

## Original Research

# Identification of inhaler technique errors with a routine procedure in Portuguese community pharmacy

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### Abstract

**Background:** A correct selection of drugs prescribed, but also the choice of the appropriate inhaler device, is crucial for the control of respiratory diseases.

**Objective:** To evaluate the inhaler technique and identify potential errors of patients when treated with inhalers by testing a routine procedure to be implemented in any community pharmacy.

**Methods:** Adults with asthma/COPD and under inhalation therapy were invited to demonstrate how they use their inhalers. After direct observation it was registered whether all the sequential steps included in the summary of product characteristics (SmPC) were performed.

**Results:** The study involved 67 patients from 4 community pharmacies (Portugal central region): 34 (50.7%) males, 65.4 (SD=18.28) years old, 42 (62.7%) with COPD, and 23 (34.3%) using more than one inhaler. The 67 patients used 95 inhalers, comprising: 57 (60.0%) multiple dose DPI (dry powder inhalers), 18 (18.9%) single dose DPI, 16 (16.8%) pMDI (pressurized metered dose inhalers), 2 (2.1%) pMDI+spacer and 2 (2.1%) SMI (soft mist inhalers). No errors were made only by 9 (13.4%) patients. In the 75 DPIs techniques, the most frequent errors were 'no previous forced expiration' (46=61.3%) and 'no 10s apnea after inhalation' (51=68.0%); in the 16 pMDIs techniques common errors were 'lack of hand-lung coordination' (7=43.8%), 'no previous forced exhalation' (8=50.0%) and 'no apnea after inhalation' (10=62.5%). After inhaling from 56 devices containing corticosteroids, 34 (60.7%) of the patients did not wash their mouth.

**Conclusion:** The study demonstrated the possibility of performing this procedure routinely in Portuguese community pharmacies and also its utility, since 58 (87%) of patients had at least one error during the inhalers use.

### Keywords

Asthma; Pulmonary Disease, Chronic Obstructive; Nebulizers and Vaporizers; Pharmacies; Pharmacists; Patient Education as Topic; Quality Assurance, Health Care; Portugal

## INTRODUCTION

Inhaled therapy is currently recognized as the first choice in the pharmacological treatment of respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD).<sup>1</sup> In fact, the inhalatory route allows the use of lower doses of drugs, a faster onset of action, and less side effects than the systemic (oral or intravenous) administration by placing the drug directly into airways and lungs.<sup>2-4</sup> Corticosteroids and bronchodilators can be delivered by a wide variety of devices currently on the market, which can be classified into pressurized metered dose inhalers (pMDI), dry powder inhalers (DPI) and soft mist inhalers (SMI).

The deposition of the inhaled drug in the lung is dependent on particle size, inhalation technique, and type of inhaler device used. The complex interaction among these factors results in the need for different inhalation techniques for each type of inhaler.<sup>3</sup> It is crucial to ensure that the choice

of the inhaler is adjusted to each patient.<sup>1,4</sup> For example, patients using pMDIs need to coordinate the activation of the device and the inspiratory effort, inhaling slowly and deeply; however, the DPIs only require a fast inspiratory flow rate. The association of a spacer to pMDIs allows the patient to perform multiple inhalations at tidal volume without the need for prior forced expiration and apnea after inhalation, and the synchronization problem with pMDIs disappears.<sup>4</sup>

Therefore, in addition to the appropriate choice of pharmacological therapy, it will be essential for a good control of respiratory diseases, to correctly use the inhaler devices. Only by ensuring adequate lung deposition of drug particles, it will be possible to maximize the benefits of treatment and to minimize potential adverse effects.<sup>3</sup> However, incorrect use of inhalers remains an obstacle in the management of respiratory disorders.<sup>5</sup> A systematic review of the literature confirmed that a large number of patients make errors in the use of their inhalers, this number may reach 94% of users, depending on the type of inhaler and on the evaluation method used.<sup>6</sup>

International guidelines recommend the optimization of the inhaled therapy follow-up of patients by healthcare professionals by means of a periodic review of the inhalation technique.<sup>3,4</sup> In fact, when an inhaled therapy is prescribed for the first time, teaching the patient how to use the device correctly is advised. However, much of the information may get lost during the complicated hospital discharge or in the first medical consultation when the

