Available online on 15.03.2019 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Open Access Research Article

A study on effectiveness and progress outcomes of educational inhaler technique intervention in asthma and COPD patients

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ABSTRACT

Aim: A study on effectiveness and success factors of educational inhaler technique intervention in asthma and COPD.
Objectives: To identify the percentage of common errors done by people who use inhalers. To identify the risk factors associated with asthma and COPD.
Method: Data was collected from the subject's face to face interview in a community setup and the lung capacities were measured using spirometer and peak flow meter; the values were noted and the subjects were asked to demonstrate their inhaler technique using placebo inhalers; numbers of correct and incorrect steps were noted. After a period of one month; the subjects were taken to follow up and measured the lung capacities and checked the inhaler steps; number of correct and incorrect steps were noted.
Results: A total of 572 samples were collected and 500 were followed up, in which 300 had Asthma and 200 had COPD. Out of which 189 were female and 311 were male. Low education level was the single most important factor leading to incorrect technique. Formal training resulted in a statistically significant increase in the percentage of correct techniques for all the devices. For pMDI (54.01% vs. 91.03%, *p=0.005 before & after training respectively). For pMDI+Spacer (52.75% vs. 94.85%, *p=0.007 before & after training respectively). For Accuhaler (54.07% vs. 91.27%, *p=0.017 before & after training respectively). For Rotahaler (63.94 vs. 98.64%. *p=0.029 before & after training respectively). For Nebuliser (56.97% vs. 91.88%, *p=0.001 before & after training respectively.
Conclusion: Proper education to patients on correct usage may not only improve control of the symptoms of the disease but might also allow dose reduction in long term. The number of subjects doing correct steps gradually increased after the pharmacist led intervention. Thus, proper counselling for the inhaler use in patients must be encouraged as it is directly linked to the quality of life of patient.

Keywords: Asthma and COPD control inhaler devices, inhaler technique, pharmacist intervention, inhaler education.

Article Info: Received 24 Jan 2019; Review Completed 27 Feb 2019; Accepted 03 March 2019; Available online 15 March 2019

Cite this article as:

Bhavana R, Suchithra R, Thejaswini M, Harish Kumar G, Apoorva D, A study on effectiveness and progress outcomes of educational inhaler technique intervention in asthma and COPD patients, Journal of Drug Delivery and Therapeutics. 2019; 9(2):170-179 http://dx.doi.org/10.22270/jddt.v9i2.2394

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INTRODUCTION

Chronic respiratory diseases are a group of chronic diseases affecting the airways and the other structures of the lungs. common chronic respiratory diseases are asthma, bronchiectasis, chronic obstructive lung disease, including chronic obstructive pulmonary disease, bronchitis and emphysema, chronic rhinosinusitis, hypersensitivity pneumonitis, lung cancer and neoplasms of respiratory and intrathoracic organs, lung fibrosis, chronic pleural diseases, pneumoconiosis, pulmonary eosinophilia, pulmonary heart disease and diseases of pulmonary circulation including pulmonary embolism, pulmonary hypertension and corpulmonale, rhinitis, sarcoidosis, sleep apnoea syndrome[1,2].

Asthma

Asthma is a chronic inflammatory disorder due to inflammation of the air passages in the lungs and affects the sensitivity of the nerve endings in the airways so they become easily irritated. In an attack, the lining of the passages swell causing the airways to narrow and reducing the flow of air in and out of the lungs[3,4].

COPD

Chronic obstructive pulmonary disease (COPD) is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible. The more familiar terms 'chronic bronchitis' and 'emphysema' are no longer used, but are

now included within the COPD diagnosis. COPD is not simply a "smoker's cough" but an under-diagnosed, life-threatening lung disease[5,6].

A COPD diagnosis is confirmed by a simple test called spirometry, which measures how deeply a person can breathe and how fast air can move into and out of the lungs. Such a diagnosis should be considered in any patient who has symptoms of cough, sputum production, or dyspnoea (difficult or labored breathing), and/or a history of exposure to risk factors for the disease[6-8].

