

## Brief Communication

### A cross-sectional observational study to assess inhaler technique in Saudi hospitalized patients with asthma and chronic obstructive pulmonary disease

*Maha Al Ammari, MSC, MPH,  
Khizra Sultana, B. Pharm, M. Clin. Pharm,  
Faisal Yunus, MBBS, MPH,  
Mohammed Al Ghobain, MD, MPH,  
Shatha M. Al Halwan, B. Pharm.*

#### ABSTRACT

**Objectives:** To assess the proportion of critical errors committed while demonstrating the inhaler technique in hospitalized patients diagnosed with asthma and chronic obstructive pulmonary disease (COPD).

**Methods:** This cross-sectional observational study was conducted in 47 asthmatic and COPD patients using inhaler devices. The study took place at King Abdulaziz Medical City, Riyadh, Saudi Arabia between September and December 2013. Two pharmacists independently assessed inhaler technique with a validated checklist.

**Results:** Seventy percent of patients made at least one critical error while demonstrating their inhaler technique, and the mean number of critical errors per patient was 1.6. Most patients used metered dose inhaler (MDI), and 73% of MDI users and 92% of dry powder inhaler users committed at least one critical error.

**Conclusion:** Inhaler technique in hospitalized Saudi patients was inadequate. Health care professionals should understand the importance of reassessing and educating patients on a regular basis for inhaler technique, recommend the use of a spacer when needed, and regularly assess and update their own inhaler technique skills.

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**B**ronchial asthma (BA) and chronic obstructive pulmonary disease (COPD) have been recognized as a worldwide challenge, placing a burden on patients and their families.<sup>1,2</sup> They have a major effect on morbidity and mortality and thereby decrease quality of life and increase health care costs.<sup>3-5</sup> It has been

reported that approximately 300 million people suffer from asthma globally, and this number is predicted to increase by 100 million by 2025.<sup>1</sup> In the Kingdom of Saudi Arabia (KSA), it has been estimated that 24% of the population suffers from asthma, and 2.4% from COPD.<sup>6</sup>

The most common route for treating BA and COPD is by using inhaled medications. Correct inhaler technique requires 7-12 steps performed in sequence, according to the various checklists developed.<sup>7-10</sup> Some of the steps are defined as critical; as their incorrect execution would lead to little or no deposition of the inhaled medication reaching the airways and lungs (namely, incorrect performance of these steps is a critical error). Improper inhaler technique and non-adherence to treatment lead to an uncontrolled disease state, side effects, and disease exacerbation leading to readmission to hospital, all contributing to increased health care costs.<sup>3-5</sup> Various studies were carried out around the world and performed in different settings such as hospital, primary care clinics, and community pharmacies have reported critical errors in the inhaler technique by patients.<sup>3,8,10,11</sup> It has been reported that 90% of patients who use the inhaler device make errors while using them.<sup>12</sup>

Three studies were reported regarding inadequate inhaler technique in KSA. They were conducted among asthma patient attending primary care clinics,<sup>5</sup> COPD patients attending outpatient clinics using metered dose inhalers (MDIs),<sup>7</sup> and asthmatics treated with inhaled corticosteroids for at least 3 months, who were admitted to the emergency room with current use of an MDIs.<sup>9</sup> None of these studies were carried out in hospitalized patients and none of them reported the proportion of critical errors committed during inhaler technique. There is insufficient information regarding the critical errors committed while using the MDIs and dry powder inhalers (DPIs) in the hospitalized Saudi population. The aim of the present study was to assess the proportion of critical errors committed during demonstrating inhaler technique by hospitalized patients with BA and COPD.

**Methods.** This cross-sectional observational study was conducted among adults (>18 years) in Saudi

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hospitalized patients with BA or COPD at King Abdulaziz Medical City (KAMC), Riyadh, Saudi Arabia between September and December 2013. We recruited a total of 47 patients. Demented, bedridden, and patients with tracheostomy or dependent on caregiver were excluded. The study was approved by the Institutional Review Board (IRB), King Abdullah International Medical Research Center (KAIMRC), and conducted according to the principles of the Declaration of Helsinki. The patients were asked to demonstrate their inhaler technique, and those with an incorrect technique were provided with feedback and guidance by the pharmacists (including verbal instructions and demonstration of correct technique) only when they had finished demonstrating their technique with each of the inhaler types that they used. Two independent pharmacists, who had received training in the correct use of inhalers, performed consecutive patient evaluations using a checklist adapted from Batterink et al<sup>8</sup> (Figure 1).

**Statistical analysis.** Statistical analyses were performed using the Statistical Packages for Social Sciences Version 19.0 (IBM Corp, Armonk, NY, USA). Continuous data are expressed as mean ± standard deviation (SD), and descriptive data are expressed as percentages. Logistic regression was used to analyze predictors of critical errors. All statistical assessments were 2-tailed, and the level of significance was set at  $p < 0.05$ . Overall agreement and Cohen's kappa  $> 0.6$  represents good inter-rater reliability of the checklists.

