pill or as complex as major lifestyle modifications, with a range of diagnostic and therapeutic interventions required to maintain a tolerable quality of life. These new behaviors may be required for a week or for a lifetime. Patients are expected to accept the need for these changes, learn the necessary skills, and implement them based on a short interaction with a care provider. For patients with pulmonary disease, these early interactions often occur in the clinic or emergency department, as they seek relief from an exacerbation, and are distracted by little things, such as taking their next breath.

It seems that most health-care systems assume that the vast majority of patients, with minimal direction from a prescribing physician and a dispensing pharmacist, will follow "simple" instructions to ensure their own well being. We presume that patients will not knowingly contrive to undermine their own therapy, and that to do so would be a consequence of self-destructive impulses or stupidity.

Next to pills, the inhaler is the most common medication form in the world.[1] Perhaps because they are so common they are considered "simple" devices that are relatively fool-proof. A review of medical textbooks used in the training of physicians revealed that only 2 of the 40 books included a simple list of steps to properly use a pressurized metered-dose inhaler (pMDI) (personal communication, Rajiv Dhand MD, University of Missouri, Columbia, Missouri). With so much complex information to include in a general medical text, it appears that instructions for a "simple" device do not merit valuable space in textbooks, or even time in the lecture hall. This would seem to correlate to reports that a large proportion of practicing and house physicians are incapable of demonstrating proper use of these "simple" devices.[2,3]

Far from simple, inhalers represent sophisticated applications of advanced technology developed over the last 50 years. In the following pages, the instructions for a range of inhalers will be reviewed (Tables 1–3), with a distillation of the critical steps (depending on the device) required to assure proper dosing (Table 4).[4] Failing to perform one or more of these steps can substantially reduce the delivery and effectiveness of the medication.

Each inhaler type has unique operating instructions. Patients are rarely prescribed just one inhaled medication, and each medication is available only in limited formulations and inhaler types. This creates the possibility of confusion between devices. For example, a pMDI requires a slow inspiratory flow rate, whereas a dry powder inhaler (DPI) requires rapid inhalation. The patient who mistakenly operates these inhalers with the wrong flow pattern substantially reduces the amount of medication inhaled.

Management of chronic airways disease is 10% medication and 90% education.[5] Over the last century, a great deal has been learned about the mechanisms of asthma, and several pharmaceutical-based strategies have been developed to relieve symptoms and control underlying inflammatory processes. If the > 16 million asthmatics in the United States were prescribed appropriate medications, and used them as prescribed, the mortality and morbidity associated with asthma would be drastically reduced. While efforts continue to improve medical options for management, the existing medication options are sufficient to provide adequate symptom relief and control for the vast majority of these patients. Unfortunately, many patients and clinicians lack the knowledge and skills required to put these tools to optimal use. It is impossible to speak of patient education without a critical assessment of the education of health-care providers and institutions.

Table 1. Use of a Pressurized Metered-Dose Inhaler

Shake the inhaler well immediately before each use
Remove the cap from the actuator mouthpiece
Breathe out fully through your mouth
Place the mouthpiece fully into your mouth, holding the inhaler in a mouthpiece-down position, and close your lips around the mouthpiece, making sure that your tongue does not obstruct the mouthpiece. An alternative is to position the mouthpiece 2 finger-widths (4 cm) from your open mouth.
While breathing in deeply and slowly, depress the top of the metal canister (at the beginning of the breath)
Hold your breath for up to 10 seconds
Replace the cap on the mouthpiece
Priming
Shake the inhaler well
Release 1–4 test sprays into the air, away from your face, before using for the first time or when the inhaler has not been used for more than 3 days.
Clean the actuator or mouthpiece at least once a week. Wash the actuator by rinsing it under running water, shake off the water, and let the device air dry.
Discard the canister after you have used the labeled number of doses. Never immerse the canister in water to determine how full the canister is.
Important Reminders About pMDIs
Keep your reliever pMDI somewhere where you can get it quickly if you need it, but out of children's reach (see http://www.asthma.ca/adults/treatment/meteredDoseInhaler.php)
Show your doctor, pharmacist, or asthma educator how you're using your pMDI.
Store your pMDI at room temperature. If it gets cold, warm it using only your hands.
Never puncture or break the canister, or try to warm it using anything except your hands.
When you begin using a pMDI, write the start date on the canister.
Check the expiration date on the pMDI before you use it.
If you're having trouble using your pMDI, ask your doctor for tips or to recommend another device.
Many doctors recommend the use of a spacer (also known as a holding chamber) with the pMDI.
Do not float the canister in water.

pMDI = pressurized metered-dose inhaler

Table 2. Typical Operation of a Valved Holding Chamber With a Pressurized Metered-Dose Inhaler

Take cap off the pMDI boot and insert into chamber
Shake pMDI with Chamber
Actuate 1 dose into chamber
Inhale from the chamber for several breaths
Adults: 1–3 inhalations
Slow deep breath with breath hold if possible, or tidal breathing
Infants: ≤10 breaths or 30 seconds tidal breathing
Remove pMDI from chamber
Replace cap on pMDI and chamber
Store both chamber and pMDI properly
Chamber maintenance: Periodically wash chamber in warm soapy water, rinse, and air dry

pMDI = pressurized metered-dose inhaler

Table 3. Specific Instructions for Use of the Turbuhaler

Priming the Turbuhaler
Before you use a new Turbuhaler for the first time
Turn the cover and lift it off
Hold the inhaler upright
Twist the brown grip fully to the right, and back again to the left
Repeat the above steps
Now you are ready to take the first dose. No need to prime at any other time, even if put aside for a prolonged period.
Using the Turbuhaler
1. Remove the cap from the inhaler: twist the cap and lift it off
2. Keep the inhaler upright when loading
3. Rotate the grip counterclockwise as far as it will go, then back until you hear a click
4. Do not shake after loading
5. Exhale away from the mouthpiece
6. Place mouthpiece between teeth and lips
7. Inhale forcefully and deeply. You may not taste or feel the medication.
8. Do not chew or bite on the mouthpiece
9. Exhale away from the mouthpiece
If more than one dose is required, just repeat the above steps
10. Place cover on inhaler and twist shut
11. Rinse mouth with water. Do not swallow
12. Keep the inhaler clean and dry at all times
13. Do not use the Turbuhaler if it has been damaged or if the mouthpiece becomes detached
Storage
Keep the inhaler in a dry place and at controlled room temperature of 68–77°F (20–25°C)
How to Know When the Turbuhaler Is Empty
When a red mark appears a the top of the window, there are 20 doses remaining
When the red mark reaches the bottom of the window, you should discard the inhaler
Do not immerse the inhaler in water to find out if it is empty

pMDI = pressurized metered-dose inhaler

The acts of prescribing and dispensing the "right" medication are not in and of themselves an adequate intervention for a majority of patients with chronic lung disease. It has been estimated that 28–68% of patients do not use their pMDI or DPI well enough to benefit from the prescribed medication. This correlates with reports that 39–67% of nurses, doctors, and respiratory therapists are unable to adequately describe or perform critical steps of inhaler use.[1,6–14] Clinicians' ability to use inhalers is typically 5–8 years behind the introduction of new devices.[1] We cannot expect clinicians to teach what they do not know (Table 5). There is a desperate need to upgrade clinician skills as well as patient skills.

