

SIXTY YEARS AFTER INHALATIONAL DEVICES- WHERE DO WE STAND?

Jayasri Helen Gali¹, Mohammed Nehad Khar², Aruna Kumari Badam³, Harsha V Varma⁴, Jameel Unnissa Begum⁵

¹Associate Professor, Department of Pulmonology, Apollo Institute of Medical Sciences and Research, Hyderabad.

²MBBS Student, Apollo Institute of Medical Sciences and Research, Hyderabad.

³Assistant Professor, Department of Pulmonology, Apollo Institute of Medical Sciences and Research, Hyderabad.

⁴Senior Resident, Department of Pulmonology, Apollo Institute of Medical Sciences and Research, Hyderabad.

⁵Junior Resident, Department of Pulmonology, Apollo Institute of Medical Sciences and Research, Hyderabad.

ABSTRACT

BACKGROUND

Bronchial asthma and chronic obstructive pulmonary disease are the Common Respiratory Diseases (CRD's). Drugs delivered through inhaler devices are the backbone for treatment of CRD's. Inhaler technique errors are common even after more than 60 years of introduction of these devices.

The aim of the study is to explore the faulty inhaler techniques among patients with asthma and chronic obstructive pulmonary diseases. Health education has significant impact on improving the inhaler technique thereby achieving better disease control and also brings out regularity of inhaler usage by patients.

MATERIALS AND METHODS

All the relevant information including patients profile and usage of inhalers was collected by a prepared questionnaire from 242 patients with asthma or COPD attending our OPD. The patient's inhaler technique was assessed using a standard checklist for proper use of a Metered-Dose Inhaler (MDI) or Dry Powder Inhaler (DPI). All the participants were asked to demonstrate their inhaler technique, which was assessed and documented. Education was given to all patients about the correct inhalational method and they were also counseled to adhere to it. Inhaler technique was reassessed in all the patients after a month and reinforcement of the correct technique was done.

Statistical Analysis- Using the chi-square test, P-values of each variable like age, gender, education, duration of illness, etc. were derived. P value of less than 0.05 was considered significant.

Settings and Design- This is a cross-sectional study with an interventional component done on 242 patients with bronchial asthma or COPD attending the pulmonology OPD in Apollo Institute of Medical Sciences and Research.

RESULTS

Out of 242 patients studied on baseline evaluation in the first visit, only 46 patients (19.008%) were able to do the technique correctly, which after education on the correct inhaler technique increased to 134 patients (55.37%) in the follow up visit done after a month.

CONCLUSION

Errors in inhaler technique still persist in patients with chronic respiratory diseases and the best way to counter this is by effective patient and physician education.

KEYWORDS

Inhaler Technique, Inhaler Devices, Bronchial Asthma, COPD, Health Education.

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BACKGROUND

Bronchial asthma and Chronic Obstructive Pulmonary Disease (COPD) are the two major Chronic Respiratory Diseases (CRDs). Worldwide, approximately 300 million have

asthma and 10% of the adult population over the age of 40 years may have COPD.¹ Prevalence of bronchial asthma and COPD in India is 2.05%² and 3.7%,³ respectively. There are about 4,89,000 deaths attributable to asthma annually² and COPD causes about 5,00,000 deaths per year in India.³

The mainstay of treatment for these CRDs is drugs (bronchodilators and steroids) given through inhaler devices. Various inhaler devices like Pressurised Metered-Dose Inhaler (pMDI), Breath Actuated Metered-Dose Inhalers (baMDI), Dry Powder Inhaler (DPI) and nebulisers are commonly used for this purpose. The selection of inhaler is generally based on availability, cost, ease of use, portability, patients and physicians preference.^{4,5} Drug delivery systems demand a certain level of physical skill, manipulation, dexterity, hand strength, lung capacity and hand-lung

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Corresponding Author:

Dr. Aruna Kumari Badam,

Assistant Professor, Department of Pulmonology,

Apollo Institute of Medical Sciences and Research,

Apollo Health City Campus,

Jubilee Hills, Hyderabad-500096.

E-mail: badamarunakumari@gmail.com

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coordination in order to ensure correct inhaler use.⁶ Different inhaler devices must be used in specific ways for optimum delivery of drug to the airways, which needs specific instructions to be given by the prescribing physicians to the patients.

