# Assessment of inhalation technique among patients of chronic respiratory disorders in Civil Hospital Karachi: A cross sectional study

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## Abstract

**Objective:** To evaluate the inhaler technique of patients and the awareness acquired during pulmonary teachings given in the beginning of the treatment.

**Methods:** This cross-sectional study was conducted at Civil Hospital, Karachi, from December 2013 to July 2014, and comprised patients diagnosed with obstructive broncho-pulmonary diseases and who were using inhaler therapy. A questionnaire was designed to assess the technique by an inhaler technique checklist, which was pilot-tested and was filled after obtaining verbal consent. SPSS 19 was used for data analysis.

**Results:** Of the 202 participants, 110(54.45%) were women and 92(45.54%) were men. Moreover, 168(83.2%) used metered-dose inhaler while 34(16.8%) used dry-powder inhaler. Besides, 134(79.8%) patients showed incorrect technique while using metered-dose inhaler while 22(61.1%) used dry-powder inhaler improperly.

**Conclusion:** In spite of the guidelines given, improper inhalation technique persisted in population leading to uncontrolled asthma and poor treatment compliance.

**Keywords:** Inhalers, Inhalation technique, Asthma. (JPMA 66: 1502; 2016)

## Introduction

Inhalation therapy is the preferred route of treatment for chronic broncho-pulmonary diseases such as asthma and chronic obstructive pulmonary disease (COPD), both associated with a high morbidity and mortality worldwide. The direct inhalation of medication to the site of disease process offers localised delivery of a high concentration of drugs to the lungs with minimal systemic adverse effects and rapid onset of action on a lower drug dose. The deposition pattern of inhaled drug is determined by multiple factors including the device used, aerosol formulation, particle size, use of a spacer, especially with metered-dose inhalers (MDI) and the patient's inhalation technique.[1] Press-and-breathe MDIs and dry-powder inhalers (DPIs) are the most commonly used delivery devices for administering aerosolised drugs. MDIs are practical, cheap, convenient and highly reproducible but their efficient drug delivery is highly technique dependent. On the other hand, DPIs are portable, effective and easy to use because they are breath-activated[2] but their ideal use is undermined by common errors of inhalation technique. Misuse of inhalers and improper inhalation technique have been commonly observed in clinical practice and is associated with increased inhaler use, decreased bronchodilation, reduced patient's adherence to the treatment regimen and poor drug delivery and disease control.[3,4]

The present study was planned to evaluate the inhalation technique of outpatients to assess the common errors performed during the inhalation technique and to discuss insinuations for maximum clinical benefit of inhaler use.

## Patients and Methods

This cross-sectional, observational study was conducted among patients presenting at the outpatient department (OPD) of Civil Hospital, Karachi, from December 2013 to July 2014. The sample size was calculated using 95% confidence interval (CI) and 5% margin of error, and a response distribution of 85% as per prevalence cited in literature.[5] The patients were inducted using convenient sampling.

Approval was obtained from the Ethical Review Board (ERB) of the Dow University of Health Sciences (DUHS), Karachi. Informed consent was obtained from all participants, and confidentiality of patients' data was ensured.

Patients diagnosed with obstructive broncho-pulmonary diseases and using inhaler therapy were included. New patients and those who had received education on

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inhaler use during the preceding week were excluded as well as those who were using two or more inhaler devices.

The patients were approached at the study site. Each participant was initially judged for eligibility criteria and then a written informed consent was taken. The self-generated questionnaire was filled using interview-based method. Data was collected in approximately 20 minutes per patient. Patients were classified as using DPI versus MDI inhaler devices based on self-reported data. Inhalation technique was assessed by asking participants to demonstrate how they use their inhaler and cross-checked with the validated standardised checklist specific to each device (Table-1).[6-9]

SPSS 19 was used for data analysis. Continuous variables were presented as mean ± standard deviation (SD) and categorical variables were presented as a percentage.