Economic Impact of Inhaler Misuse

It has been estimated that more than 500 million medical inhalers are purchased each year. If we assume an average cost of $50/inhaler, the annual expenditure is in excess of $25 billion. If the previously stated 28–68% of patients do not effectively use their inhalers, then improper inhaler use causes $7–15.7 billion to be wasted, without benefit to the patient or the health-care system. Worse than the direct dollars wasted is the impact on patients who believe they are receiving appropriate care for their disease but who continue to suffer avoidable dyspnea, discomfort, morbidity, and mortality from their incompletely-controlled or uncontrolled airways disease. This frustration is shared with the health-care provider, who continues to "step up" the dose in an attempt to cross a therapeutic threshold for the patient, further increasing cost with more wasted medication. Failure to control symptoms causes more frequent unscheduled clinic visits, more emergency department visits, and more hospital admissions. The impact of lost productivity associated with missed days at work or school is staggering, estimated to be in the billions of dollars.[15]

The solution to this problem would seem to be obvious: effective patient and provider education. But in the current health-care environment, no one has time to teach. This, of course, is a major part of the problem. An expenditure of $30 dollars a year in the training of each of an estimated 30 million inhaler users would represent a $900 million investment, with the potential to reduce wasted expenditures due to improper inhaler use by more than 5-fold. As we know from the diabetes experience, once clinicians, administrators, and policy makers are convinced that education saves lives and reduces overall costs, the system can find money to support educators. The health-care industry desperately needs to create a similar sensitivity to the needs of our respiratory patients.

Table 4. Critical Steps for Using Various Inhalers

pMDI	Rotahaler	Diskhaler	Diskus	Turbuhaler	Aerolizer	Twisthaler	Handihaler
1. Take cap off mouthpiece 2. Warm to room or hand temperature 3. Shake thoroughly 4. Exhale fully 5. Place mouthpiece between lips or 2 finger-widths in front of open mouth 6. Actuate as you begin a slow deep breath 7. Breath-hold 8. Place cap on mouthpiece	1. Insert capsule 2. Twist device to break capsule 3. Keep device level while rapidly inhaling dose 4. Breath-hold 5. Remove device from mouth and exhale away from device 6. Store device in a cool, dry place	1. Remove mouthpiece cover 2. Pull tray out from device 3. Place disk on wheel (numbers up) 4. Rotate disk by sliding tray out and in 5. Lift back of lid until fully upright so that needle pierces both sides of blister 6. Keep device level while rapidly inhaling dose 7. Breath-hold 8. Remove device from mouth and exhale away from device 9. Brush off any powder remaining within device once every week 10. Store device in a cool, dry place	1. Open the device 2. Slide the lever 3. Keep device level while inhaling dose 4. Exhale away from device, to residual volume 5. Inhale rapidly and fully 6. Breath-hold 7. Remove device from mouth and exhale away from device 8. Store device in a cool, dry place	1. Twist and remove cover 2. Hold inhaler upright (mouthpiece up) 3. Turn grip right, then left, until it clicks 4. Exhale away from device to residual volume 5. Inhale rapidly and fully. Inhaler may be held upright or horizontal for this step 6. Breath-hold 7. Remove device from mouth and exhale away from device 8. Replace cover and twist to close 9. Store device in a cool, dry place	1. Remove cover and twist open inhaler 2. Peel back blister and take out capsule 3. Place capsule in the chamber in the inhaler 4. Twist the inhaler closed 5. Press blue buttons on both sides to pierce capsule 6. Fully exhale away from device 7. Tilt head slightly back, inhale rapidly and fully 8. Breath-hold 9. Twist open inhaler and dispose of capsule 10. Store device in a cool, dry place	1. Keep inhaler straight up when removing cap 2. Twist cap counterclockwise to lift off cap 3. Exhale fully away from inhaler 4. Inhale rapidly and fully 5. Remove from mouth 6. Breath-hold 7. Wipe mouthpiece dry 8. Arrow in line with dose counter 9. Twist cap clockwise until you hear click 10. Store device in a cool, dry place	1. Remove mouthpiece cover 2. Take capsule from package 3. Place capsule into the inhaler 4. Close the inhaler 5. Press button so that needle pierces both sides of capsule 6. Keep device level while inhaling dose rapidly and fully 7. Breath-hold 8. Remove device from mouth and exhale away from device 9. Brush off any powder remaining within device once every week 10. Store device in a cool, dry place

(Adapted from Reference 4.)

Table 5. What Clinicians Need to Know About Each Inhaler

How to select an inhaler
Advantages
Limitations
Performance
Ease of use
Cost
How to use
How to maintain

Problems With Inhaler Use

While both pMDIs and DPIs are relatively simple devices to operate, their proper use is not entirely intuitive, and each has technical limitations that can limit effectiveness. Each specific type of inhaler is different, with device-specific instructions for use. In some cases the steps can be confused between devices, resulting in severe reductions in drug available to the patient. Unfortunately, no single manufacturer currently produces a full range of medications required for managing diseases such as asthma and chronic obstructive pulmonary disease (COPD) within the same type of inhaler. This requires patients to learn 2 or more devices, each with different operating instructions, creating what Geller has labeled "device dementia." Multiple devices can cause confusion in patients.[16]

Problems With pMDIs

Over the last 50 years, numerous problems with pMDIs have been described (Table 6). In general, pMDIs require hand-breath coordination (actuation during the beginning part of inspiration) and a relatively low inspiratory flow (< 30 L/min).[6] These devices require the patient to coordinate actuation with the beginning of inspiration. Hand-breath asynchrony drastically reduces the mass of medication inhaled from a pMDI. Actuation 1 second prior to inhalation reduces inhaled mass by 90%.[17] Similarly, actuation late in the inspiratory cycle may fill the anatomic dead space with aerosol, which is then exhaled before it can enter the target airways.