The first therapeutic handy aerosol devices were developed in the 1950s, which were the MDIs.^{7,8} Subsequently, in the 1990s, DPIs were developed.⁷ Despite long time since development, more than 60 years, inhaler technique errors continue to be common among respiratory patients thus reducing the benefits of inhaled medications.⁹ Problems with inhaler techniques were recognised shortly after the launch of pMDIs in the 1960s and reviews show that incorrect inhaler technique is unacceptably frequent and has not improved over the past 40 years.¹⁰ Furthermore, incorrect technique has been reported in up to 94% of patients^{4,8,11-13} and poor technique was estimated to be prevalent in an average of 50% of cases.¹⁴

The main advantages of inhaler devices over oral tablets for chronic respiratory diseases include lower dose, rapid onset of action, desired local action and no gastric or systemic adverse drug reactions.¹⁵ The pMDI is compact, portable and convenient, which explains its widespread acceptance.¹⁶ DPIs are flow-dependant devices and require minimal patient device coordination.¹⁷

Despite their advantages over oral tablets and easy use, inhaler devices have their own limitations. MDIs are difficult to use, have a high rate of incorrect handling (7-71%) and require patient device coordination.¹⁷ In some cases, steps can be confused between devices, resulting in severe reductions in drug available to the patients.¹⁸ Studies have shown that with incorrect technique drug delivery to the distal airways is affected, which prevents drug deposition on the respiratory epithelium.^{6,9,19} Poor inhaler technique with inhaled corticosteroids and bronchodilators results in loss of their effect, increased reliever use and worsening asthma.²⁰

Patients are unable to use them properly due to the lack of knowledge and education on proper inhalational techniques. Studies have shown that education improves the inhaler technique.

The education on the use of inhaler devices is given by the Healthcare Professionals (HCPs) who typically lack the appropriate knowledge and skills in using different inhaler devices. Prescribers often have not much time to educate the patients regarding proper methods of use and cleaning the devices.²⁰ It is pivotal that HCPs extend their role beyond prescription of the inhaler devices to educating the patients about the proper inhalational methods and also understanding the patients difficulties in using the inhaler. The Global Initiative for Asthma and the Global Initiative for Chronic Obstructive Lung Disease, both recommend that inhaler technique should be regularly assessed at each clinic visit, since it is known that failure to control symptoms of CRDs due to incorrect technique causes more frequent unscheduled clinic visits, more emergency department visits and more hospital admissions.

There is very limited information available on patient's handling the inhalers in a tertiary care hospital, which

motivated us to undertake this study. The purpose of our study was to highlight the inhaler technique errors in the Indian group of patients, study the various determinants of inhaler technique and bring out the impact of health education on inhaler technique of patients. Identifying the common faulty steps would serve as a guide to effectively educate the patients for optimal control of the disease. The experimental design of our study was to collect the sociodemographic data in a questionnaire with details about the inhaler technique. Health education was the intervention done with subsequent follow up.

The significance of our study lies in the fact that management of chronic airway diseases is 10% medication and 90% education. It is mandatory to identify the common faulty steps, the patient's technique and to assess this technique before increasing or decreasing the dose or changing the device. With the proper inhalational method, delivery of the drug to the lungs is ensured, which is essential for the good control of the disease thereby improving the quality of life in patients. Also, correct technique results in decreased frequency of exacerbations with minimal load on the emergency medical services and reduces the number of hospital admissions, which lowers the cost of healthcare. It is crucial to utilise the existing healthcare resources efficiently in an already taxed healthcare system in a developing country like India. Morbidity and mortality associated with CRDs will also be reduced with correct inhalational methods.

AIMS AND OBJECTIVES

1. To explore the faulty inhalational techniques predominantly among patients with asthma and Chronic Obstructive Pulmonary Disease (COPD).
2. To study the effect of various patient and device determinants on the inhaler technique.
3. To emphasise the role of health education to minimise the errors in inhaler technique.
4. To bring out the regularity of inhaler usage by patients and emphasise on the various reasons for the irregular use of these devices.

MATERIALS AND METHODS

The institutional ethical committee approval was obtained before the commencement of the study. The study design was cross-sectional with an interventional component focusing on health education. Desired sample was 257, but 15 patients were excluded as they could not complete the follow up evaluation and thus a sample of 242 was taken for the study.