Aim

To study on effectiveness and progress outcomes of educational inhaler technique intervention in asthma and COPD patients.

Objectives

- To identify the percentage of common errors done by people who use inhales.
- To identify the risk factors associated with asthma and COPD.
- To identify the type of inhalers and medications used by patients.
- Educating and training correct inhalation techniques to achieve the optimal therapeutic benefit.
- To conduct the patient counselling and assess the knowledge gained and to improve patient quality of life.

MATERIALS AND METHODS

Study site:

In and around areas of south parts (Hanumanth nagar, Jayanagar) of Bengaluru, Karnataka, India.

Study design:

This is a prospective, community based study.

Study period:

The study was carried out for a period of six months.

Study criteria:

Inclusion criteria

- ✓ All patients who are diagnosed with asthma and COPD
- ✓ Patients who use inhalers
- ✓ Age 5-85 years' old
- ✓ Both the gender
- ✓ Different educational status
- ✓ Patients who are willing to give consent

Exclusion criteria

- ✓ Patients who are not using inhalers are excluded
- ✓ Patients having other respiratory problems (bronchitis, pneumonia etc.) other than asthma and COPD are excluded.

Materials used

1. Peak Expiratory Flow meter
2. Three ball incentive spirometer

Peak expiratory flow meter

The Peak Flow Meter here used was Wright's Peak Flow Meter. The peak expiratory flow (PEF), also called peak expiratory flow rate (PEFR) is a person's maximum speed of expiration, as measured with a peak flow meter, a small, hand-held device used to monitor a person's ability to breathe out air. It measures the airflow through the bronchi and thus the degree of obstruction in the airways. Peak expiratory flow is typically measured in units of litres per minute (L/min).

Three ball incentive spirometers

The incentive spirometer here used was Romsons Respirometer.

Study procedure

The participants who attended the camp with their prescriptions which was been printed in the pamphlets, which was distributed the previous day were given with the complete information about our study. The interested subjects were given with the informed consent form. After taking the consent, in the local vulnerable language and the patient was made to rest for five minutes, in this time, the patient details such as demographic details, whether they have asthma or COPD, family history, smoking status, allergies, symptoms, comorbidities, medications etc. Then we ask them to perform the spirometer for 3 times will take the average of two readings and followed by peak flow meter will note the readings. Then we will ask the patients what kind of inhalers they are using and ask them to demonstrate the inhaler use and will note the steps how they are using. After their demonstration, we will educate the patients about correct inhaler techniques followed by life style modification. After certain period (1month) we will follow the same procedure within the same subjects and we have compared the results. The data was analysed using suitable statistical methods to assess the correct inhaler techniques.

Statistical analysis

The data collected was transferred and analysed using SPSS Software version 24. Descriptive statistics, such as the mean and standard deviations, were used to summarize the quantitative variables. The percentage and numbers were used to summarize categorical variables. Chi square test was used for the measurement of spirometer and one way ANOVA and was used for the measurement of peak flow meter to test the association between lung capacities across the good inhaler technique. Paired T- test were used to measure the inhaler techniques. All the analysis was done using SPSS version 24. All the analysis was considered statistically significant at 5% level (p-value<0.05).

RESULTS

A prospective community based study was conducted over a period of 6 months in and around areas of south parts (Hanumanth Nagar, Jayanagar) of Bengaluru, Karnataka. During the study 572 patients with asthma and COPD were enrolled and 500 patients were followed up.