Table 6. Errors in MDI Use*

Error	Frequency (%)
Hand-breath discoordination	27
Breath-hold too short	26
Inspiratory flow too rapid	19
Inadequate shaking of inhaler	13
Abrupt stop of inhalation ("cold-Freon effect")	6
MDI actuation at total lung capacity	4
Multiple actuations with a single breath	3
Firing MDI in mouth, inhaling through nose	2
Exhaled during actuation	1
Wrong end of inhaler in mouth	<1
Cap left on MDI boot	<1
Inspiration without actuation	<1
Actuation without inspiration	<1

*In descending order of frequency.[1]
MDI = metered-dose inhaler
(Data from Reference 1.)

While the majority of patients over the age of 6 years can be trained to coordinate actuation with early inspiration when they are stable and not distressed, during severe exacerbations many patients seem to be less capable of this basic coordination. Breath-actuated pMDIs reduce the problem of hand-breath coordination. These devices emit a dose when a sufficient inspiratory flow (< 30 L/min) is achieved. This appears to be an achievable flow rate for children > 4 years old, and patients in the emergency department.[18] Actuation near end-inspiration can occur, reducing the inhaled dose. Patients need to be trained and observed to trigger the actuation near the beginning of inspiration, and this training can be achieved in as little as 6 min.[19]

Shaking the pMDI is required to assure homogenous mixing of the various ingredients in the canister, which can settle out or layer over time, prior to refilling the metering chamber.[20,21] The pMDI is shaken prior to a dose to assure that the following dose is appropriately mixed, even though this dose may not be emitted for several hours or days. Failure to shake prior to the first actuation after a period of hours or days may increase dose variability and consistency across the life of the pMDI.

Priming is the process of actuating the pMDI prior to inhalation, to assure dose consistency, and is recommended prior to first use and after a specific number of days have elapsed between actuations.[20–23] Priming is a necessary step for all pMDIs, though the number of puffs and frequency differ for specific devices. Prior to first use, a pMDI should be shaken, followed by several (1–4) actuations wasted to the atmosphere. The number of actuations depends on the drug, formulation, propellants, and manufacturer. In addition, a pMDI should be primed if it has not been used for 24–48 hours (with chlorofluorocarbon [CFC] pMDIs) or 4–7 days (with hydrofluoroalkane pMDIs).

Because the pMDI canister is a closed, rigid container that contains volatile propellants, the pressure of the propellants is affected by temperature.[20,21] Reducing the canister temperature to below 15°C substantially reduces the emitted dose, especially with the CFC pMDIs. Warming the inhaler to room (or hand) temperature brings it into optimal operating range. During winter conditions, patients who experience bronchospasm in response to exposure to cold air tend to keep their inhalers in their outer garments, where they can be easily accessed. Patients should be instructed to keep their CFC pMDI in an interior pocket,

where it is protected from the external temperature extreme.

The high initial velocity and particle size of the expanding plume emitted from the pMDI is associated with high oropharyngeal deposition, representing as much as 80% of the emitted dose.[21,23–25] Much of this deposition occurs on the tongue and in the hypopharynx (which is difficult to clear with gargling). The patient should be trained to flatten his or her tongue while inhaling, clearing the tongue out of the path of the aerosol as much as possible. Some manufacturers recommend tilting the pMDI so that it points up slightly, directing the plume over the tongue.

The distance from the pMDI to the oropharynx affects aerosol velocity and particle size at the point of impaction at the hypopharynx. The greater the distance, the more time the plume has to mature (particle size and velocity reduction) and, therefore, the lower the oropharyngeal deposition.[24,25] Placing the mouthpiece of the pMDI between the lips is specified on the label of every pMDI. However, researchers have demonstrated that placing the mouthpiece 2 finger widths in front of the lips, allowing greater distance for the aerosol plume to lose velocity before impacting the hypopharynx, reduces oropharyngeal deposition, making more drug available for inhalation.

High inspiratory flow decreases pMDI effectiveness. Inspiratory flow $>$ 30 L/min is inversely related to pulmonary deposition of the drug emitted from a pMDI. High inspiratory flow causes turbulence, which causes larger particles to impact in the upper airway. High flow also decreases the time available for the larger particles to evaporate into smaller particles.

The expanding plume, with rapid evaporation of its volatile liquids, can generate a cold spray. In some patients, particularly children, there is a reflexive tendency to stop inhalation when the cold spray reaches the back of the throat, drastically reducing the amount of drug that reaches the lungs. This "cold-Freon effect" does not appear to be as prevalent with hydrofluoroalkane pMDIs.[20]

Though pMDIs have long provided portability and multidose convenience, the absence of a dose-counting mechanism is a serious limitation that commonly places patients at risk. There is little auditory or taste evidence to alert patients when they have used the number of doses that the pMDI is designed to reliably deliver. After the life of the canister (the labeled number of actuations have been administered), pMDIs have a "tailing-off" effect, during which the output of up to 50 subsequent actuations can vary between the label dose and virtually no dose at all.[20] This is a critical problem with both reliever and controller medications, in that the patient receives less than the required threshold dose to maintain the therapeutic objective. Though the hydrofluoroalkane pMDIs have been reported to have less tailing-off than the CFC pMDIs, continued use of an "empty" inhaler is still a problem.

To mitigate the risk of a patient continuing to use an "empty" inhaler, pharmaceutical manufacturers instruct patients to count their inhaled doses over the life of the canister. This is inconvenient, impractical, unrealistic, and unreliable. Most patients simply do not keep a running tally of the doses used, especially with their reliever medications.[26] In the past, some pMDI manufacturers had suggested floating the canister (without boot) in a bowl of water as a rough indicator to determine remaining contents. Not only does this not work reliably, but water entering the nozzle can radically reduce the subsequent dose, so floating the canister is no longer a recommended technique by most in the industry.

Consequently, determining the doses remaining in a pMDI canister is beyond the technical means of most patients, unless they are extremely disciplined in recording device-use or have a laboratory-grade balance at home to weigh the canister. Third-party dose-counting devices are available, but add additional expense. Regulations requiring new pMDIs to have built in dose-counters may eliminate this problem in the near future.

pMDI Accessory Devices

There are a variety of third-party accessory devices marketed for use with pMDIs. They are intended to help mitigate one or more of the problems described above. The accessory devices range from spacers and valved holding chambers to dose counters. Often these devices are intended to work with a variety of pMDIs types and formulations, though the majority were designed primarily for use with CFC pMDIs, often albuterol.