The study population included patients from outpatient clinics of Pulmonology Department belonging to the age group of 15-75 years attending Apollo General Hospital and Apollo Health City, Hyderabad. This study was conducted over a period of three months from June to August 2016. Patients were enrolled in the study based on the following inclusion and exclusion criteria, which are as follows.

Inclusion Criteria

1. Asthmatics- 15-75 years.
2. COPD patients- 40-75 years.

Exclusion Criteria

1. Age less than 15 years and more than 75 years.
2. Patients using spacer devices and other devices (Turbohaler/Diskhaler/baMDIs, etc.).
3. During acute exacerbation of asthma or COPD.
4. Patients with concomitant infections.
5. Mentally challenged patients.

The primary interest of the study was to assess the device usage in terms of proper inhaler technique. The bio-data (name, age, gender, occupation, education level) and details about the inhaler usage and technique (type of inhaler, duration of usage, regularity of usage, trained and prescribed by) were taken in a questionnaire designed for the study.

The patient's inhaler technique was assessed using a standardised checklist for proper use of a Metered-Dose Inhaler (MDI) and Dry Powder Inhaler (DPI). The participants were asked to demonstrate their inhaler technique, which was followed by assessment and documentation of every step done by the patient.

All patients were educated by face-to-face demonstration of the proper inhalational method. The patients were asked to repeat the demonstration given to them were counseled to adhere to the proper method. Patients were followed up after one month, the inhaler technique was re-checked, errors were identified and documented and re-enforcement of the correct technique was done.

Verbal informed consent was taken from all the patients. The data collected from the questionnaire was analysed and results were presented using absolute figures and

percentages. The chi-square test of significance was used for all statistical analysis.

Checklist of Steps of MDI Usage, which was Assessed in Our Study¹⁸

1. Remove cap.
2. Shake inhaler.
3. Hold upright.
4. Breathe out completely.
5. Make a proper seal between lips and the mouthpiece.
6. Trigger the MDI and keep breathing slowly and deeply till lungs are full.
7. Hold breath for 10 seconds.
8. Exhale slowly.
9. If necessary, repeat after 10 seconds.
10. Replace cap.

Checklist of Steps of DPI Usage, which was Assessed in our Study

1. Remove cap/assemble the parts of the device as required.
2. Place the capsule in the device chamber, press piercing button if needed.
3. Rotate the mouthpiece till it clicks.
4. Breathe out completely.
5. Make a good seal between lips and the mouthpiece.
6. Breathe in rapidly so that the capsule vibrates and continue to breathe in till lungs are full.
7. Hold breath and remove inhaler.
8. Exhale slowly.
9. Repeat steps 6, 7 and 8 till the drug is delivered.
10. Replace cap.

Study Questionnaire

Name	
Age	
Gender	
Occupation	
Education level	
Contact number	
Diagnosis	
Duration of illness	
Any recent exacerbation/hospitalisation	
History of any other medical conditions (hypertension/diabetes mellitus/epilepsy/hypothyroidism)	
Inhaler prescribed-MDI/DPI	
Inhaler usage- regular/irregular If irregular-reasons for irregular use	
Have you read the information leaflet, understood it and followed instructions?	
Duration of inhaler usage	
Trained and prescribed by-pulmonologist/general physician/others (pharmacists, nurse)	
Prior inhaler technique instructions- Not explained and not demonstrated/explained verbally only/explained verbally and demonstrated	

OBSERVATIONS AND RESULTS

Among the 257 patients observed, 15 were excluded because they could not complete the follow up. Hence, the sample size was 242 of which 124 (51.24%) were males and 118 (48.76%) were females. The mean age of the patients was 47.28 years.

In terms of literacy, 7.02% (n=17) were either graduates or postgraduates, 15.29% (n=37) were educated till intermediate level (10+2), 30.58% (n=74) were educated till tenth grade and 47.11% (n=114) were illiterates.

Total patients of bronchial asthma and COPD were 200 (82.64%) and 42 (17.36%), respectively and the mean duration of illness in patients was 6.663 years. The mean duration of inhaler usage was 51.49 months (4.29 years). Less than half of patients (n=93, 38.43%) had an exacerbation of at least more than a month back and co-morbidities

(hypertension/diabetes/epilepsy/hypothyroidism) were present in 26.45% (n=64) of patients.