Table 1: Gender distribution

Gender	No. of subjects
Female	189 (37.8%)
Male	311 (62.2%)
Total	500 (100%)

Table 2: Distribution of patients according to age group

Age category	Male	Female	No. of subjects
0-19	5 (1.6%)	5 (2.6%)	10 (2%)
20-29	29 (9.3%)	31 (16.4%)	60 (12%)
30-39	64 (20.5%)	41 (21.6%)	105 (21%)
40-49	73 (23.4%)	40 (21.16%)	113 (22.6%)
50-59	58 (18.6%)	38 (20.1%)	96 (19.2%)
60-69	48 (15.4%)	26 (13.7%)	74 (14.8%)
70-79	27 (8.6%)	6 (3.1%)	33 (6.6%)
80-89	7 (2.2%)	2 (1.0%)	9(1.8%)
Total (N) =	311(100%)	189 (100%)	500 (100%)

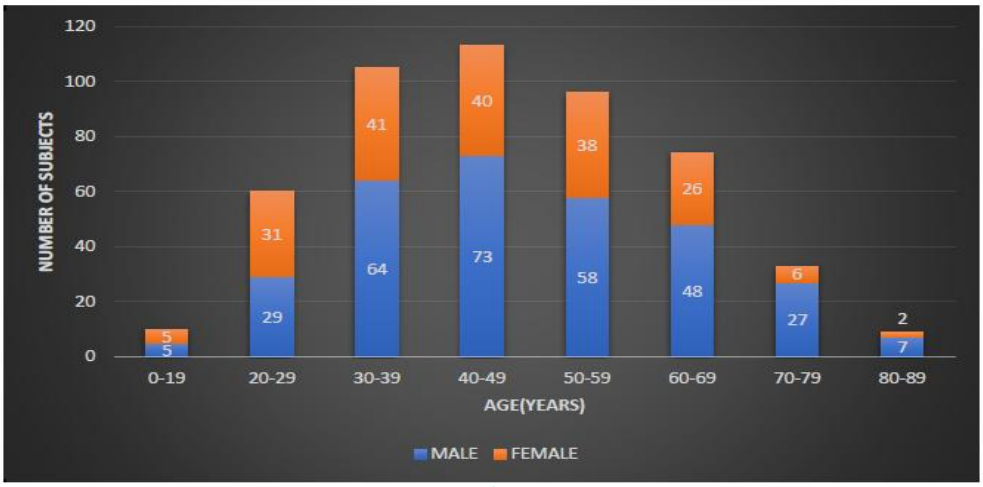

Figure 1: Distribution according to age (in years) group

Out of 500 subjects enrolled, the overall age group of subjects ranged from 10-90 years old. In 40-49yrs of age group 113(22.6%) patients were both asthma and COPD, whereas in 30-39 there were 105(21%), then in 50-59 there were 96(19.2%), then in 60-69 there were 74(14.8%), then 20-29 there were 60(12%), then in 70-79 there were 33(6.6%) and in 10-19 there were 10(2%) asthma and COPD subjects, then least was found in 80-89 age there were 9(1.8%) of subjects. Most of the patients were between the age range from 40-49 years in both asthma and COPD.

Table 3: Number of subjects based on asthma and COPD

Condition	No. of subjects (%)
Asthma	300 (60%)
COPD	200 (40%)
Total	500 (100%)

Table 4: Gender distribution based on asthma and COPD

Gender	Asthma	COPD
Male	130 (43%)	183 (92%)
Female	170 (57%)	17 (9%)
Total (N=500)	300 (100%)	200 (100%)

Table 5: Grouping subjects based on spirometry (Three ball test) before and after follow up

Spirometry	Before follow up	After follow up
Poor	245(49%)	62(12.4%)
Average	203(40.6%)	281(56.2%)
Good	52(10.45%)	157(31.4%)
Total	500(100%)	500(100%)

