

# Practical aspects of inhaler use in the management of chronic obstructive pulmonary disease in the primary care setting

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**Abstract:** Sustained bronchodilation using inhaled medications in moderate to severe chronic obstructive pulmonary disease (COPD) grades 2 and 3 (Global Initiative for Chronic Obstructive Lung Disease guidelines) has been shown to have clinical benefits on long-term symptom control and quality of life, with possible additional benefits on disease progression and longevity. Aggressive diagnosis and treatment of symptomatic COPD is an integral and pivotal part of COPD management, which usually begins with primary care physicians. The current standard of care involves the use of one or more inhaled bronchodilators, and depending on COPD severity and phenotype, inhaled corticosteroids. There is a wide range of inhaler devices available for delivery of inhaled medications, but suboptimal inhaler use is a common problem that can limit the clinical effectiveness of inhaled therapies in the real-world setting. Patients' comorbidities, other physical or mental limitations, and the level of inhaler technique instruction may limit proper inhaler use. This paper presents information that can overcome barriers to proper inhaler use, including issues in device selection, steps in correct technique for various inhaler devices, and suggestions for assessing and monitoring inhaler techniques. Ensuring proper inhaler technique can maximize drug effectiveness and aid clinical management at all grades of COPD.

**Keywords:** COPD, inhaler technique, bronchodilator, clinical management

## Background

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease that is the third-leading cause of death in the United States.<sup>1</sup> However, much can be done to improve significantly the quality, and perhaps, duration of life for people with COPD; for instance, modern pharmacotherapy can effectively reduce exacerbations, avoiding morbidity and costly hospitalization.<sup>2-7</sup> There are also encouraging trends to suggest that pharmacotherapy might have an impact on reducing both the rate of forced expiratory volume in 1 second (FEV<sub>1</sub>) decline and the risk of earlier mortality.<sup>3-8</sup> Nonpharmacologic therapy, such as collaborative self-management education<sup>9,10</sup> and pulmonary rehabilitation,<sup>11</sup> is equally important for COPD management, often enhancing pharmacotherapy approaches.

Primary care physicians make most initial COPD diagnoses based on symptoms of dyspnea and cough in adults aged 40 years and older with a smoking history. Clinical diagnosis requires spirometry confirmation of airflow obstruction.<sup>12,13</sup> Treatment is then begun and tailored to a patient's needs based on the latest COPD guidelines.<sup>14,15</sup> The Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines clearly state that the choice of inhaler device should depend upon drug availability, cost, the preference of the prescribing physician, and the skills and abilities of the patient.<sup>15,16</sup>

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The management of COPD is often not optimal, and poor inhaler technique is one of the prime reasons for this.<sup>17–19</sup> Physicians frequently prescribe inhaler devices based on available/preferred drugs, without considering whether the patient can effectively use them.<sup>20</sup> Most COPD occurs in older adults who may have comorbid conditions, such as tremor, poor eyesight, arthritis, and cognitive problems that may aggravate effective inhaler device use. Therefore, device selection must be based on COPD severity and the patient's physical and cognitive abilities, as well as insurer and provider tiering, requests for prior authorization, and patient cost-saving requests.

Pharmacologic treatment can provide symptom relief, improve health status, improve exercise capacity, and reduce the frequency and severity of COPD exacerbations.<sup>15</sup>

**Table 1** Inhaled medications available to accomplish goals of COPD therapy in the United States, 2010

Goal of COPD therapy	Available inhaled medications
Relief of breathlessness <sup>14,15</sup>	<ul style="list-style-type: none"> <li>• Short-acting <math>\beta_2</math>-adrenergic bronchodilators</li> <li>• Short-acting anticholinergic bronchodilators</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilators</li> <li>• Long-acting anticholinergic bronchodilators</li> </ul>
Improved quality of life <sup>3,7,8</sup>	<ul style="list-style-type: none"> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilators</li> <li>• Long-acting anticholinergic bronchodilators</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilator–ICS combinations</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilator–ICS combinations plus long-acting anticholinergic bronchodilators</li> </ul>
Improved exercise capacity <sup>14,15</sup>	<ul style="list-style-type: none"> <li>• Short-acting <math>\beta_2</math>-adrenergic bronchodilators</li> <li>• Short-acting anticholinergic bronchodilators</li> <li>• Long-acting anticholinergic bronchodilators</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilators</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilator–ICS combinations</li> </ul>
Reduced COPD exacerbations <sup>14,15</sup>	<ul style="list-style-type: none"> <li>• Long-acting anticholinergic bronchodilators</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilators</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilator–ICS combinations</li> </ul>
Trend to a reduced age-related loss of lung function <sup>2,3,5,7</sup>	<ul style="list-style-type: none"> <li>• Long-acting anticholinergic bronchodilators</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilator–ICS combinations</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilator–ICS combinations plus long-acting anticholinergic bronchodilators</li> </ul>
Trend to improved longevity <sup>3,5,6</sup>	<ul style="list-style-type: none"> <li>• Long-acting anticholinergic bronchodilators</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilators alone</li> <li>• Long-acting <math>\beta_2</math>-adrenergic bronchodilator–ICS combinations</li> </ul>