Most patients were on a MDI (n=183, 75.61%) and the remaining were on a DPI device (n=59, 24.38%).

About 54.55% (n=132) used the inhaler on a regular basis as advised by the prescribing person and 45.45% (n=110) used the inhaler irregularly. The reasons for irregularity were high cost of the inhaler (n=47, 42.72%), symptom relief (n=30, 27.27%), no relief from symptoms (n=23, 20.9%) and the remaining (n=10, 9.09%) considered the inhaler as a social taboo (leads to addiction or infertility) or were not advised to take the inhaler regularly. A very low percentage of patients reported as having read the inhaler package instruction leaflet (n=57, 23.55%).

Majority of patients (n=187, 77.27%) were trained and prescribed by a pulmonologist and the remaining by general physicians (n=42, 17.36%) or others like pharmacists/nurses (n=13, 5.37%). More than half of

patients reported that they were given a physical demonstration and a verbal explanation (n=143, 59.09%) on usage of the inhaler device by the prescribing person and the remaining were either given a verbal explanation only (n=73, 30.17%) or had not received any instructions at all (n=26, 10.74%). In the first visit to the hospital, we found that only 46 patients (19.008%) were able to do the technique correctly and 196 patients (80.992%) made at least one error.

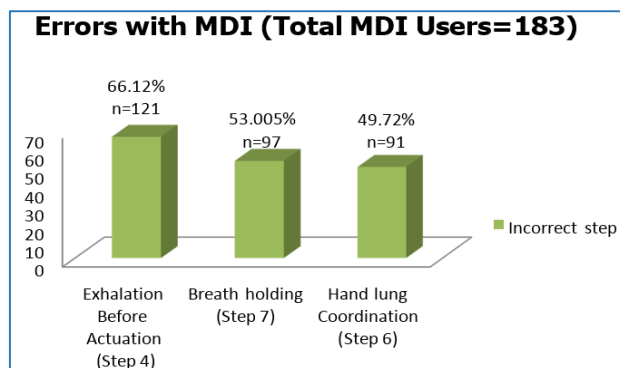


Figure 1. Errors with MDI

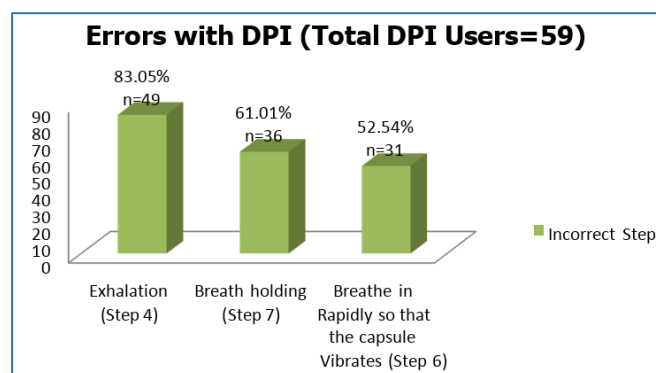


Figure 2. Errors with DPI

MDI		DPI	
Error	%	Error	%
Multiple actuations	37.62	Breaking the capsule before placing in the device chamber	2.67
Swallowing the medicine after actuation	18.04		
Actuation away from mouth with mouth open	3.09		

Table 1. Other Errors

We also observed that 31.34% of DPI patients did not maintain their device properly.

Using the chi-square test, P-values of each variable like age, gender, education, diagnosis, duration of illness, recent exacerbation, co-morbidities, inhaler type, regularity of inhaler usage, reading the inhaler package insert, duration of inhaler usage, person who trained and prescribed, prior inhaler technique instructions were derived. A p value of less than 0.05 was considered significant.

According to this, the trainer and the prescribing person (pulmonologist/general physician/others pharmacists, nurse) (p=0.0038) and prior inhaler technique instructions (p=0.0012) were significantly associated with the overall inhaler technique of the patients. Regularity of usage of inhaler was near significant (p=0.05). No significant association was found with other variables and the inhaler technique.