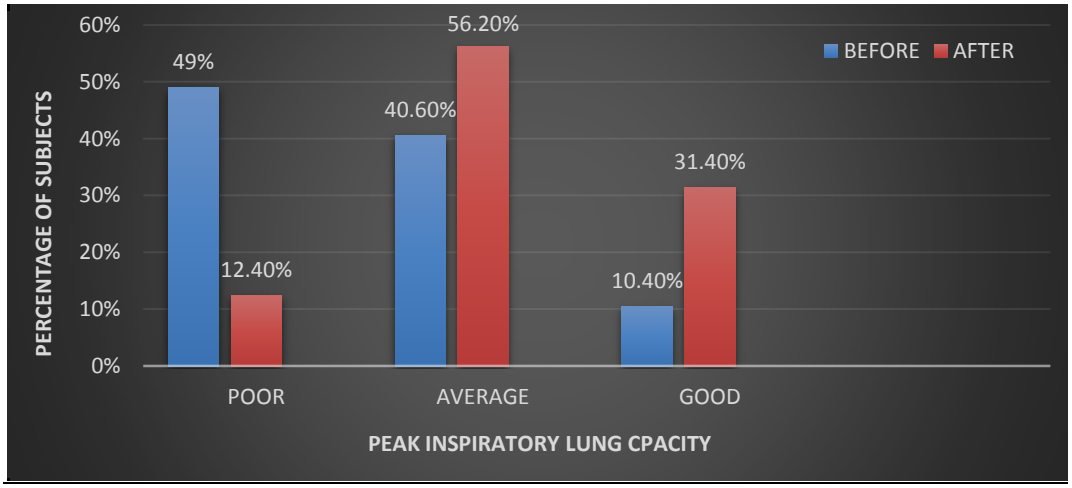

Figure 2: Percentage of subjects based on spirometer

Out of 500 subjects; 245 (49%) subjects had poor inspiratory lung capacity, 203(40.6%) subjects had average inspiratory lung capacity, and 52 (10.4%) subjects had good inspiratory lung capacity. After a period of one month 62(12.4%) had poor inspiratory lung capacity, 281(56.2%) had average inspiratory lung capacity, 157(31.4%) has good inspiratory lung capacity.

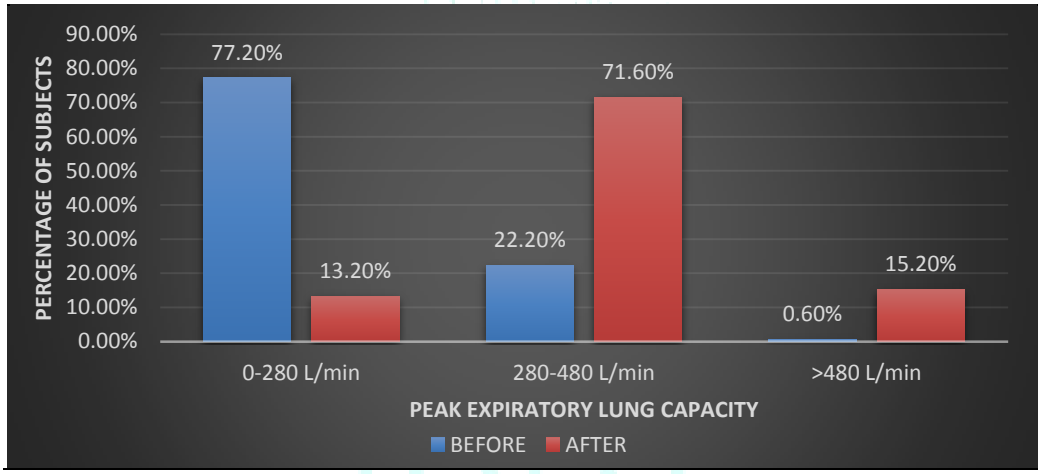

Figure 3: Percentage of subjects based on peak flow meter

Out of 500 subjects; 386 (77.2%) subjects had poor expiratory lung capacity, 111(22.2%) subjects had average expiratory lung capacity,3(0.6%) subjects had good expiratory lung capacity. After a period of one month 66(13.2%) had poor expiratory lung capacity, 358(71.6%) had average expiratory lung capacity,76(15.2%) has good expiratory lung capacity.