## Results

Of the 202 participants, 110(54.45%) were women and 92(45.54%) were men. The overall mean age was53±16 years (range: 30 to 65 years). Moreover, 172(85.1%) patients suffering from bronchial asthma were literate and 30(14.9%) were illiterate. Besides, 24(11.8%) patients had been using inhalers for less than one month, 56(27.25%) for 1-12 months, 84(41.2%) for 1-10 years and 40(19.6%) for above 10 years (Table-2).

Furthermore, 168(83.2%) used MDI, mostly Albuterol (Ventolin) and Fluticasone/Salmetrol (Seretide), while 34(16.8%) patients used DPI as their inhaler. Of the subjects using MDI, 52(31%) attached spacer with it and 116(69%) used MDI without spacer. Moreover, 134(79.8%) of the patients showed incorrect technique while using MDI. Of those using MDI with spacer, 42(80.8%) patients were using the wrong method whereas 92(79.3%) were incorrectly using MDI alone. Besides, 22(61.1%) of the DPI users were employing the wrong method.

Of those who were using MDI without spacer, 70(60.3%) were not exhaling before using the inhaler while 50(43.1%) were not holding their breath for 10 seconds after using the inhaler (Table-3).

Of those using MDI with an attached spacer, 24(46.2%) patients were forgetting to shake the MDI before usage

**Table-2:** Demographics of the study participants.

| | |
|---|---|
| Age (years) | 53 ± 16 |
| **Gender:** | **n(%)** |
| Male | 92(45.5%) |
| Female | 110(54.5%) |
| **Education:** | |
| Illiterate | 30(14.9%) |
| Primary | 6(3%) |
| Secondary | 18(8.9%) |
| Matric | 68(33.7%) |
| Graduate | 56(22.7%) |
| Post-Graduate | 24(11.9%) |
| **Timeframe of usage of inhalers:** | |
| < 1 month | 24(11.8%) |
| >1 month - <12 months | 56(27.5%) |
| >1 year - <10 years | 84(41.2%) |
| >10 years | 40(19.6%) |
| **Disease:** | |
| Bronchial asthma | |
| Chronic obstructive pulmonary disease | |

**Table-1:** Steps evaluated in demonstrating the use of meter dose inhaler (MDI) and dry powdered inhaler (DPI).[6-9]

| Correct steps of inhalation technique MDI | Correct steps of inhalation technique DPI |
|---|---|
| Remove mouthpiece cap | Remove or turn cover |
| Shake inhaler (suspensions only) | Correctly insert capsule |
| Breathe out before firing | Pierce capsule |
| Inhaler upright during firing | Load dose |
| One inhalation for actuation | Hold inhaler upright |
| Place mouthpiece between lips and over tongue | Breathe out the device mouthpiece |
| Actuation in the first half of inhalation | Inhale deeply and quickly |
| Fire while breathing in deeply and slowly and continue until total lung capacity | Inhale by mouth |
| Inhalation by mouth | Place mouthpiece between lips |
| Hold breath for 10 seconds | Forceful and deep inhalation |
| Tilt the head back. | Breathe out the device mouthpiece |
| Exhale to residual volume | Exhale to residual volume |
| Breathe out through the nose. | Breath-hold |
| Use one puff. | Control if capsule is broken and does not contain residual powder |
| Wait 30 seconds before administering another puff. | |

MDI: metered-dose inhaler
DPI: dry-powder inhaler.