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		n (%)
Gender	Male	34 (50.7)
	Female	33 (49.3)
Age (years)	18-24	3 (4.5)
	25-44	8 (11.9)
	45-64	14 (20.9)
	65-74	17 (25.4)
	75 and over	25 (37.3)
Disease	Asthma	25 (37.3)
	COPD	42 (62.7)
Number of inhalers	1	44 (65.7)
	2	19 (28.4)
	3	3 (4.5)
	4	1 (1.5)
Types of inhaler	1	47 (70.1)
	2	18 (26.9)
	3	2 (3.0)
COPD - Chronic Obstructive Pulmonary Disease.		

	n (%)
pMDI	16 (16.8%)
pMDI-spacer	2 (2.1%)
SMI	2 (2.1%)
DPI	
Aerolizer*	6 (6.3%)
Breezhaler*	8 (8.4%)
Handihaler*	4 (4.2%)
Diskus*	32 (33.7%)
Ellipta*	2 (2.1%)
Genuair*	2 (2.1%)
Novolizer*	1 (1.1%)
Spiromax*	1 (1.1%)
Turbohaler*	19 (20.0%)
DPI - Dry Powder Inhaler; pMDI - pressurized Metered Dose Inhaler; SMI - Soft Mist Inhaler	

patient was diagnosed and prescribed.<sup>7</sup> Several studies show that patients often display incorrect inhalation techniques just a few days after being taught them.<sup>6</sup>

Community pharmacists are in an excellent position to continuously educate patients on the use of inhalers. A patient's first visit to the pharmacy represents the time for the patient to independently learn how to manage the inhaler, so the educational intervention at this moment is highly important.<sup>8,9</sup> Many studies have been published focusing on the incorrect use of inhaler devices<sup>6</sup>, but few refer to the possibility of such assessments to be done routinely in a community pharmacy.<sup>8,10,11</sup> To our knowledge, nothing has been published in Portugal in this area. Thus, the aim of this study was to evaluate the inhaler technique and identify potential errors of patients treated with inhalers, by testing a routine procedure to be implemented in community pharmacies.

## METHODS

The study was approved by the Ethics Committee of Coimbra University (EC-017/2014). The study took place between 1<sup>st</sup> February and 31<sup>th</sup> May 2015 in four pharmacies in the Central Region of Portugal. Advertisement posters were displayed in participant pharmacies to inform respiratory disease patients of the need for a periodic review of their inhalation technique. Portuguese speaking patients with asthma or COPD, and with instituted inhaled therapy, were invited to participate when they came to pick their prescriptions or when they asked about the posters. Exclusion criteria included a) younger than 18 years patients, b) inhaled therapy first time users, c) inhalers used for respiratory disorders other than asthma or COPD, and d) any obvious signs of cognitive impairment. All individuals who showed interest and who fulfilled the inclusion criteria signed a consent form to participate in the study.

The study consisted of asking participants to demonstrate how they normally used their inhalers. In a private

counselling room, participants were asked to perform the inhalation technique with their own inhaler(s) or with an identical device containing placebo. Specific checklists for each type of device were prepared with information obtained from inhalers' official summaries of product characteristics (SmPCs). When several medicines with identical device existed, the information contained in their SmPCs was compiled and a unique checklist was created for all of them. Each checklist comprised a series of steps that should be sequentially executed. A community pharmacist member of the research team, specifically trained in the use of these checklists, recorded if the patient correctly performed each of the steps included in the checklists.

Descriptive statistics with absolute and relative frequencies of errors identified for each of the steps in each checklist were performed. Percentage of errors per technique was calculated taking into consideration the number of steps required for each device.

## RESULTS

The study involved a total of 67 patients whose characteristics are presented in Table 1. Patients aged between 18 and 93 years old. It was counted more than an inhaler in 23 (34.3%) patients and more than one type of inhaler in 20 (87.0%) of these patients. In total 95 inhalation techniques were evaluated: 57 (60.0%) with multiple dose DPI, 18 (18.9%) with single dose DPI, 16 (16.8%) with pMDI, 2 (2.1%) with pMDI with a spacer and 2 (2.1%) with SMI (Table 2). In the 95 inhalation techniques evaluated, 17 (17.9%) involved relief medication (12 (12.6%) with pMDI, 2 (2.1%) with spacer in combination with a pMDI and 3 (3.2%) with Turbohaler DPI (also called Turbuhaler in other countries). Each evaluation procedure took between 5 and 10 minutes

Table 3 shows the errors identified for the different categories of inhaler devices (DPIs, pMDIs and SMI) in the total evaluated inhalation techniques. No errors were made by 9 (13.4%) patients. It was also found that in 34 of the 56 (60.7%) inhalation techniques in which there was administration of corticosteroids, patients did not wash the oral cavity after inhalation, as recommended with this type of drug.