**Abbreviations:** COPD, chronic obstructive pulmonary disease; ICS, inhaled corticosteroids.

Table 1 lists the drug combinations for COPD care that are available for inhalation via various devices, including nebulizers, pressurized metered-dose inhalers (pMDIs), and dry-powder inhalers (DPIs).

This review focuses on the practical aspects of inhaler use, including appropriate device selection to best meet an individual patient's needs,<sup>21</sup> as well as information to facilitate adequate training and monitoring to ensure proper inhaler technique. Key barriers to optimal inhaler use are highlighted, followed by some practical advice to overcome device misuse by the patient with COPD.

## Available inhaler devices

All types of inhaler devices have similar efficacy when tested under strict clinical trial conditions,<sup>17,22,23</sup> however, in the real-life setting of clinical practice, each inhaler has distinct characteristics that can become advantages or disadvantages for individual patients, affecting clinical outcomes, patient satisfaction, and thus adherence.<sup>19,24,25</sup> For the individual patient, “inhalers” should not be viewed as equivalent, and device type must become an important variable to consider when planning optimal COPD management.<sup>23</sup>

## Pressurized metered-dose inhalers

The first handheld inhaler was launched by Abbott Laboratories in 1948; however, development of pMDIs in 1955, which are small, portable, and offer quick and reproducible drug delivery, was a big step forward in inhaler design.<sup>26</sup> There are two types: those that are triggered by a mechanical device (usually a button that should be pushed just after inspiration begins), and those that are breath-actuated, which removes the need to coordinate breathing and push the actuator. Limited published evidence exists on the relative benefits of the two types of pMDI.<sup>27</sup> While inhalation of drugs was a great advance, putting the drugs where they are needed and limiting systemic exposure, the advantages of pMDIs are limited by the need for a specific breathing technique that involves coordination between inspiration and actuation, slow and steady inspiration, and a breath hold. Some of these problems can be overcome by using a pMDI in conjunction with a spacer or holding chamber. Although spacer misuse and failure to properly clean a spacer can decrease drug delivery,<sup>28,29</sup> use of non-electrostatic spacers, such as Vortex (PARI Respiratory Equipment, Midlothian, VA) and the AeroChamber Max (Monaghan Medical, Plattsburgh, NY) can overcome this issue. A pMDI is a good inhaler option for many patients

with COPD; however, inadequate hand–breath coordination, poor fine motor control, hand or finger muscle weakness, or arthritis of the hand can prohibit proper pMDI use. pMDIs with longer drug-delivery periods may reduce some of the impact of poor coordination of efforts. Elderly patients may prefer a breath-actuated pMDI over the usual pMDI, but must have sufficient inspiratory flow (minimum usually considered to be 30 mL/second) to trigger the device.

## Dry-powder inhalers

The DPIs were devised to be easier to operate than pMDIs,<sup>22</sup> although they require a certain level of peak inspiratory flow (PIF), making them unsuitable for some very infirm or very severe COPD patients.<sup>30</sup> While in general, many adults find DPIs easier to use than pMDIs,<sup>31</sup> the different types of DPI (self-contained blister pack device and those requiring capsule insertion), each requiring different techniques, can lead to confusion and ineffective drug delivery.<sup>32</sup> The self-contained blister pack device requires opening the device, cocking it, and inhaling. Counters should be checked to ensure the device is not empty. DPIs with dry-powder capsules require removal of the capsule from the individual packets, insertion of the capsule into the device, puncturing the capsule, and inhaling. Dry-powder devices require only a single inhalation.

## Nebulizers

Nebulizers are the oldest form of inhalation device.<sup>22</sup> Nebulizer use should be limited to patients for whom handheld inhalers are unsuitable, such as those with coordination problems. The devices are generally bulky and inconvenient, expensive, and require regular maintenance and long treatment-delivery times. Use of a nebulizer prolongs drug delivery from seconds to 10–15 minutes. Proper device cleaning is required to prevent bacterial, yeast, or mold contamination.