Every formulation involves subtle differences in pMDI design and performance, including dose emitted, pressure, nozzle dimensions, and resulting plume characteristics. An accessory device that works well with one pMDI type and formulation might not work well with others.[21,23–27] These devices are not necessarily tested with every formulation or pMDI type.

Clinicians should not prescribe accessory devices unless they know how they will work with the prescribed medications. Unfortunately, most of the information about the performance of these third-party devices is generated by fourth-party researchers, including academicians and industry-based and -sponsored researchers. With the exception of the "toilet paper roll" and other home-made spacers, most commercial accessory devices require a physician prescription. As with any prescribed drug, the clinician has an inherent obligation to understand what the device does and how it performs with the specific medications with which it will be used. In general, any device that requires the canister to be removed from the boot that was designed by the manufacturer presents a greater risk of not working well with a variety of formulation and pMDI types.

Spacers

Simple spacers increase the distance and space between the nozzle and mouthpiece of the pMDI and the patient's oropharynx, allowing the relatively large particles emitted from the nozzle to evaporate and reduce in size, reducing oropharyngeal deposition by up to 90%. The size and design of the spacer can impact effectiveness and relative cost of inhaled medications. Small spacers with volumes less than 100 mL can reduce the amount of respirable drug available to the patient, compared to use of the pMDI alone, and they offer no protection against hand-breath asynchrony.[17,28] Larger spacers, such as the simple toilet paper roll have been shown to provide some protection against actuating the pMDI prior to inspiration, and they reduce oropharyngeal deposition without reducing the respirable dose available to the patient.[17]

Valved holding chambers can reduce oropharyngeal deposition by as much as 99%, increase inhaled medication by 4-fold compared to pMDI alone, and provide protection from poor hand-breath coordination.[17,28–31] These characteristics make the best of the valved holding chambers generally preferable to simple spacers. Holding-chamber materials, volume, valve placement, and valve design all impact performance and the likelihood that the patient will use the device.

Electrostatic charge on the interior surface of a clean plastic holding chamber reduces the respirable fraction available to the patient. Coating the chamber's interior with a deionizing agent can increase lung delivery 4-fold.[32–34] This can be as simple as washing the plastic chamber in water with a few drops of dishwashing liquid (just enough to make some suds) and allowing it to dry. This works whether or not the chamber is rinsed after washing, and the effects last for up to 30 days. Some manufacturers have begun using plastics that do not have an electrostatic charge, whereas others construct the chamber with conducting metal, which allows dissipation of static charge.

Size does matter, at least with regard to valved holding chambers. Larger chambers $>$ 200 mL, mostly available outside of the United States, make more respirable drug available to the patient (but sometimes detrimentally so[35,36]), the trade-off being the inconvenience factor of toting a device the size of a football. Perhaps if it could be converted to a designer purse it would be easier to travel with. Smaller devices, in the 100–200 mL range, still pose problems for portability, which is often the reason patients give for not using them. Portability issues are partially mitigated by suggesting that, when possible, patients use the valved holding chamber for controller drugs, which are often taken just once or twice a day, at home, and use it only with their reliever medication during periods of exacerbation. This provides benefit on a daily basis with controller drugs, and makes the device available for improved dosing of bronchodilators during periods of greatest need.

Valves serve 2 purposes in the holding chamber: they allow the patient to exhale to the atmosphere without blowing the aerosol out of the chamber, and they act as a baffle when placed between the chamber and the patient's airway, which reduces particle size and oropharyngeal deposition. At their best, valved holding chambers do not change output characteristics of the pMDI, and multiple actuations between individual breaths still reduce output and reduce available aerosol.[37]

Valve design and placement can also impact the rebreathed volume of the device, which is a critical factor when using a valved holding chamber with infants and small children. Valves are often the only moving part of the valved holding chamber, and are commonly made of flexible components that may wear or change shape with extended use and cleaning. Patients should be taught how to examine valve integrity to determine the need to replace the valve or chamber. Chambers that can be disassembled into multiple parts for cleaning add a level of complexity that can be difficult for the patient. Removable valves may require fairly precise reassembly for proper performance, and the reassembly may not be properly done by some patients. The clinician who prescribes a valved holding chamber (or any device) that can be disassembled has an obligation to assure that the patient can properly reassemble the device.

Problems With DPIs

Currently available DPI systems are passive, meaning that the mechanical energy that releases the drug from the inhaler is supplied by the patient's inspiratory effort. Depending on the design of the inhaler, this may require inspiratory flow of 30–90 L/min. Failure to produce the minimum inspiratory flow for a specific DPI substantially reduces the inhaled dose.[4]

In some cases, such as children $<$ 6 years old, the patient may not be able to sustain the necessary flow rate to use a DPI correctly, so it is generally recommended that DPIs may not be suitable for children under the age of 5 years.[15,38]

Exhalation into a DPI reduces inhaled dose. Exhaling into a DPI device presents 2 problems. First, exhaled gas can blow the powder out of the chamber, making it unavailable for inhalation. Second, exhaled gas is high in humidity, which can cause the carrier and/or drug to cake or agglomerate, reducing its ability to break up into individual respirable particles during inspiration.[4]

Failure to hold the DPI in proper orientation can cause the dose to fall out of the dosing chamber or inhalation path. Many devices, such as the Turbuhaler, Twisthaler,

and Diskus, must be maintained upright during priming and dose administration. Shaking a DPI can shake the dose out of the inhalation flow path, drastically reducing inhaled dose.

Failure to prime the inhaler, pierce the capsule, or open the blister pack results in no dose delivered to the patient. Each device has a different priming method, and with most inhalers it is relatively easy to omit this critical step.

Failure to keep the flow path open eliminates the ability to inhale through the device. This may be as simple as not removing the mouthpiece, or, with a device such as the Diskus, returning the lever to its original position prior to inhalation, which closes the pathway from the mouthpiece to the drug.

Failure to Keep the DPI Dry

Most powders are susceptible to negative effects from humidity. Devices that store the powder in a cake are particularly vulnerable to environmental humidity. It has been estimated that effects occur within minutes of exposure and can affect performance through the life of the inhaler. Consequently, in warm and humid climates some inhalers provide a lower inhaled dose than they do in cold, relatively dry, winter climates. Individual sealed doses provide greater protection from humidity, but they should be inhaled immediately upon opening the packet or piercing the capsule.[4]

What Do Patients Need to Know About Their Medications?