Table 6: Reported risk factors for asthma and COPD

Factors	Asthma	COPD
Allergies (pollens, house dust mites, cooking)	146 (48.6%)	0
Smoking	16 (5.3%)	116 (58%)
Family history	83 (27.6%)	22 (11%)
Air pollution	48 (16%)	44 (22%).
Occupational exposure	7 (2.33%)	18 (9%)
Total	300 (100%)	200 (100%)

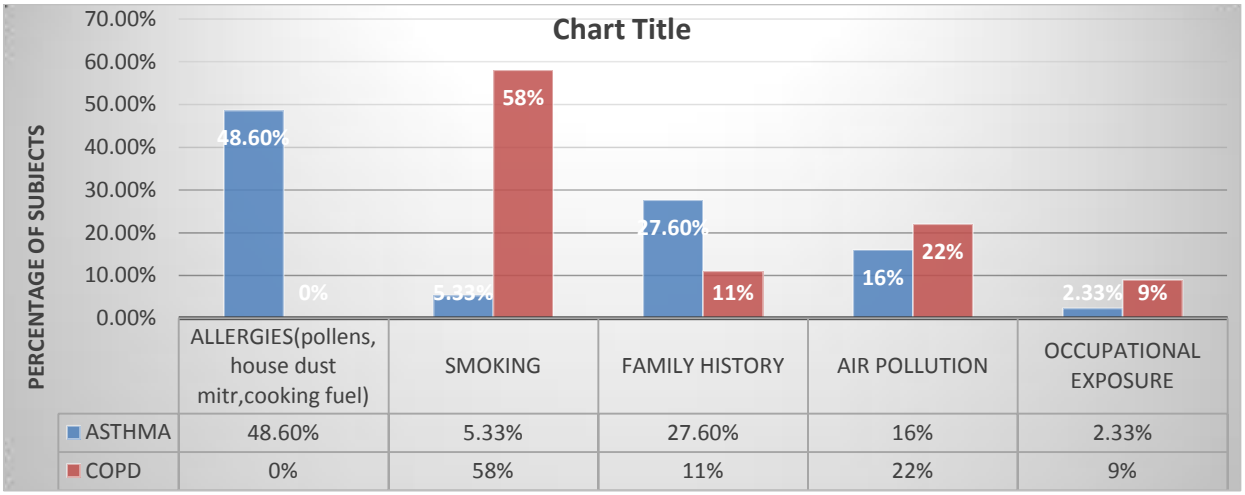

Figure 4: Percentage of risk factors for asthma and COPD

Out of 300 subjects of asthma 146 (48.6%) were exposed to allergies, 16 (5.33%) were exposed to smoking, 83 (27.6%) were exposed to family history, 48 (16%) were exposed to air pollution, 7 (2.33%) were exposed to occupational exposure. The population of asthmatic patients 146 (48.6%) having allergy.

Out of 200 subjects of COPD 116 (58%) were exposed to smoking, tobacco, 44 (22%) were exposed to alcohol, 22 (11%) were exposed to air pollution, 48 (16%), 18 (9%) were exposed to occupational exposure. There was higher number of Patients diagnosed with COPD who had smoking habit 116 (58%) than patients diagnosed with asthma 16 (5.33%).

Table 7: Signs and symptoms of COPD

Signs and symptoms	No. of subjects
Shortness of breath, wheezing, chest tightness	57 (28.5%)
Cough, cough with sputum	94 (47%)
Respiratory infections	18 (9%)
Weight loss/ weakness	31 (15.5%)
Total	200 (100%)

The major symptoms presented by COPD patients were found to be cough, cough with sputum (47%), shortness of breath, wheezing, chest tightness (28.5%), weight loss or weakness (15.5%), respiratory infection (9%).

Table 8: Signs and symptoms of asthma

Signs and symptoms	Number of subjects
Chest tightness, wheezing, difficulty breathing	176 (58.6%)
Cough	116 (38.7%)
Respirator/throat infections	8 (2.7%)
Total (N)=	300 (100%)

In our study, the major symptoms presented by the asthma patients were found to be chest tightness, wheezing, difficulty in breathing (58.6%), cough (38.7%), respiratory or throat infections (8.27%). Most commonly seen sign &symptom were cough in COPD patients and chest tightness, wheezing, difficulty in breathing in asthma patients. Least commonly seen was respiratory/throat infections in both.