## Soft-mist inhalers

A new type of handheld inhaler device is the soft-mist inhaler (SMI), which produces a slow-moving, very fine liquid aerosol (a “soft mist”). Because the mist is produced over 1.5 seconds instead of the <0.5-second period with most other inhalers, it should allow more flexibility with synchronization between device actuation and inhalation, and therefore may provide greater lower-airway deposition.<sup>33</sup> Respimat Soft Mist Inhaler (Boehringer Ingelheim, Ingelheim, Germany) is currently available in European, Asian, and South American countries, and will be available in the US in July 2012.<sup>34</sup>

## Inhaler device misuse and adherence in the real-world setting

Several studies have demonstrated that errors in inhaler use are common among patients with COPD<sup>35,36</sup> (Table 2). One study estimated that while 76% of pMDI users and 49%–55% of DPI users made at least one error, only 28% and 11%–32% of pMDI and DPI users, respectively, made errors that compromised the clinical benefits of their medications.<sup>35</sup> In contrast, a recent study showed that more patients using DPIs made mistakes compared with those using MDIs.<sup>18</sup> Reasons for poor inhaler use may be divided into a few simple categories: device issues, patient issues, physician and health-care professional issues, practice issues, and cost issues leading to failure to obtain the inhalers. While multiple issues may affect any single patient, we will address the issues individually.

## Device issues

The pMDIs are known to be affected by a variety of problems, including lack of coordination, inadequate breath hold, overly rapid inhalation, and inadequate shaking/mixing (priming) of the inhaler before actuation.<sup>37</sup> Some devices require upright storage, and priming recommendations are widely variable.

**Table 2** Critical inhaler errors

Critical error	pMDI	Multidose DPI Diskus/turbuhaler	Single-dose DPI HandiHaler/aerolizer
Failure to remove cap	X	X	X
Holding inhaler upside down	X	X	X
Failure to load dose		X	X
Failure to pierce capsule			X
Exhaling into device		X	X
Failure to make tight seal with lips		X	X
Failure to synchronize inhalation with device actuation	X		
Inhalation too weak or too slow		X	X

**Abbreviations:** DPI, dry powder inhaler; pMDI, pressurized metered-dose inhaler.

High- and low-temperature extremes such as those found in a car's glove compartment disrupt the delivery system and may inactivate the drug. Most pMDIs are fairly resistant to humidity and can be stored in a bathroom.

Common DPI errors include failure to hold the device upright, exhaling through the mouthpiece, shaking the device, failing to inhale forcefully, and inhaling with an open mouth/failing to maintain a tight seal.<sup>38,39</sup> DPIs are sensitive to humidity and should not be stored in the bathroom. The capsule packets can be difficult to open, but because of humidity concerns should never be opened and emptied into another container for easier access.

As COPD progresses, the GOLD guidelines recommend the use of multiple classes of inhaled drugs.<sup>15</sup> In early COPD, all patients should use short-acting inhaled bronchodilators as needed, available by pMDI, DPI, and SMI in various jurisdictions. As the disease progresses, long-acting inhaled bronchodilators are added, requiring the patient to use two inhalers; these inhalers are likely to be of different types, since long-acting bronchodilators are available as pMDIs, DPIs, and SMIs in various jurisdictions. The need for multiple inhalers of different types and different inhaler techniques may confuse patients and impede correct inhaler use.<sup>32</sup> The automatic substitution of similar long-acting inhaled bronchodilators in DPI format by pharmacists could produce even more confusion, with patients switching from self-contained blister pack DPIs to capsule-based DPIs without proper explanation or education. The different brands of DPI are not simply interchangeable.<sup>39,40</sup> In severe to very severe COPD (grades 3–4), nebulized medications may also be added to the pMDI and one or more types of DPI or SMI, making therapy regimens complex and confusing.

## Patient issues

Comorbidities, physical and mental capabilities, and inhaler preference or satisfaction will influence the patient's inhalation technique and should affect device selection. Most patients with COPD are long-term smokers and older, meaning they may have a number of comorbidities that can present barriers to effective inhaler use.<sup>41</sup> Physical issues, such as tremors, poor hand–eye coordination, poor dexterity, arthritis, poor eyesight, poor hearing, or low inspiratory flow rates can impair pMDI, DPI, and SMI use.<sup>22,42,43</sup>