Patients need to understand the nature of their disease and what each of the prescribed interventions is intended to accomplish. From the clinician's viewpoint, the drug was prescribed and should be taken as prescribed. From the patient's perspective the drug costs money; it may be inconvenient, uncomfortable, or unpleasant to take; it may not work; and it may make them feel bad in new ways. Any of these, without prior initiation, may cause the patient to stop taking the medication and lose confidence in the health-care provider. Providing a context for the patient as to why he or she is taking the drug and what to expect in terms of benefits and potential adverse effects goes a long way in gaining the patient's acceptance of the prescribed regimen.[15,39,40]

Most drugs have some unwanted or adverse effects, but these adverse effects are much less daunting when their possibility has been discussed and they are not totally unexpected, and the patient can associate the effect with a specific new intervention. Questions to be answered for the patient are listed in Table 7.

Table 7. Questions Clinicians Should Answer for Their Patients

What should the drug do?
Why is it being prescribed?
How do I know the drug is working?
How do I know if the drug is not working?
What are expected adverse effects?
What are unexpected or less common adverse effects?
How do I take it?
How will it taste, feel, etc?
When do I take it?
How much do I take?
How often do I take it?
When should dose or frequency change?
When should I call for help?

Seldom is a patient with respiratory problems prescribed a single drug. Each drug has its own benefits, adverse effects, dose, frequency, and method of administration. The addition of each new drug increases the complexity of the requirements to perform the prescribed regimen and reduces their chance of success. A medication plan is an organizational tool that can help the patient to integrate and coordinate his or her prescribed medication regimen with the rest of his or her routines. While much has been made of the use of medication and treatment action plans for managing asthma,[41] these tools are just as important for patients with COPD and other chronic diseases.

The medication plan should list each of the patient's prescribed medications, and each medication's role, dose, and frequency. Efforts should be made to differentiate rapid-acting, short-duration medications, such as bronchodilators or rescue medications, and slow-onset, longer-acting medications, such as steroids, nonsteroidal anti-inflammatory agents, and long-acting bronchodilators. Confusing the use of short-acting and long-acting bronchodilators can be life-threatening for a patient in acute need of reliever medication. The patient needs to know which medications should be increased in dose or frequency during an exacerbation. This is the role of the treatment action plan.[41]

Treatment action plans are different from, and should be provided in addition to, the medication plan (Table 8). The treatment action plan should identify methods to monitor symptoms, and it should provide guidance about when to modify the dose or frequency of each relevant medication. In the case of chronic pulmonary disease the action plan should include when to take oral steroids or antibiotics, and guide the patient or care provider about when and how to call the clinician or team for help and when to head into the emergency department.

In addition, patients need to know (and be able to demonstrate) proper use of each pMDI and DPI prescribed. Patients need to be able to articulate how each inhaler is different. Patients should also be instructed to bring in each of their prescribed medications to each clinic visit. In

Table 8. Components of a Treatment Action Plan

A list of the triggers responsible for your asthma and how to avoid them
A list of peak flow meter readings and zones based on your personal best
A list of routine symptoms such as coughing, wheezing, tightness in the chest, shortness of breath, and excessive mucus production, as well as what you should do if these symptoms occur
What you should do if nighttime asthma symptoms awaken you
A list of more serious asthma symptoms such as breathlessness and decreased effectiveness of your reliever medicine, and what you should do if these symptoms occur
The name and dose of the quick-acting or rescue medication that needs to be taken even when there are no symptoms, and the name and dose of the reliever medication that needs to be taken when you are having an asthma attack
Emergency telephone numbers and locations of emergency care
Instructions about when to contact your doctor, whom to call if your doctor is unavailable, and a list of where to get emergency treatment

addition to daily use, priming and cleaning should be covered with each inhaler. Patients need to know the function of each prescribed accessory device, how and when to use it, and how to clean and maintain it.

Patients need to know each medication they are taking: what each is supposed to do for them, how much they should take, how often, and how to tell when each is or is not working. This includes expectations about adverse effects and when to call for a change. It is very important to differentiate short-acting reliever medications from longer-acting medications that should not be taken on an as-needed basis during exacerbation.

Cost of Inhalers

With 30 million working uninsured in the United States, the patient's medication plan needs to be developed based on his or her access to resources and the cost of the intervention. All too often the out-of-pocket cost of inhalers requires a patient to decide whether to buy their inhaler or feed their family. There are a number of drugs available within each basic class of reliever and controller that can effectively meet the patient's therapeutic goals. When confronted with the choice of the best drug that the patient can not pay for or an adequate alternative that is more affordable, the prescribing clinician needs to make informed choices. A survey of house staff and attendings reported that, while 88% believe that cost is important, less than 30% have easy access to cost information, and less than 18% actually received training concerning costs of medications.[42] Table 9 lists the recent costs of common inhaled medications.

Matching the correct drug to the correct device is also of paramount importance. For instance, the new long-acting bronchodilator/steroid combinations offer some great advantages in term of dosing convenience and clinical effect for certain patients. Unfortunately, inhaled steroids have not been shown to benefit more than 10–20% of COPD patients.[43,44] How then do we justify the expense of using this combined therapy in COPD patients unless we have empirical evidence that the individual patient will benefit from the combined therapy?

Problems in Patient Education

Beyond the limitations and complexity of each inhaler, accessory device, or nebulizer option, a number of factors impact the patient's ability to learn (Table 10).[1] At the risk of stating the obvious, most patients seek health care when they don't feel well. By the time they come to a clinic, emergency department, or hospital, they are tired, frustrated, uncomfortable, anxious, or downright scared, and, of course, sick. In addition, patients with chronic pulmonary disease are subject to depression that may reduce their response to and retention of information presented.[45,46] All these contribute to a poor attention span and poor retention of new information.

Even were the patient able to learn, there is no time to teach. In all of the above settings, time is limited. There is barely time to get a history, perform a physical, review symptoms, determine a diagnosis, and prescribe several interventions, much less provide comprehensive instruction on each therapy and device.

The ability to communicate is basic to education. Patients who have a different primary language than the healthcare provider or who have low literacy skills present special challenges. In the cultural and multinational melting pot of the United States, clinicians commonly care for and prescribe treatment for patients who have limited comprehension of the care provider's language, independent of their level of education. In many cases these patients are hesitant or embarrassed to admit to the professional that the instructions are not clearly understood.