Variable	Technique		p-value
Age	Correct	Incorrect	
15-40 (n=87)	18 (20.68%)	69 (79.32%)	0.42
41-60 (n=109)	17 (15.59%)	92 (84.41%)	
61-75 (n=46)	11 (23.91%)	35 (76.09%)	
Gender			
Males (n=124)	18 (14.51%)	106 (85.49%)	0.06
Females (n=118)	28 (23.72%)	90 (76.28%)	
Education Level			
Illiterate (n=114)	17 (14.91%)	97 (85.09%)	0.44
High school (Tenth grade) (n=74)	17 (22.97%)	57 (77.03%)	
Intermediate (n=37)	9 (24.32%)	28 (75.68%)	
Graduate or post graduate (n=17)	3 (17.64%)	14 (82.36%)	
Diagnosis			
Bronchial asthma (n=200)	37 (18.5%)	163 (81.5%)	0.65
COPD (n=42)	9 (21.42%)	33 (78.58%)	
Duration of Illness			
<1 year (n=24)	1 (4.16%)	23 (95.84%)	0.19
>1 year to <3 years (n=66)	11 (16.66%)	55 (83.34%)	
>3 years to <6 years (n=64)	17 (26.56%)	47 (73.44%)	
>6 years to <9 years (n=29)	6 (20.68%)	23 (79.32%)	
>9 years (n=59)	11 (18.64%)	48 (81.36%)	
Any Recent Exacerbation			
Yes (n=93)	17 (18.27%)	76 (81.73%)	0.82
No (n=149)	29 (19.46%)	120 (80.54%)	
Co-Morbidities			
Yes (n=64)	11 (17.18%)	53 (82.82%)	0.66
No (n=178)	35 (19.66%)	143 (80.34%)	
Inhaler Type			
MDI (n=183)	30 (16.39%)	153 (83.61%)	0.06
DPI (n=59)	16 (27.11%)	43 (72.89%)	
Inhaler Usage			
Regular (n=132)	31 (23.48%)	101 (76.51%)	0.05
Irregular (n=110)	15 (13.63%)	95 (86.36%)	
Reading Information Leaflet			
Yes (n=57)	14 (24.56%)	43 (75.44%)	0.22
No (n=185)	32 (17.29%)	153 (82.71%)	
Duration of Inhaler Usage			
<1 year (n=53)	6 (11.32%)	47 (88.68%)	0.22
>1 year to <3 years (n=89)	18 (20.22%)	71 (79.78%)	
>3 years to <6 years (n=44)	9 (20.45%)	35 (79.55%)	
>6 years to <9 years (n=20)	7 (35%)	13 (65%)	
>9 years (n=36)	6 (16.66%)	30 (83.34%)	
Trained and Prescribed by			
Pulmonologist (n=187)	44 (23.5%)	143 (76.5%)	0.0038***
General physician (n=42)	1 (2.38%)	41 (97.62%)	
Others (pharmacists/nurse) (n=13)	1 (7.69%)	12 (92.31%)	
Prior Inhaler Technique Instructions			
Not explained and not demonstrated (n=26)	1 (3.84%)	25 (96.16%)	0.0012***
Explained verbally only (n=73)	7 (9.58%)	66 (90.42%)	
Explained verbally and physically demonstrated (n=143)	38 (26.57%)	105 (73.43%)	

Table 2. Comparison of Inhaler Technique with Characteristics of Patients and Details About the Inhaler

Significant Associations Found

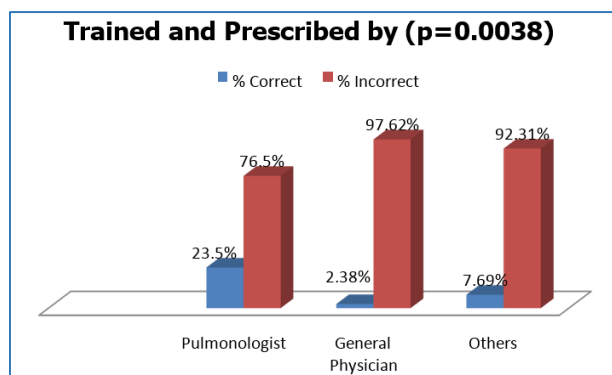


Figure 3. (Others-Pharmacists/Nurses)