Table 9: Types of inhalers used

Inhaler device	No. of subjects
pMDI	168 (33.6%)
pMDI + Spacer	49 (9.8%)
Rotahaler	98 (19.6%)
Accuhaler	118 (23.6%)
Nebulise	68 (13.6%)
Total (N)=	500 (100%)

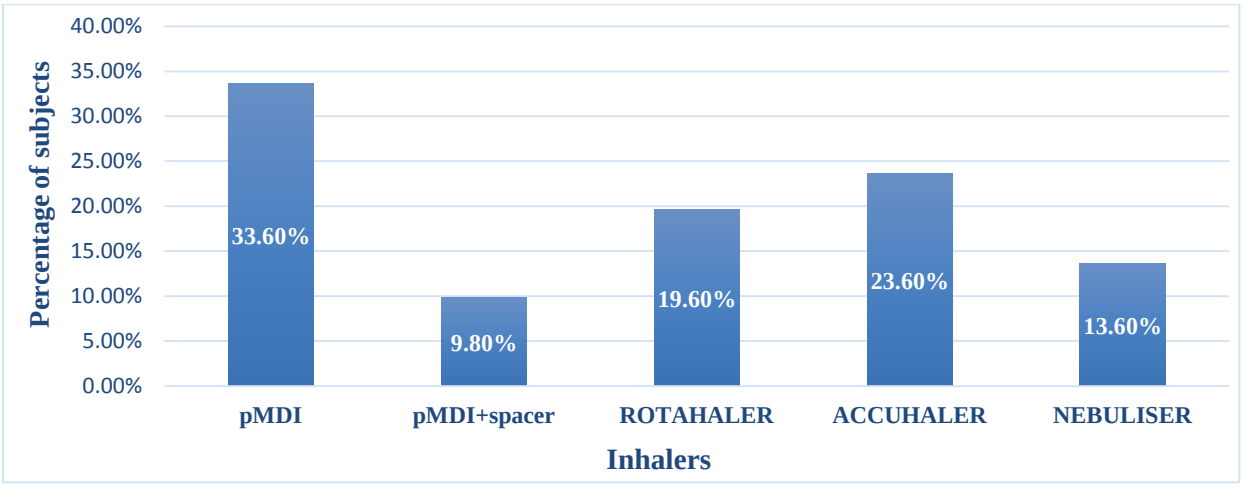

Figure 5: Percentage of different types of inhalers used

Out of 500 patients of asthma and COPD 168 (33.60%) were using PMDI whereas 49 (9.8%) were using PMDI+SPACER; 98 (19.6%) were using rotahaler, 117 (23.6%) were using accuhaler, 68 (13.6%) were using nebuliser.