**Results.** During the study period, a total of 111 patients were  $> 18$  years admitted under medical wards with the diagnosis of BA and COPD. Of these, 47 met the eligibility criteria. Of the 64 patients who were excluded, 50 (78%) were dependent on a caregiver, 7 (10%) were tracheostomy patients, 5 (7%) refused to participate, and 2 were younger than 18 years. The demographic and clinical characteristics of the enrolled patients are summarized in Table 1.

Forty patients (70%) committed at least one critical error while demonstrating their inhaler technique. The mean number of critical errors per patient was 1.6. Thirty patients (75%) who were using MDIs committed critical errors, and only 10 (25%) demonstrated the correct technique. In patients using MDI with spacer, 3 (100%) committed at least one critical error. For DPI, at least one critical error was committed by 9 patients (5 using turbuhaler, one using handihaler, and one using diskus), and 2 patients had the correct technique. There was statistically significant good agreement between the 2 observers for MDI checklist with Cohen's kappa value of 0.80 ( $p < 0.001$ ) and handihaler with Kappa value of 0.63 ( $p < 0.05$ ).

**Figure 1** - Checklist for the correct technique for each of 5 inhaler devices.

<p><b>MDI</b></p> <ol style="list-style-type: none"> <li>1. *Remove cap</li> <li>2. *Shake well</li> <li>3. Breathe out normally</li> <li>4. Keep head upright or slightly tilted</li> <li>5. Seal lips around mouthpiece</li> <li>6. *Inhale slowly, actuating once during first half of inhalation</li> <li>7. *Continue slow and deep inhalation</li> <li>8. Hold breath for 5 or more seconds</li> </ol>
<p><b>MDI with spacer</b></p> <ol style="list-style-type: none"> <li>1. *Remove caps</li> <li>2. *Shake MDI well</li> <li>3. Insert MDI into spacer</li> <li>4. Breathe out normally</li> <li>5. Seal lips around mouthpiece</li> <li>6. *Actuate MDI</li> <li>7. *Inhale slowly and deeply</li> <li>8. Hold breath for 5 or more seconds</li> </ol>
<p><b>Diskus</b></p> <ol style="list-style-type: none"> <li>1. *Open to expose mouthpiece</li> <li>2. *Slide lever until click heard</li> <li>3. *Keep level throughout</li> <li>4. Breathe out normally and away from inhaler</li> <li>5. Seal lips around mouthpiece</li> <li>6. *Inhale forcefully and deeply</li> <li>7. Hold breath for 5 or more seconds</li> <li>8. Exhale but not through inhaler</li> </ol>
<p><b>Turbuhaler</b></p> <ol style="list-style-type: none"> <li>1. *Hold upright without occluding air vents</li> <li>2. *Turn colored wheel one way, then back</li> <li>3. Breathe out normally and away from mouthpiece</li> <li>4. Seal lips around mouthpiece without occluding air vents</li> <li>5. *Inhale forcefully and deeply</li> <li>6. Hold breath for at least 5 seconds</li> <li>7. *Exhale but not through inhaler</li> </ol>
<p><b>HandiHaler</b></p> <ol style="list-style-type: none"> <li>1. *Open lid and mouthpiece</li> <li>2. *Place capsule in chamber</li> <li>3. Close mouthpiece, ensuring click is heard</li> <li>4. *Holding inhaler upright, press blue button fully</li> <li>5. Breathe out normally and away from inhaler</li> <li>6. Seal lips around the mouthpiece</li> <li>7. Inhale forcefully and deeply so that capsule vibrates</li> <li>8. Hold breath for 5 or more seconds</li> <li>9. *Repeat steps 6-8</li> </ol>
<p>MDI - metered dose inhaler, *steps that are critical, incorrect performance of which would lead to little or no medication reaching the lungs. Republished Copyright permission from: Batterink J, Dahri K, Aulakh A, Rempel C, Can J. Evaluation of the use of inhaled medications by hospital inpatients with chronic obstructive pulmonary disease. Hospital Pharmacy 2012; 65(2): 111-118.</p>

Table 2 highlights the types of critical error most commonly encountered for the various inhalation devices. For the MDI, which was the most commonly-used inhaler, the proportion of patients who incorrectly performed critical step 2 (shake the device well before use) was 41%, step 6 (namely, they did not inhale slowly while actuating the device once during the first half of

the inhalation) was 71%, and step 7 (did not continue slow and deep inhalation) was 66%. The critical errors made by the patients using MDIs were cross-tabulated against other demographic and clinical characteristics, and no statistically significant associations were detected. No significant associations were detected for number of critical errors versus age (odds ratio [OR]: -0.96; 95% confidence interval [CI]: 0.90-1.02;  $p=0.271$ ), number of critical errors versus gender (OR: 1.97; 95% CI: 0.29-13.35;  $p=0.487$ ), number of critical errors versus BA (OR: -6.13; 95% CI: 0.54-69.44;  $p=0.142$ ).