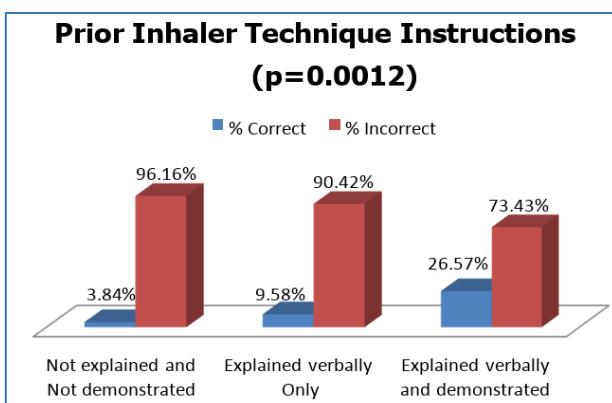


Figure 4. Prior Inhaler Technique Instructions

Education and face-to-face demonstration on the correct inhaler technique was given to all the patients in the first visit. Patients were asked to demonstrate the technique and were counseled to adhere to it. Patients were instructed to come back after a month and the inhaler technique was re-checked. Chi-square test was done to derive the P-value to know the significance of the outcome. In the follow up visit, a total of 134 patients did the technique correctly and 108 patients did at least one step wrong.

We observed that there was significant improvement in number of patients doing the technique correctly from 19.008% in the first visit to 55.37% in the follow up visit.

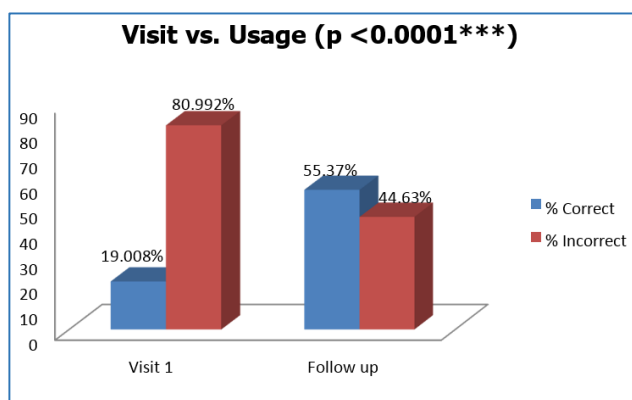


Figure 5. Visit vs. Usage

Improvement in Asthmatics (n=200)				P-value
First Visit		Follow up Visit		Less than 0.0001***
Correct	Incorrect	Correct	Incorrect	
37 (18.5%)	163 (81.5%)	111 (55.5%)	89 (44.5%)	

Table 3. Improvement in Technique in Asthmatics

Improvement in COPD Patients (n=42)				P-value
First visit		Follow up visit		0.0017***
Correct	Incorrect	Correct	Incorrect	
9 (21.42%)	33 (78.58%)	23 (54.76%)	19 (45.24%)	

Table 4. Improvement in Technique in COPD Patients

Improvement in the Technique as per the Diagnosis and the Inhaler Used

Improvement in Asthmatics on MDI (n=154)				P-value
First Visit		Follow up Visit		Less than 0.0001***
Correct	Incorrect	Correct	Incorrect	
25 (16.23%)	129 (83.77%)	83 (53.89%)	71 (46.11%)	

Table 5. Bronchial Asthma Patients Using MDI

Improvement in COPD patients on MDI (n=29)				P-value
First visit		Follow up visit		0.0232**
Correct	Incorrect	Correct	Incorrect	
5 (17.24%)	24 (82.76%)	13 (44.82%)	16 (55.18%)	

Table 6. COPD patients using MDI

Improvement in Asthmatics on DPI (n=46)				P-value
First Visit		Follow up Visit		0.0008**
Correct	Incorrect	Correct	Incorrect	
12 (26.08%)	34 (73.92%)	28 (60.86%)	18 (39.14%)	

Table 7. Bronchial Asthma Patients using DPI

Improvement in COPD patients on DPI (n=13)				P-value
First Visit		Follow up Visit		0.0183**
Correct	Incorrect	Correct	Incorrect	
4 (30.76%)	9 (69.24%)	10 (76.92%)	3 (23.08%)	

Table 8. COPD Patients using DPI

DISCUSSION

This study conducted in Apollo General Hospital and Apollo Health City, Hyderabad, showed that on baseline evaluation only 19.008% patients were able to handle their inhalers correctly, which significantly increased to 55.37% during the follow up visit. This explains that patients on inhalers perform better after having been taught the correct technique. Studies have previously documented an improvement in number of patients who handle their

inhalers correctly after an intervention. Even though, there was significant improvement between the first and the follow-up visit, not all the patients were correct in their technique.