Table 3. Errors identified in all inhalation techniques (n=95).

Error (n (%))	DPI (n=75)	pMDI (n=16)	pMDI-spacer (n=2)	SMI (n=2)
Failure to pierce capsule (n=18)	3 (16.7%)	-	-	-
Error in dose activation with multiple dose DPI (n=57)	8 (14.0%)	-	-	-
Not breathing out gently away before inhalation	46 (61.3%)	8 (50.0%)	-	1 (50.0%)
Inhalation too slow	25 (33.3%)	-	-	-
Not holding breath for about 10 seconds after inhalation	51 (68.0%)	10 (62.5%)	-	2 (100.0%)
Not replacing the cap after inhalation (n=57)	2 (3.5%)	-	-	-
Not shaking the device before inhalation	-	6 (37.5%)	0 (0.0%)	-
Failure to make tight seal with lips	-	3 (18.8%)	-	-
Failure to synchronize inhalation with device actuation	-	7 (43.8%)	-	-
Not use mask or mouthpiece well adapted	-	-	0 (0.0%)	-
Not perform 10 inhalations in tidal volume	-	-	0 (0.0%)	-
Not properly rotating the transparent base with SMI	-	-	-	1 (50.0%)
Not pressing the dose release button with SMI	-	-	-	1 (50.0%)
No errors	13 (17.3%)	1 (6.3%)	2 (100.0%)	0 (0.0%)

DPI - Dry Powder Inhaler; pMDI - pressurized Metered Dose Inhaler; SMI - Soft Mist Inhaler.

## DISCUSSION

The results obtained in this study reveal that not only it is possible to use a routine procedure in Portuguese community pharmacies to check the inhalation techniques performed by patients but is also advisable, since 87% of participants had at least one error in the execution of their inhalation technique. Several studies have demonstrated the added value of the community pharmacist intervention in respiratory diseases, particularly among asthmatic patients. The published studies refer complex interventions focused either on knowledge regarding the disease and beliefs about medication or on the use of such medication and treatment adherence, evaluating repercussions in terms of clinical, economic and humanistic outcomes.<sup>12-17</sup>

Considering that incorrect inhalation technique is often the main obstacle to successfully treat patients with asthma or COPD<sup>6,7,18</sup>, our study sought to test a service to assess the inhalation technique in patients using inhaler devices, and the feasibility to be implemented in the routine of a Portuguese community pharmacy. Each intervention took between 5 and 10 minutes, proving to be compatible with the daily commitments of dispensing in a community pharmacy. This fact had already been approached by Basheti *et al.* in Australian pharmacies with assistance of about 2.5 min/patient<sup>8</sup>, by Hämmerlein *et al.* in community German pharmacies with assistance from about 15 min/patient<sup>10</sup>, and by García-Cárdenas *et al.* in Spanish community pharmacies.<sup>9</sup> Extending this service to all community pharmacies in Portugal would facilitate overcoming the incorrect use of inhalers, increasing the chances of a correct control of respiratory diseases. Additionally, this simple procedure would also allow periodic patient monitor over the time, preventing possible deviations resulting from the routine use and loose of attention with the device.<sup>4</sup> According to Asthma<sup>19</sup> or COPD<sup>20</sup> international guidelines, before modifying the prescription of pharmacological therapy the inhalation technique should be assessed and eventual errors corrected.

Community pharmacist could be an ideal professional to perform this assessment in a routinary basis. Since 2005 Denmark is an example of the implementation of an inhaler technique assessment in community pharmacies, officially funded, the "Inhaler Technique Assessment Service (ITAS)". However Kae & Sporrang recently explored the reasons why users join or not to this service, and they found that

the vast majority of users do not feel the need for this service and will adhere only if persuaded to do so.<sup>21</sup> Interestingly, the literature reveals that between 50% and 80% or more of patients had at least one error in their inhalation technique<sup>8-11,18</sup>, which was higher in our study (87%). Further studies should focus on assessing the reasons why patients do not sufficiently value these services and what should pharmacists do to improve their acceptance.