**Discussion.** In the literature, there is a lack of agreement on the checklists used for inhaler technique for different inhalers and type of critical errors. Hence, we used the checklist created by Batternick et al<sup>8</sup> for the purpose of this study. In the present study, 70% of

patients made at least one critical error, which is much higher than the study carried out by Batternick et al<sup>8</sup> in hospitalized patients, where 59% committed one or more critical errors, but smaller than a study carried out in outpatient clinics<sup>11</sup> where 92.4% of the patients had committed at least one critical error. A study which was conducted in the community pharmacy,<sup>10</sup> 47.5% of patients made at least one critical error. Another study<sup>3</sup> carried out in the chest clinics in Italy reported 12% of patients committed at least one critical error. We evaluated patients whose pulmonary condition had been exacerbated; hence, it is more likely that they used their

**Table 1** - Demographic characteristics of the study participants admitted with the diagnosis of bronchial asthma (N=47).

Characteristics	n (%)
Age (years) $\pm$ SD	58.4 $\pm$ 17.9
<b>Gender</b>	
Male	24 (51.1)
Female	23 (48.9)
<b>Current smokers</b>	
Patient educational level	4 (8.5)
Illiterate or basic reading and writing	23 (48.9)
Completed primary school	12 (25.5)
Completed high school	5 (10.6)
Completed College or above	7 (15.0)
<b>Pulmonary diseases in the patients</b>	
Bronchial asthma	29 (61.7)
COPD	18 (38.3)
<b>Comorbidities</b>	
Cardiovascular	15 (31.9)
Diabetes	22 (46.8)
Renal	5 (10.6)
Others	7 (14.9)
<b>Number of inhalers used by each patient</b>	
One (of any type)	37 (78.7)
More than one	10 (21.3)
<b>Types of inhalers used</b>	
MDI	32 (68.1)
MDI with spacer	2 (4.3)
Turbuhaler	4 (8.5)
MDI and turbuhaler	4 (8.5)
MDI and handihaler	3 (6.4)
MDI with spacer and handihaler	1 (2.1)
MDI with diskus	1 (2.1)

COPD - chronic obstructive pulmonary disease,  
MDI - metered dose inhaler

**Table 2** - Types of critical errors committed while using inhalational devices among inpatients with bronchial asthma and chronic obstructive pulmonary disease.

Inhalers (number using the device)	Type of critical errors	Patients committing the error n (%)
MDI (n=41)	Step 1 - Remove cap	0
	Step 2 - Shake well	17 (41)
	Step 6 - Inhale slowly, actuating once during first half of inhalation	29 (71)
	Step 7 - Continue slow and deep inhalation	27 (66)
MDI with spacer (n=3)	Step 1 - Remove caps	0
	Step 2 - Shake MDI well	3 (100)
	Step 5 - Seal lips around mouth piece	1 (33)
	Step 6 - Actuate MDI	1 (33)
Turbuhaler (n=8)	Step 1 - Hold upright without occluding air vents	1 (13)
	Step 2 - Turn colored wheel one way, then back	1 (13)
	Step 5 - Inhale forcefully and deeply	3 (38)
	Step 7 - Exhale but not through inhaler	3 (38)
Handihaler (n=4)	Step 1 - Open lid and mouthpiece	0
	Step 2 - Place capsule in chamber	0
	Step 4 - Holding inhaler upright, press blue button fully	1 (25)
	Step 9 - Repeat steps 6-8	1 (25)
Diskus (n=1)	Step 1 - Open to expose mouthpiece	0
	Step 2 - Slide lever until click heard	0
	Step 3 - Keep level throughout	0
	Step 6 - Inhale forcefully and deeply	1 (100)