Cognitive and mood disorders can also impair a patient's ability to learn and remember inhalation techniques.<sup>22,42</sup> Depression is frequent in patients with COPD,<sup>44,45</sup> and may lead to nonadherence with proper and regular therapy use.<sup>46</sup> Patients may also have health-literacy or language

barriers inhibiting understanding of any inhaler instruction provided.<sup>47</sup> Patient perceptions about their lung conditions and treatments can also affect treatment adherence (ie, under-use, overuse, and misuse).<sup>24,48</sup> For example, patients may have negative beliefs that their disease is untreatable, that their physicians cannot help them, or that the treatment will be ineffective or cause side effects. Others save the medications for a time when they will “really need” them and lose the benefit of regular therapy. The level of support through family/caregivers may affect patient enthusiasm for treatment and adherence. Some patients and caregivers may try to cope with the stress of illness by abuse of alcohol or sedatives, which will usually have a negative impact on consistency and success of disease management.<sup>49</sup>

An important variation of improper inhaler use is failure to use the inhaler at all. Patient adherence in COPD is multifactorial and is influenced by the patient, the physician, and society.<sup>24,48–50</sup> A recent study of 11,376 patients with COPD showed that only 52% used any COPD medications, 40% discontinued their medication within 30 days, and 70% discontinued within 90 days.<sup>51</sup> Nonadherence can be either intentional (patient does not like using the inhaler) or unintentional (patient likes and uses the inhaler, but has poor technique).<sup>38,39,52,53</sup> Patients may stop using their inhalers if, through poor technique, they are not achieving symptom relief.<sup>43,54–56</sup> In the Towards a Revolution in COPD Health (TORCH) survival study, good adherence to use of the study drug was found to result in substantially improved outcomes compared with nonadherence, as use of >80% of study medication over the 3 years of this trial was associated with significantly lower mortality, and exacerbation and hospitalization rates. Of interest, good adherence to placebo also resulted in significantly lower all-cause mortality.<sup>57</sup>

## Physician and health-care professional issues

Many primary care as well as specialty physicians and nurses lack the awareness, knowledge, and training required to instruct patients in proper inhaler use.<sup>58–60</sup> In one survey, among health professionals, respiratory therapists were the only group of which 50% could perform all of the critical steps required for proper inhaler use.<sup>36</sup> This knowledge gap must be filled. Health professionals must be capable of using multiple educational techniques (eg, verbal, visual, demonstration) to instruct patients, families, and caregivers on why, when, and how inhalers are to be used. Instruction and review must be repeated at each visit to ensure maintenance of proper inhaler technique. Side effects must be

explained without engendering undue concern.<sup>61</sup> In primary care, patients are seen multiple times over months or years, and therefore educational messages can be delivered in short segments and repeated as necessary to ensure patient and family understanding.<sup>61</sup>

## Practice issues

Practice systems can also serve as barriers to proper inhaler device selection and technique education. By prohibiting drug-sample use, practices may be left with no devices for patient trials or training. Obtaining placebo devices may overcome this barrier, but requires time and often requests to the pharmaceutical companies manufacturing each of the devices. Busy practices may have little opportunity for interdisciplinary sharing of inhaler technique methods or successful instruction strategies. Having a regularly scheduled annual or biannual inhaler update and review for all clinic employees could improve everyone's ability to teach and ensure correct inhaler use. Sharing responsibility and accountability for inhaler instruction and review can ensure it occurs even when a patient has multiple health concerns to address, as do many patients with COPD.<sup>59</sup>

## Cost issues

Physicians must have information on inhaler costs to share with the patient, including whether a medication has a deductible or co-pay, or the patient must pay the entire cost. Formulary restraints may result in drug substitution by the pharmacist, leaving the patient with a new or unexpected device and no information about its proper use.<sup>40</sup> Asking pharmacists to always demonstrate inhaler technique may help because not all pharmacists provide this instruction, and simply handing the patient written instructions is often unhelpful.<sup>60</sup>

## Practical solutions

The American College of Chest Physicians and the American College of Asthma, Allergy and Immunology have developed an eight-point checklist to aid in physician selection of inhaler device.<sup>17</sup> We have distilled the eight points into four practical questions that should be addressed for each patient.

**(1) For the chosen drug(s), what devices are available and what is the fewest number of device types that can be used?**

Physicians usually prescribe from a wide variety of medications (Table 1), and inhaler type is often a secondary consideration. Currently, there is a sufficient variety of drug-inhaler combinations to allow selection of desired

drugs while attempting to limit the number of different devices required. It is also important to provide sufficient and repeated education about the anticipated benefits of therapy and the likely course of drug use over time.<sup>61</sup> This information is particularly beneficial to patients who have unrealistic expectations and may stop using their inhaler because of perceived failure of their COPD treatment.