No association was found between age or gender and the correct technique, which was also documented by research done in the past.^{11,19} However, some studies have shown that correct technique is influenced by gender and that older age group was more prone for errors.¹³

Our study showed that education level of patients was not associated with correct inhaler technique, but it is not wrong to consider that literacy of patients influences the inhaler technique though it was statistically insignificant in our study. There are varying results in different studies regarding the level of education and the inhaler technique. Some studies have shown that literacy rate of patients is not associated with the correct technique,^{11,19} whereas other studies have shown that education level does have an impact on the inhaler technique.^{4,7,13}

There was also no significant difference in the technique between asthmatics and the COPD patients, which could be because the number of COPD patients (n=42) when compared to asthmatics (n=200) were less in our study. The improvement in asthmatics in the follow up visit was found to be more significant when compared to the COPD patients. Few studies have mentioned that the diagnosis of the disease does not have an impact on the inhaler technique, but it was found in a study done in Jordan¹⁷ that COPD patients were more predisposed for errors because of their higher age and associated co-morbidities.

There was no significant association between the inhalation technique and a history of exacerbation in the past. This can be related to the minimal improvement in the patient's technique for a short duration after an exacerbation probably due to frequent interaction with the healthcare providers that would eventually wane over time without regular follow up visits. However, more studies are needed to substantiate this association.

The type of inhaler (MDI/DPI) was not a significant determinant of the inhaler technique in our study. Few studies have shown that the type of inhaler was associated with the inhaler technique.²⁰ We saw that MDI users made more errors (83.61%) when compared to DPI users (72.89%) in the first visit. This finding has been previously documented in other studies comparing different inhalers. The improvement in the technique for DPI was also better than the MDI in the follow up visit for both asthma and COPD patients. This may be due to the less complexity of steps involved with the breath actuated DPIs¹¹ or the fact that the MDI is inherently difficult to use as a greater motor coordination is required regardless of the quality of instruction given.¹⁷

The most common error by patients in our study for both MDI and DPI was failure to exhale before actuation, which correlates with research done in the past. Some studies have shown that steps like shake the inhaler, hold the device upright. Hand-lung coordination were the most common errors done by the MDI users. The most common errors with

the DPI in our study were failure to exhale before inhalation, breath-holding and breathing in rapidly when capsule was vibrating. These were also found to be the most common errors in other studies.¹² It is known that an important factor for the correct use of the DPI is generation of forceful and deep inhalation,¹² which most of our patients failed to do.

We observed multiple actuations in 37.62% of patients; a similar finding was recorded in a study done in Jaipur, Rajasthan.¹⁹ Patients must be educated that multiple actuations do not provide any extra benefit as the drug is not carried due to inadequate pressure build-up within the device.¹⁹ Patients might resort to multiple actuations assuming that the disease control would be better.

The association between regularity of usage of the inhaler and the inhaler technique was near significant ($p=0.05$), which was a new finding in our study. We saw that out of all the regular users 23.48% had a correct technique and out of all the irregular users 13.63% had a correct technique. The reason could be that a patient who uses the inhaler regularly tends to come for regular follow up visits and also takes the advice given by the treating physician diligently.

There was no association found between duration of device usage and the inhaler technique as seen in a previous study. This can be attributed to the lack of frequent doctor-patient interaction, infrequent follow up visits and the nature of education given, which greatly influence the inhaler technique regardless of the duration of device usage. Only 16.66% of patients with duration of device usage more than nine years had a correct technique. An Indian study¹³ found that the number of errors increased in patients who have been using their inhaler for more than two years and they attributed this fact to overconfidence of patients towards the use of their device. Another Indian study in Rajasthan¹⁹ showed that patients using the device for more than one year had a significantly better technique, which could be due to an improvement in the level of understanding of the technique because of interaction of the patient with multiple healthcare professionals over the year.

We observed that patients who were trained and prescribed by a pulmonologist performed better with their devices when compared to patients who received the same by general physicians or others (pharmacists, nurses). This can be explained by the fact that pulmonologists have better understanding and knowledge about the inhaler devices and their techniques. At the same time, it cannot be certified that all pulmonologists are well versed with the inhaler technique as 76.5% of patients trained and prescribed by a pulmonologist in our study made at least one error. This finding is much greater than a study showing that 32.4% of patients who were trained by a chest diseases specialist either showed incorrect or false use. Also, 80.34% of patients who were trained and prescribed by doctors (both pulmonologists and general physicians) made at least one error.