MDI - metered dose inhaler

inhalers incorrectly compared with the previous studies performed from the outpatient population.<sup>3,7,10,11</sup> Most hospital patients were using the MDI and at least one critical error was committed by 73% of patients, which was comparatively low in comparison with the previous study,<sup>8</sup> where 93% of hospital patients using MDI committed at least one critical error. In outpatient clinics, 94.2% of patients using MDI and 53% of patients in the community pharmacy setting committed at least one critical error.<sup>10,11</sup> In our study, most patients were using the MDI and we concentrated on the incorrect performance of critical steps in this device. Forty-one percent of patients using MDI did not perform step 2 correctly (namely, shake the device well before use), which was similar to the results of Souza et al,<sup>11</sup> where 41.8% of patients performed step 2 incorrectly. In previous studies,<sup>8,10</sup> step 2 was incorrectly performed by 37% and 30% of the patients. In addition, 71% of patients in our study incorrectly performed step 6 (namely, inhale slowly, actuating once during first half of the inhalation), a common problem that has been identified in previous studies.<sup>3,7,8,10</sup> The most common reason for this problem has been reported as patients' lack of understanding, as a result of not having been shown the correct inhalation technique by their health care professionals.<sup>8</sup> We observed that step 7 (continue slow and deep inhalation) was incorrectly performed in 66% of our inpatients as compared with the study of Batternick et al,<sup>8</sup> where 70% of inpatients performed this incorrectly. In another 2 studies, 29%<sup>3</sup> and 5%<sup>10</sup> of patients did not perform step 7 correctly.

In Saudi Arabia, the inhaler device that is prescribed to the patient is generally determined by the physician. An interesting finding of the present study is that the number of patients who used a spacer with their MDI device was small, which is also similar to the results of other studies<sup>7,10,11</sup> (use of a spacer with MDI devices eliminates the need for coordination, required for actuation and inhalation, in Step 6).

One or more critical errors in the inhaler technique results in 50% increase in the course of corticosteroids, hospital admissions, or emergency visits.<sup>12</sup> Treatment failure in patients who suffer from asthma or COPD occurs as a result of incorrect use of inhaled medications due to lack of counseling, inadequate counseling, educational strategies not suited to the learning styles of the patients, poor vision of patients, and the quality of instructions given. The lack of educational support may be due to various factors, including the fact that health care professionals (HCP's) themselves are not always adequately trained in providing instruction on inhaler technique.<sup>12</sup> A study in Saudi Arabia on

patients with asthma found that 45% of patients did not use their device properly, 40% had not received education on how to use the inhaler, and only 6-7% had been educated by a certified asthma educator or a pharmacist.<sup>5</sup> Another study<sup>13</sup> carried out in Saudi Arabia to assess the inhaler technique skill of HCP's showed that most of them did not have skill in using an MDI and spacer device. Pharmacists are usually the patients last point of contact with the health care system before discharge. They have an important role to play in ensuring that patients are using their inhalers correctly. However, it has been reported that many pharmacists and respiratory therapists lack the skills required to demonstrate correct inhaler technique.<sup>13</sup> In support of greater efforts to improve this situation, the PHARMACOP (effectiveness of pharmaceutical care for patients with chronic obstructive pulmonary disease) trial demonstrated that pharmacist care programs improve inhaler technique and medication adherence.<sup>14</sup> The cost-effect analysis of the PHARMACOP trial<sup>15</sup> showed a saving of €227 per patient per year and decreased 0.07 hospital treated exacerbations per patient for the first 3 months as compared with the usual care.

One of the strengths of the present study is that evaluations were performed by 2 pharmacists, with good overall concordance. The limitation is the small number of patients from a single hospital due to which potential associations could not be explored between inhaler misuse and various sociodemographic characteristics. Additionally, we were unable to establish whether the patients had previously been educated on inhaler technique (and if so, by whom), or to ascertain the type and quality of any instruction they may have received. Determining the financial cost, in terms of wasted medication due to inhaler misuse, was beyond the scope of the present study as there is a lack of a system in the hospital to receive, and determine the cost of returned or wasted medications. Future studies that address these aspects may help to highlight the economic cost and health burden due to misuse of inhaler devices by inpatients in Saudi Arabia.

In conclusions, the results of our study clearly demonstrate that the inhaler technique among the inpatients admitted due to exacerbation of BA and COPD in our hospital is unsatisfactory. Health care professionals should understand that the importance of reassessing and educating patients on a regular basis is crucial for effective management of their disease. Additionally, HCP's should also reassess their own knowledge and skills at regular intervals, so that they can provide effective instruction on correct inhaler technique. We recommend that patients receive



education on inhaler technique upon admission, and re-education on the day of discharge. Furthermore, their technique should be reassessed at each clinic visit, according to the published recommendations. The importance of correct inhaler technique is emphasized to patient's education on the use of an MDI with a spacer should also be provided.

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From the Pharmaceutical Care Services (Ammari, Al Halwan) King Abdulaziz Medical City, the King Abdullah International Medical Research Centre (Sultana), the Department of Epidemiology and Biostatistics (Yunus), College of Public Health and Health Informatics, the Department of Pulmonology (Al Ghobain), College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Kingdom of Saudi Arabia. Address correspondence and reprints request to: Dr. Maha Al Ammari, Clinical Pharmacist, Pharmaceutical Care Services King Abdulaziz Medical City, Riyadh, Kingdom of Saudi Arabia. E-mail: ammarima@ngha.med.sa

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