**Table-3:** Errors observed in prevalent practices of patients using MDI without spacer.

| Checklist of inhalation techniques error | N(%) |
|---|---|
| Patients not shaking MDI before usage | 24 (20.7%) |
| Patients not exhaling before placing inhaler in mouth | 70 (60.3%) |
| Patients not inhaling the MDI properly and deeply after pressing the canister | 48 (41.4%) |
| Patients not holding breath for 10secs | 50 (43.1%) |
| Patients using 2 puffs at the same time and not stopping to take a time interval in between | 28 (24.1%) |

**Table-4:** Errors observed in prevalent practices of patients using MDI with spacer.

| Checklist of inhalation techniques error | N (%) |
|---|---|
| Patients not shaking the MDI before usage | 24 (46.2%) |
| Patients failing to tightly close their mouth around the mouthpiece | 4(7.7%) |
| Patients not exhaling before usage | 22(42.3%) |
| Patients failing to inhale in deeply through spacer | 14(26.9%) |
| Patient not holding breath for 10seconds | 22(42.3%) |
| Patients using 2 puffs at the same time and not stopping to take a time interval in between | 22 (42.3%) |

**Table-5:** Errors observed in prevalent practices of patients using revolizer.

| Checklist of inhalation techniques error | N (%) |
|---|---|
| Patients not putting the tablet in the device correctly | 6(16.7%) |
| Patients not exhaling before usage | 18(50%) |
| Patients not inhaling the drug properly and failing to hold breath after usage | 4(11.1%) |

and 22(42.3%) were not exhaling before usage (Table-4).

Among patients using DPI, 18(52.94%) did not exhale before usage, 6(17.65%) did not put the tablet in the device correctly and 4(11.76%) did not inhale the drug properly and failed to hold their breath after usage (Table-5).

## Discussion

Inhalers are considered as the mainstay treatment for different chronic respiratory disease conditions worldwide. Previous researches have shown that asthma is poorly controlled if there is improper technique of using the inhaler.[10] In our study, we have tried to assess the technique used by patients in our set-up and to enlighten the measures to be taken to maximise drug delivery by using proper technique. Another factor which can lead to improper use of inhalers is patient's poor knowledge regarding their disease.

In the current study, first few questions in the questionnaire demonstrated demographics and patient's literacy level was also assessed as it can contribute to patient's lack of understanding. The majority of patients, i.e. 84(41.2%), had been using an inhaler for10 years while the average use of inhaler was 2 years as a whole. The overall result enunciated that regardless of the type of inhaler used, wrong treatment is significantly associated with older population (aged 50 years or above). A research indicated that medical conditions like arthritis, impaired vision and weakness can contribute to poor inhalation technique in the elderly population.[11]

In our study, out of 202 participants, 168(83.2%) used MDI, mainly Ventolin and Seretide, while 34(16.8%) used DPI. The use of spacer is very important as Keeley et al. stated in their research that MDI with spacer, deposits at least 30% more drugs in lungs.[12] Unfortunately, our result demonstrated that of all patients using MDI, only 52(31%) attached spacer with it. We divided patients with respect to MDI users and DPI users and the results revealed that 79.8% were using MDI incorrectly. Of all the DPI users, 61.1% were using improper technique. Similarly, a study conducted in Nigeria demonstrated that 77.8% participants used pressurised metered-dose inhaler (pMDI) incorrectly while 62.7% used Revolizer incorrectly.[13]

Studies have shown some common mistakes while using MDI, such as incorrect position of inhaler, not exhaling prior to inhalation, failure to hold breath after inhalation and failure to inhale forcefully and deeply.[14] In our study, the results are consistent with previous findings. In the result, we first indicated the errors done by patients using MDI without spacer. Shaking the MDI before use is included in standard protocol to deliver a therapeutic dose.[15] In our study, about 24(20.7%) patients did not shake MDI before use. A similar study in Brazil demonstrated that 21% patients did not shake MDI prior to use. It is important to correct patient's technique as missing this step reduces dose delivery by up to 36% making the proper education of inhaler use to patients mandatory.[16] Exhaling prior to placing inhaler in mouth is also very important as experts recommend as that clears the lungs allowing the patient to breathe deeply while drug is being inhaled.[17] In our study, about 70(60.3%) patients failed to exhale before placing inhaler in the mouth, making it the most common error in this study. This is consistent with a study conducted at the University of Texas where failure to exhale was also found to be the most common missed step as about 66% patients failed to do so.[18] According to studies, slow and deep inhalation is the most important aspect of inhalation.[19] The most common error in a research conducted in Nigeria was unable to trigger inhaler while breathing deeply and discontinuing inhalation before lungs are completely

filled.[13] Likewise in our study, unfortunately 48(41.4%) patients failed to perform this step.