The use of any inhaler involves performing a series of steps correctly and in the proper order. If the patient makes errors, the amount of drug that reaches his lungs will be significantly reduced and thus he will be unable to control his respiratory disorder.<sup>6,8</sup> In the present study, pMDIs were associated with a higher percentage of errors than DPIs (26.6% and 18.2%, respectively, taking into account both the number of inhalation techniques carried out and the number of steps of each one). An observational study to evaluate the inhalation technique in patients with asthma and COPD performed by Arora *et al.* in New Delhi also found that 82.3% of 300 patients included in the study made errors, and 94.3% and 82.3% of patients with pMDI and DPIs, respectively, held at least one error.<sup>18</sup> These results are the consequence of the most predictable difficulty in the use of pMDIs, which requires a good ability of hand-lung coordination, compared to the use of DPIs, not requiring this ability of coordination by the patient.<sup>6,22,23</sup>

García-Cárdenas *et al.* specifically explored the Turbohaler device in a Spanish population of asthma patients and found that 47.0% of patients using Turbohaler did not exhale before inhalation and 42.5% did not hold their breath then for 8 seconds.<sup>9</sup> The errors in our study are coincident with these and are common to all types of devices, namely, not exhaling to residual lung capacity before inhalation (73.3% - 55/75) and not suspending breathing for 10 seconds after inhalation (84.0%). These errors are also referred as the most common by Lavorini *et al.* on a systematic review of the topic.<sup>6</sup> In a study by Hämmerlein *et al.* involving 597 patients at 55 community pharmacies in Germany, the most common error detected, albeit at a lower percentage, was not to suspend breath for 5-10 seconds after inhalation (35.8%).<sup>10</sup> However the results obtained in our study – nearly 70% for not breath holding after inhalation – may be overstated because an

apnea period of 10 seconds was considered, instead of 5-10 seconds.<sup>9,10</sup>

In the present study, 61.1% of patients receiving inhaled corticosteroids did not wash their mouth after inhalation as recommended in order to avoid the deposition of the corticosteroid at the level of the oropharynx with consequent risk of adverse effects such as candidiasis, cough or dysphonia.<sup>4</sup> In the study of García-Cárdenas *et al.* 42.8% of patients did not rinse their mouths with water after inhalation.<sup>9</sup>

Another error often detected was inhaling with an inappropriate speed for the type of device. Thus, contrary to what is desirable, in our study there was a rapid inhalation with pMDIs in 42.9% of patients and a slow inhalation with DPIs in 34.7% of patients. García-Cárdenas *et al.* reported that 21.5% of 367 asthma patients involved in a study evaluating the inhalation technique with Turbohaler did not inhale quickly and vigorously as recommended.<sup>9</sup> In turn, Hämmerlein *et al.* recorded an inhalational flow inadequate in only 17.8% of patients.<sup>10</sup>

Though the present study has focused only on the possibility of implementing a routine procedure for evaluation and possible correction of the inhalation technique in users of Portuguese community pharmacies, some studies demonstrated the added value of pharmacists' intervention on the quality of inhalation technique, confirming the need for reevaluation and reeducation of patients about their inhalation technique regularly over the course of therapy.<sup>7,8,10</sup> These services are not currently reimbursed in Portugal, but studies like the present might open the room for claiming for payment.

The main limitation of the study was the small number of participants (n=67), resulting from the short time of the study and the involvement of only 4 pharmacies. Another limitation was the restriction to a small geographic area, in the Center of Portugal region, which prevents generalization of the results to the rest of the country.

## CONCLUSIONS

This study tested a routine procedure for verification of the inhalation techniques performed by patients in real life in Portuguese community pharmacies. The study allowed the rapid identification of errors in order to its immediate correction. The results confirm that it is feasible to use this routine procedure in a community pharmacy, but also that is a necessary procedure because 87% of participants exhibited at least one error in the execution of their inhalation technique. Participation of the community pharmacists should not be limited to identifying the inhalation technique errors, but to educate the patient to correct them. Future studies should assess the efficacy of the pharmacists in this goal.

## CONFLICT OF INTEREST

None.

## FUNDING

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