Literacy is not a problem limited to patients for whom English is a second language. Traditional patient education relies heavily on printed materials, which are often written at a level too complex for low-literacy patients.[47] Nationally, almost one quarter of the adult population in the United States cannot read and understand very basic written materials.[48–50] These instructions range from taking a pill with a meal to using and maintaining an aerosol device.

In a study of 483 patients who presented to either an emergency department or special asthma clinic, $> 66\%$ claimed to be high school graduates, but only 27% read at the high-school level. Patient reading level was the strongest predictor of asthma knowledge and proper inhaler technique. Poor MDI technique (≤ 3 correct steps) was

Table 9. Form, Dosage, Name, and Cost of Typical Inhaled Medications*

Drug	Form	Name (Manufacturer)	Inhalations/Unit	Unit Dose	Cost ($)	Cost/dose ($)
Corticosteroids						
Beclomethasone dipropionate	pMD1	Qvar HFA (IVAX)	100	40 μg/inh	60.84	0.61
			100	80 μg/inh	73.57	0.74
Budesonide	DPI	Pulmicort Turbuhaler (AstraZeneca)	200	200 μg/inh	148.12	0.74
	Nebule	Pulmicort Respules (AstraZeneca)	30	0.25 mg/2 mL	145.04	4.83
			30	0.5 mg/2 mL	156.50	5.22
Flunisolide	pMDI	AeroBid (Forest Laboratories)	100	250 μg/inh	74.57	0.75
Fluticasone propionate	pMDI	Flovent HFA (GlaxoSmithKline)	120	44 μg/inh	69.06	0.58
			120	110 μg/inh	92.46	0.77
			120	220 μg/inh	131.00	1.09
Mometasone furoate	DPI	Asmanex Twisthaler (Schering-Plough)	30, 60, or 120	220 μg/inh	Price not set	NA
Triamcinolone acetonide	pMDI	Azmacort (Kos Pharmaceuticals)	240	100 μg/inh	89.99	0.37
Short-Acting β_2 Adrenergic Agonists						
Albuterol	pMDI	Proventil (Schering-Plough)	200	90 μg/inh	40.29	0.20
	pMDI	Generic	200	90 μg/inh	18.36	0.09
	pMDI	Proventil HFA (Schering-Plough)	200	90 μg/inh	40.54	0.20
	pMDI	Ventolin HFA (GlaxoSmithKline)	200	90 μg/inh	39.61	0.20
	Nebule	Generic	24	0.83 mg/mL	17.99	0.75
	Nebule	AccuNeb (Dey)	25	0.42 mg/mL	41.59	1.66
Levalbuterol	Nebule	Xopenex (Sepracor)	24	0.31, 0.63, or 1.25 mg/3 mL	65.74	2.74
	pMDI	Xopenex HFA (Sepracor)	200	45 μg/inh	Price not set	NA
Pirbuterol	Breath-actuated pMDI	Maxair Autohaler (3M)	400	200 μg/inh	94.76	0.24
Metaproterenol	pMDI	Alupent (Boehringer Ingelheim)	200	0.65 mg/inh	32.87	0.16
	Nebulizer	Alupent (Boehringer Ingelheim)	25	0.4% solution	55.99	2.24
Racemic Epinephrine	pMDI	Primatene Mist (Wyeth)	270	0.22 μg/inh	14.99	0.06
Long-Acting Inhaled β_2 Adrenergic Agonists						
Formoterol	DPI	Foradil (Novartis)	60	12 μg/inh	79.99	1.33
Salmeterol	DPI	Serevent Diskus (GlaxoSmithKline)	60	50 μg/inh	91.97	1.53

*Based on prices listed on Drugstore.com and Walgreens.com.
HFA = hydrofluoroalkane
DPI = dry powder inhaler
inh = inhalation
can = canister
NA = not applicable

continued

Table 9. Form, Dosage, Name, and Cost of Typical Inhaled Medications* (Continued)

Drug	Form	Name (Manufacturer)	Inhalations/Unit	Unit Dose	Cost ($)	Cost/dose ($)
Anticholinergic Bronchodilator						
Ipratropium bromide	pMD1	Atrovent (Boehringer Ingelheim)	200	18 μg/inh	55.99	0.28
	pMDI	Atrovent HFA (Boehringer Ingelheim)	200	17 μg/inh	72.99	0.36
	Nebule	Atrovent (Boehringer Ingelheim)	25	0.02% solution in 2.5 mL	77.32	3.09
	Nebule	Generic	25	0.02% solution in 2.5 mL	11.95	0.48
Tiotropium bromide	DPI	Spiriva Handihaler (Boehringer Ingelheim)	30	18 μg/cap	163.47	5.45
Anticholinergic Plus β_2-Agonist Bronchodilator						
Ipratropium bromide and Albuterol	pMDI	Combivent (Boehringer Ingelheim)	200	18 μg or 103 μg/inh	67.99	0.34
Ipratropium and Albuterol sulphate	Nebule	Duoneb (Dey)	60	0.5 mg or 3.0 mg/3 mL	118.96	1.98
Corticosteroid Plus Long-Acting β_2 Agonist						
Fluticasone/salmeterol	DPI	Advair Diskus (GlaxoSmithKline)	60	100 μg/50 μg	113.99	1.90
			60	250 μg/50 μg	139.99	2.33
			60	500 μg/50 μg	195.99	3.27
Budesonide/formoterol	DPI	Symbicort Turbuhaler (AstraZeneca)	120	80 μg/4.5 μg	Price not set	NA
			120	160 μg/4.5 μg	Price not set	NA
Cromolyn Sodium						
Cromolyn Sodium	pMDI	Intal (King)	200	800 μg/inh	90.47	0.45
	Nebulizer	Intal (King)	60	10 mg/mL, 2 mL	46.61	0.78
Nedocromil Sodium	pMDI	Tilade (Aventis)	104	1.75 mg/inh	88.41	0.85

*Based on prices listed on Drugstore.com and Walgreens.com.
HFA = hydrofluoroalkane
DPI = dry powder inhaler
inh = inhalation
can = canister
NA = not applicable

Table 10. Problems in Patient Education

Low literacy
Poor attention span, especially when sick
Inadequate time to learn
Inadequate information
Inadequate follow-up
Patient hesitant to ask questions
Limited financial incentives for education

found among 89% of patients who read at the third-grade level and 48% of patients reading at the high-school level.[48] Many patients with low literacy are hesitant to ask questions to clarify written instructions. Providers need to recognize the limitations of written instructions and care plans.[51] Printed instructions, from instructional booklets to package inserts, may not be adequately understood. The failure of some instructional booklets to provide accurate or adequate information further complicates these problems.[51]

While there are a large number of sources of information on inhaler use, these sources may provide incomplete or inaccurate information. National standards such as those of the National Asthma Education and Prevention Program (NAEPP) and the Global Initiative for Chronic Obstructive Lung Disease (GOLD) are valuable sources of information. Medical specialty, allied health, and patient-advocacy groups have produced a variety of useful materials for patient education. Journals such as RESPIRATORY CARE, *Journal of Aerosol Medicine*, *Chest*, *American Journal of Respiratory and Critical Care Medicine*, and *European Respiratory Journal* provide valuable review articles and original research. Peer-reviewed literature provides the best analysis of discrete individual issues of proper use and device selection, but takes extensive time and training to review, analyze, and integrate into individual practice.