We found that only 19.66% of patients who had received training and education from doctors (both pulmonologists and general physicians) had the correct technique. Our

finding is supported by another study where only 21% patients who received training from the doctors had the correct technique. This can be explained due to lack of regular follow up visits, doctors themselves lacking knowledge, the specialists not spending enough time to educate their patients and/or the patient making new errors overtime.

A study in Nigeria¹⁸ had shown that none of the patients trained by the nurses or the pharmacists had the correct technique. In our study, we found that 7.69% of patients trained by pharmacists and nurses were correct in their technique. This calls for a need to train and educate the other important group of the healthcare staff comprising the nurses and the pharmacists.

The proportion of errors in our study was more for patients who had not received a physical demonstration at the time of prescription when compared to those who had been given a demonstration. This finding correlates with a study, which showed that patients who received appropriate instructions in the past were more likely to be correct. This is because certain steps in the inhaler usage like exhalation before actuation, breath-holding, hand-lung coordination require a demonstration, which the patient has to comprehend and execute simultaneously rather than a mere verbal explanation.

Around 73.43% of patients who had received a verbal explanation and a physical demonstration in the past made at least one error. This indicated that even though patients received a demonstration on correct usage of the device in the past their technique was lacking, which could potentially decrease the efficacy of the inhaled drug. It has been stated by research in the past that healthcare professionals do not have the adequate knowledge to educate their patients on the correct technique. Thus, it is important to not only train and educate the patients, but also the healthcare staff to decrease the percentage of errors.

It is the role of the prescribing person to educate their patients on correct inhaler technique and make sure that this technique is being maintained overtime. Proper training of healthcare staff other than doctors will also help in patient education as it is not always possible for a specialist to educate the patients.¹⁹ Prescribers should also take time to educate patients on maintenance of the devices. Many DPI users in our study did not maintain their device properly. This can reduce the drug delivery despite having a correct technique.

Patient's concerns regarding the inhaler devices must be clarified as we observed that some patients thought of the inhaler as a taboo. The knowledge, beliefs and attitudes of the patients towards the inhaler has been shown in previous studies and it was seen that more than 80% of people perceived the inhaler as a social stigma. It is equally important to educate patients not to discontinue their inhalers once the symptoms are relieved, as by doing so, it might worsen the disease stability.

Studies have shown that inhaler technique gradually deteriorates overtime and regular reinforcement is needed to counter this. There are very few studies showing the

impact of health education in reducing the errors of inhaler technique assessed during the follow up visits.

A study on inhaler technique in COPD patients⁴ showed that in the first visit 74.8% patients did at least one step incorrectly and training resulted in a significant decrease in the percentage of errors. These results are similar to our COPD data where we found that in the first visit 78.58% COPD patients did at least one step incorrectly, which decreased significantly after education was given to the patients. One study in New Delhi had shown that 97.4% of patients did the inhaler technique correctly after three educational sessions were given.

It is known that inhaler device misuse worsens the clinical outcome of patients and thus efforts must be made to focus on health education and regular reinforcements on the correct technique by directing continuous and interactive educational workshops for the healthcare professionals and the patients. Patient education on the inhaler devices with regular follow up visits must be an integral part in pulmonary practice. This will reduce the disease burden not only on the patient, but also the medical services.

We propose our own four-step protocol to improve the patient's inhaler technique, which is as follows-

Step 1- Right dose, right device and right technique.

Step 2- Reassess after a month and reinforce the correct technique.

Step 3- Regular reassessments on a monthly basis till the inhaler technique is right.

Step 4- Regular follow-up visits with reinforcements at least once in three months.

Note- Remind the patients to carry their inhalers during every hospital visit.

CONCLUSION

We conclude that errors in inhaler techniques still persist in chronic respiratory disease patients and the only way to counter this is by effective patient and physician education.

Patients who were trained and prescribed by a pulmonologist performed better when compared to others and the most efficient way to train and educate patients on inhaler techniques was physical demonstration with a verbal explanation.

Face-to-face demonstration of the right inhaler technique with regular follow up visits will surely minimise the errors, lower the cost of healthcare and also achieve optimal disease control. Further studies are needed to show the impact of correct techniques on the course of these chronic respiratory diseases.

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