**(2) What device is the patient likely to use properly (given the patient's age and ability)?**

It is best to try to match available inhaler devices with the individual patient's ability to use the device effectively.<sup>62</sup> Caregiver and family expectations, intelligence, reading ability, and emotional stability should also be addressed when assessing inhaler choice.<sup>63</sup>

If the patient has already been prescribed an inhaler, request that he or she demonstrate how it is normally used, and correct for critical errors (Table 2).

For DPI selection, consider whether more than one type of DPI is needed and ensure that patients have the required PIF of >30 L/minute. Small PIF-testing devices are available at no cost or minimal cost. Alternatively, patients who can perform adequate spirometry can usually generate a sufficient PIF to operate most DPIs.<sup>64</sup>

For pMDIs, observing use and repeated practice can improve the needed coordination of breathing with actuation. Use of a spacer can remove concerns about timing, but not the strength and dexterity required for actuation. Table 3 lists suitable inhaler device types based upon the patient's inhalation skills.<sup>65</sup>

**(3) How can I ensure that the correct inhaler technique will be taught to the patient?**

Training and monitoring patients in correct inhaler use can help improve pMDI, DPI, and SMI use.<sup>42,66</sup> Several placebo devices are available for training patients to use inhalers correctly;<sup>67</sup> however, simply having training devices available is insufficient. Inhaler instruction, assessment, and monitoring should become an assigned and accountable clinical task, in the same way that assessing and recording smoking status has become a required vital sign.<sup>68</sup> Assumptions that patients, families, or caregivers will understand how to use their inhaler device, correctly following instructions received from their pharmacist or by reading the package inserts, are unjustified.<sup>60</sup>

Inhaler technique should be assessed at each visit, and either individual or group learning can be used depending on feasibility. Combinations of devices should be avoided

**Table 3** Inhaler suitability based on patient breathing and coordination

Good breath actuation and coordination		Poor breath actuation and coordination	
Peak inspiratory flow > 30 L/minute	Peak inspiratory flow < 30 L/minute	Peak inspiratory flow > 30 L/minute	Peak inspiratory flow < 30 L/minute
Nebulizer	Nebulizer	Nebulizer	Nebulizer
pMDI	pMDI	pMDI + spacer	pMDI + spacer
DPI	DPI (HandiHaler)	DPI	DPI (HandiHaler)
SMI <sup>a</sup>	SMI <sup>a</sup>	SMI <sup>a</sup>	SMI <sup>a</sup>

**Notes:** <sup>a</sup>Because of its slow-moving aerosol cloud, the SMI may be less error-prone even in patients with poor coordination, although this has not been specifically studied. Copyright © 2001, Elsevier Masson SAS. Adapted with permission from Voshhaar T, App EM, Berdel D, et al. Recommendations for the choice of inhalatory systems for drug prescription *Pneumologie*. 2001;55(12):579–586. German.<sup>65</sup>

**Abbreviations:** DPI, dry powder inhaler; pMDI, pressurized metered-dose inhaler; SMI, soft mist inhaler.

whenever possible, but if both DPIs and pMDIs are used, visual cues can be used. For example, place stickers on the devices such as “slow breath in” (pMDI) or “quick breath in” (DPI).

#### (4) Patient preferences and affordability

##### a. Which devices are affordable/reimbursable for the patient?

Affordability may be the ultimate factor in patient preference. Health professionals need to know the cost implications when prescribing any drug and device. When substitutes are not clinically acceptable, alternative payment strategies and support are required. Social, public health, and pharmaceutical company services may be helpful.

##### b. Does the patient have a device preference?

The patient may have a preference for a particular device, based on familiarity or past experiences with specific inhalers. This may lead to better adherence and faster technique mastery, although whether this results in improved clinical outcome has never been proven.<sup>25</sup>

##### c. Monitoring inhaler use and adherence

COPD occurs later in life, when a patient’s physical and cognitive abilities are likely to decline over time; therefore, not only must the appropriateness of the drug be assessed and reassessed but also the device. In many cases, the type of device used for inhaled medications must be modified to fit the patient’s changing needs and abilities.

## Summary

Sustained bronchodilator therapy for moderate to severe COPD (GOLD grades 2 and 3), has been shown to have clinical benefits on long-term symptom control and quality of life, with possible benefits on disease progression and longevity.<sup>2–6,8,57</sup> The importance of correct inhaler device use in achieving optimum disease management in COPD cannot be overemphasized. Understanding the practical aspects of

inhaler use, including device selection, correct inhalation techniques, and adherence is key to the early and successful management of patients with COPD in the primary care setting.<sup>69</sup> Successful COPD management will be achieved by improving device selection based on individual patients’ needs, together with patient education, training, high-quality physician–patient communication, and regular monitoring.

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