General textbooks used by medical students, nurses, and even respiratory therapists all too often fail to include basic information on how to use and maintain inhalers. The situation is not much better in current respiratory therapy texts, where the steps of use are more frequently included, but other essential information on proper use is not included. This is in part due to the limited number of pages available to cover aerosol therapy. Typically 20–40 pages are allocated in a 1,200-page text. Aerosol therapy is more than 60% of what respiratory therapists do in clinical practice, but is less than 4% of their required reading. A recent search of the Internet for "how to use an inhaler" returned more than 57,000 hits, some with excellent information and some that contained a great deal of unsubstantiated and possibly dangerously misleading information. Clinicians should evaluate materials for accuracy and completeness prior to recommending them for patients.[51]

Table 11. Problems in Clinician Teaching

Lack of familiarity with use of specific devices
Inadequate time to teach
Poor training techniques
Poor training materials
Lack of follow-up

The entire health-care team has responsibility for patient education, but few of us are formally prepared or trained to be effective educators, especially in our current environments (Tables 11 and 12). The clinician's role in patient education extends beyond device selection to include teaching, demonstration, evaluation of the patient's technique, and reevaluation at subsequent visits.

Common Myths About Inhaler Use

Myth 1: Inhalers are so simple they need no instruction.

As explained above, no inhaler seems to pass the "foolproof" test for patients or clinicians. Without instruction, a relatively high percentage of patients and clinicians don't use the devices to full effect.

Myth 2: DPIs are easier to use than pMDIs.

Improper use of DPIs is similar to that documented with pMDIs. DPIs have a similar to greater number of steps as

Table 12. Teaching Psychomotor Skills: General Principles

Set aside uninterrupted time to complete the instruction
Perform the demonstration in a suitable environment
Have all necessary equipment and spares close at hand
Engage the patient's attention
Explain verbally what you will do and why
Conduct a demonstration of inhaler technique, verbally naming and explaining each step
Repeat the demonstration without explanation (talking is necessary in the above step, but talking interferes with the correct timing of the inspiratory maneuver)
Repeat again with verbal comments
Have the patient demonstrate the maneuver, including correct identification of inhalers and assembly of inhaler/spacer combination
Identify problems in the patient's performance, repeat the instruction, and have the patient demonstrate again
Ask the patient to verbalize the most important aspects of the procedure, and those he or she finds most troublesome
Arrange for follow-up instruction. Assure the patient that some loss of skill over time is typical and can be corrected
Remind the patient to bring his or her inhalers and spacers to every appointment
Provide instruction to family or friends, if requested
Review and dispense instructional leaflets or videos if available

(Adapted from Reference 8.)

pMDIs (see Table 4). There are a similar percentage of patients who do not perform key steps with each type of inhaler.

Myth 3: Nebulizers are more effective than inhalers.

A recent review of the evidence of device effectiveness[52] reported that nebulizers, DPIs, and pMDIs are all comparably effective when used properly.

Myth 4: Nebulizers are easier to use than inhalers.

Although a less frequent topic of research, the typical home nebulizer requires a more complex interface with the patient for proper use than do inhalers. Instructions are largely based on placing a unit dose of drug in the nebulizer, attaching the tube to the compressor, plugging in the nebulizer, turning on the compressor, and breathing until the nebulizer begins to sputter. Mouth breathing with tidal breathing is typically recommended. The complexity comes with the need to disassemble, wash, dry, and reassemble the nebulizer between treatments, and to periodically sterilize it. Nebulizer compressors require periodic maintenance, such as filter replacement. Clinicians should periodically inspect patients' nebulizers to see the condition of the compressor/nebulizer and how it is being used.

Myth 5: Someone else will teach the patient if I don't.

Though the list of health care professionals who should be capable of teaching inhaler use is relatively long, the literature suggest that no one profession is consistently knowledgeable about inhaler use or proactively "picks up the slack" when a patient's education requirements are not met by the primary health-care provider.[53–55] Consequently, each clinician and service provider should be knowledgeable and take responsibility to either teach directly or refer the patient to an available resource in the community who has proven skills in patient instruction.

Myth 6: I know and follow the National Asthma Management Guidelines.

This is a self-perpetuating problem of not getting much-needed education, because the clinician believes that he or she already knows the material. Many clinicians have had some orientation to the National Asthma Guidelines, but few have actively integrated the recommendations into their practice. This results in a large number of their patients overusing β agonists and being poorly controlled with anti-inflammatory agents. Physicians in general practice and internal medicine have a broad range of clinical problems across their patient populations, from hypertension to diabetes, that require periodic educational updates. With limited hours available for continuing education, they naturally select courses about which they perceive a need. If they believe that they know and follow a specific guideline, that is not where they will go for additional information. There is a need to alert physicians to periodically update their knowledge of new inhalers as well pulmonary disease management standards.[14]

Myth 7: Once inhaled medications are prescribed, patients will conscientiously take them.

Unfortunately, a large number of patients do not fill their inhaler prescriptions.[56–59] The reasons range from the patient's inability to afford the medications to the belief that the medication will do long-term damage. Difficulty of use, adverse effects, or unpleasant experiences with a medication can lead to failure to fill prescriptions. Often the patient does not volunteer to the prescribing clinician that they are not taking a prescribed medication, which helps perpetuate this myth. Clinicians should ask patients which medications they regularly take, which they do not, and what the patient does not like about each medication.

Myth 8: I teach the patients well, but they do not use their inhalers right.