To ensure proper drug delivery while using inhalers, it is important to hold the breath for 10 seconds as rapid triggers can decrease the dose delivery.[15] A study demonstrated that about 26% of patients failed to hold their breath for the time required for effective drug delivery. However, in our study, a total of 22(42.3%) patients failed to perform this technique. This can contribute to the increased numbers of cases of uncontrolled asthma in our set-up. It is essential to take gap of about 30-60 seconds between two doses as it allows the inhaled medication to be effective and relax the airway.[20] About 28(24.1%) patients in our study, while taking more than one puff, didn't have a gap for at least 1 minute. However, a study in Saudi Arabia stated that 80% of their participants missed this step.[21] This error of failing to take a gap between two consecutive doses was found more significantly in the age group of 50 years and younger which was found to be statistically significant.

The result of assessment of technique demonstrated by patients using MDI with spacer also revealed some errors. But the percentages indicated that patients using inhaler device with spacer made less mistakes in their inhalation technique as compared to patients using MDI without any spacer. In our study, most commonly missed step was failure to shake MDI before usage, noted in 24(46.2%) participants. Likewise, a research indicated that 31.7% of patients did not shake MDI prior to use.[22] This is followed by two other common errors comprising of not exhaling prior to actuation and failure to hold breathe for 10 seconds after inhalation. Both of these steps were missed by 22(42.3%) patients in our study. In contrast, another study in Saudi Arabia stated that both of these steps were missed by 77% participants.[21] It is recommended as a basic step to take deep and slow breaths, around 3-5 seconds for each breath, to ensure proper drug delivery while inhalation.[23] In our study, around 14(26.9%) patients missed this step. In contrast, a similar research stated that around 72% participants failed to inhale deeply.[24] Another important step for delivering effective dose is to seal lips tightly around the device. A study regarding inhaler competence in asthma defined this as one of the commonly missed steps in assessment of inhaler technique[25] but not in our research, as only 4(7.7%) patients failed to perform this step. Furthermore, 22(42.3%) patients did not take a time interval between two puffs, which is not satisfactory as the significance of this crucial step is defined above.

When the techniques of usage of DPI were assessed, we observed some missed steps. In our study, the most common error was failure to exhale prior to inhaler usage, observed in about 18(50%) of patients. This result coincides with a similar study in India in which exhalation prior to inhalation was the most common error observed.[26] This result points out the importance of explanation of proper technique to patients in their first visit. Another error demonstrated by patients is their inability to put tablet in the device correctly, but fortunately the percentage was not very alarming as only 6(16.7%) patients were unable to do so. This is similar to another study conducted in India where only some of their participants failed to place the drug properly in the device.[27] In our study, failure to inhale drug properly and not holding breath after usage of DPI was the least common error observed, only in about 4(11.1%) patients. The same errors were observed in a similar research.[27]

On the basis of our findings, it is recommended that measures should be taken to improve patients' basic knowledge and technical skills in the first visit. Apart from leaflets comprising current guidelines demonstrating complete steps of usage of different type of inhalers, verbal guidance in small groups or video tutorials should also be provided.[28] When prescribing MDI for the first time, it is important to determine the patients preference, as it can be a valuable guide to asses patients compliance and acceptance with the prescribed device.[29] Furthermore, there should be follow-up checks on inhaler technique to ensure the performance of patients.

## Conclusion

Despite the wide use of inhalers, different errors were observed while using MDI and DPI. The majority of patients made multiple mistakes and consequently they didn't find the treatment to be beneficial in case of a severe attack.

**Disclaimer:** None.

**Conflict of Interest:** None.

**Source of Funding:** None.

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