This myth implies that the clinician is doing everything within reason, and that the patients, for some obscure reason, refuse to use the devices properly. It is much more likely that the clinician, by definition, is not being an effective educator. Adopting strategies such as demonstration with placebo followed by return demonstration, use of clear, easy-to-understand explanations and handouts, and having the patient demonstrate the use of each inhaler at every clinic visit should be sufficient to totally debunk this myth.[60–62]

Summary

The primary responsibility for patient education rests with the prescribing clinician and the dispensing pharmacist. However, the entire health-care team has a role and responsibility to assure that the patient is armed with the tools required for effective self-management. As clinicians we must understand how to use and differentially select and match the best device for the individual patient. We must adapt modern teaching techniques to optimize the effectiveness of our teaching efforts. As patient-care advocates we need to educate administrators and legislators of the need to make time for teaching and provide resources so that proper education is the norm rather than the exception.

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Discussion

Geller: We all know that device education is important for patients, but there are other factors involved, including financial ones. It is challenging for anybody to teach properly, including specialists, and especially primary caregivers. If you see any more than 10 patients in a half day, it is very difficult to make the time to do it properly. So it is a huge challenge. We have to do this, but instituting it is another subject. And it has to be made easier with new educational tools that caregivers can use to relieve their time constraints. For example, the American College of Chest Physicians [ACCP] have a relatively new DVD for $30 that goes over MDI/DPI instructions. Mark Everard, in the United Kingdom, has developed a Web site for practitioner education on basic aerosol principles. So I think we're getting a little bit better, but there are a few more bridges to cross.

Fink: Your point's well taken. About 7 years ago I started the ACCP video project to demonstrate the use of aerosol devices. The concept was to make comprehensive visual step-by-step instructions for each type of inhaler and nebulizer, and make it available on the Web or as a CD. But the production costs were so high that the scope of the project was reduced to include only one type of MDI, valved holding chamber, DPI, and nebulizer. In a more recent project, we are developing printable, illustrated instruction sheets that show the steps for each particular type of MDI, DPI, accessory device, and nebulizer.

The problem remains that most clinicians do not know how to use these devices, don't know how to teach their use, and do not monitor to make sure their patients are using them properly. Over the past few years the International Society of Aerosols in Medicine sponsored a post-graduate workshop presented at major international conferences such as the ACCP, AARC [American Association for Respiratory Care], and ATS [American Thoracic Society]. While clinicians are lined up to attend ventilator workshops, we're lucky to be able to draw 30–60 clinicians to learn about aerosol techniques. With all the things that clinicians need to stay on top of, that they know are important to their practice, how do you draw them to a topic that they do not even recognize as a problem?

Dhand: I think you did a very good job of stressing the need to improve basic understanding about the disease itself. Lack of knowledge is another impediment to effective treatment. We all know how important it is to get the right information in the hands of patients.

Fink: How many universities around the world have a faculty member who is really familiar with the aerosol literature, who is available in-house to train residents and fellows and assist patients with clinic activities? I would bet it's less than 5 percent. If it is not in the textbooks and there is no local champion to teach the students and staff, how are we going to break this cycle of ignorance?

Anderson: I don't feel like I'm doing a very good job keeping up with the literature or with patient or housestaff inhaler education, and I'm a supposed "aerosol expert." I feel guilty in clinic because I just rush around and have the nurse teach them about the inhaler. There is very little

time or resources for inhaler education and assessment in the clinic.

Gutmann:* It boils down to 2 things: supply and demand for in formation and education. On the one hand, there is the supply of information or education. On the other hand the question is, how do we create the demand so that people will go after the supply? Both the demand and the supply aspects have problems. On the demand side, patients' willingness to use it depends on patients' habits. How do they use the information available? How do they approach their search? How much of what they learn do they think they need to adhere to? What can we do from outside their world that would increase the patient's demand?

Fink: One thing we can do is reach outside of our individual disciplines and tell the publishing companies that produce the 40 or 50 major general medicine textbooks that we have information they need to put in those books; we should highlight the economic impact of the information and ask them to give us a few pages.

We need to do that with respiratory therapy textbooks, pharmacy textbooks, and nursing textbooks as well. We need to teach student clinicians how to teach people in the clinical environment, and provide them strategies that they can integrate into their day-to-day routines. We should create good materials that are readily accessible, including videos that patients can watch while in the waiting room, for instance, which would help decrease the amount of information the patient has to go over with the physician. A process to validate these education materials, to show they're accessible, effective, and useful is essential, and allows us to identify sources of misinformation.

Gutmann: There is much technical information out there, through the Internet and other sources; the amount of material is overwhelming. The issue is that a lay person has little chance of determining the quality of the information, except with the help of a continuously trained health-care professional. What information can they and we trust?

Atkins: Good point. Patient and physician education is critical for the effective use of these devices. In general practices, how often is inhaler technique checked? Every couple of years? I recall when a large pharmaceutical company was showing an inhaler demonstration at its booth at a major conference, and I was sure that with the method they were demonstrating you would not get the appropriate dose. I think there is a responsibility there, and I think you've highlighted it very well.

Amato:† When was the last time a meeting was held where anyone talked in depth about some of the issues that we've talked about here?

Fink: This topic tends to be the "elephant in the room." Many are at least partly aware of the problem, but it is much easier to ignore than tackle. Perhaps future programs can address this subject in greater detail.

Atkins: I think this meeting will achieve results, by education, and I think it has raised the priority of this subject for some of us here. At other meetings, Chet and I have talked to limited audiences and made them to think about this issue, which has become more relevant now. If we could just improve the way inhalers are used, the return on investment would be good, I think.

Nikander:‡ Do you use patient-support groups in your education program?

Fink: There's a lot of literature that supports the use of patient groups instead of individualized education, both for education and establishing peer networking. Support groups seem to be more prevalent for some disease groups than others. Most offer education components periodically on topics such as inhaler use. The American Lung Association's Better Breather Clubs and community asthma consortiums all over the country have put together free or easily accessible support groups with training. But there are by no means enough of these groups available to meet the existing need in most communities.

Hess: What's a good source for MDI placebos? I can't find them anymore, which impedes patient education. I have Diskus placebos, but I can't find MDI placebos.

Atkins: Most of the MDIs still have CFCs, and manufacture of CFC products has been capped, so you can't get them.

Fink: That is an important point. We need to be able to demonstrate both MDI and DPI use to patients, with initial training and as they return for subsequent visits. Drug and device manufacturers should be encouraged to supply placebo devices to every dispensing physician, pharmacist, respiratory therapist, and asthma educator responsible for training patients in their use.

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