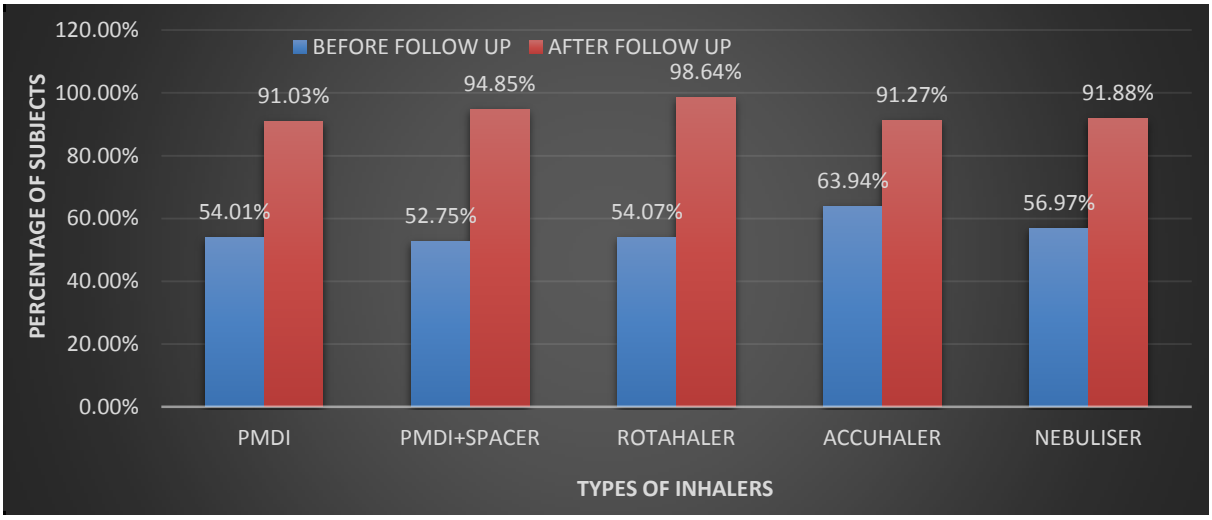

Figure 6: Percentage of subjects with correct inhaler technique

Our study confirms a significant increase in percentage of improvement in inhalation technique after face to face demonstrations and training. Although the inhalation technique significantly improved among pMDI, pMDI+Spacer, accuhaler, rotahaler, nebulizer. These results suggest that patients should bring all their inhalers to each visit, and should be able to demonstrate their correct use. All patients need face to face training and retraining for successful inhaler use.

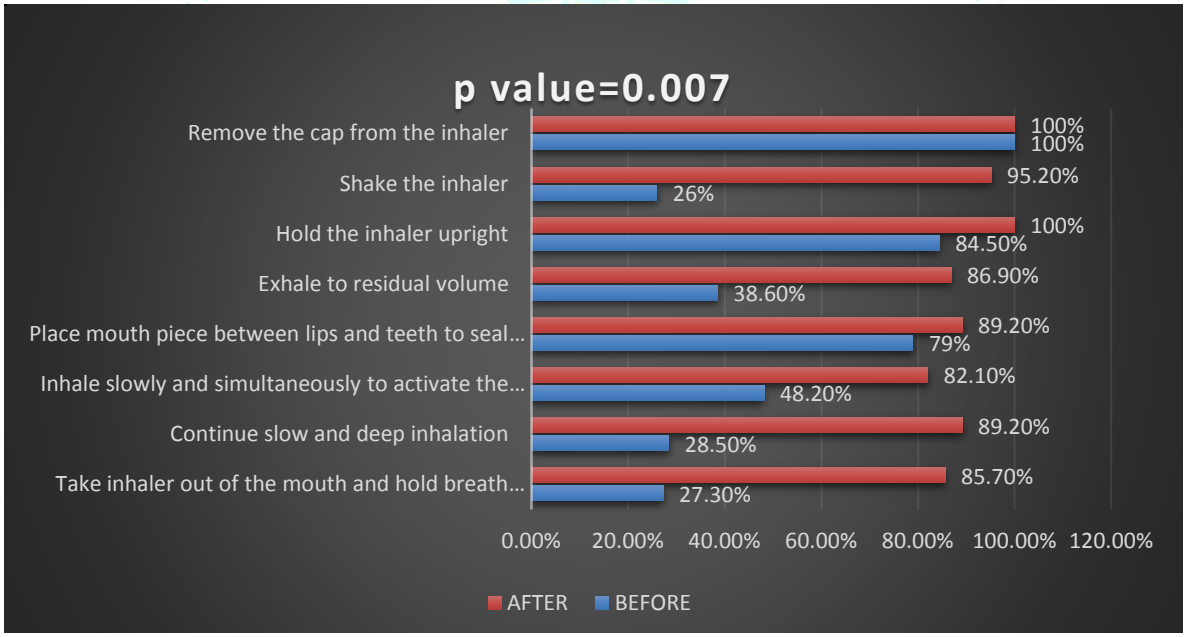

Figure 7: pMDI (% of subjects doing correct steps before and after follow up)

In PMDI the most common error done by the patient was shake the inhaler, continue slow and deep inhalation and hold breath for 5-10 sec before face to face training. After educating and demonstrating the good inhaler technique they gradually increased the correct use of inhaler and have been show to improve symptoms. Hence the *p value = 0.005 hence it is statistically significant.

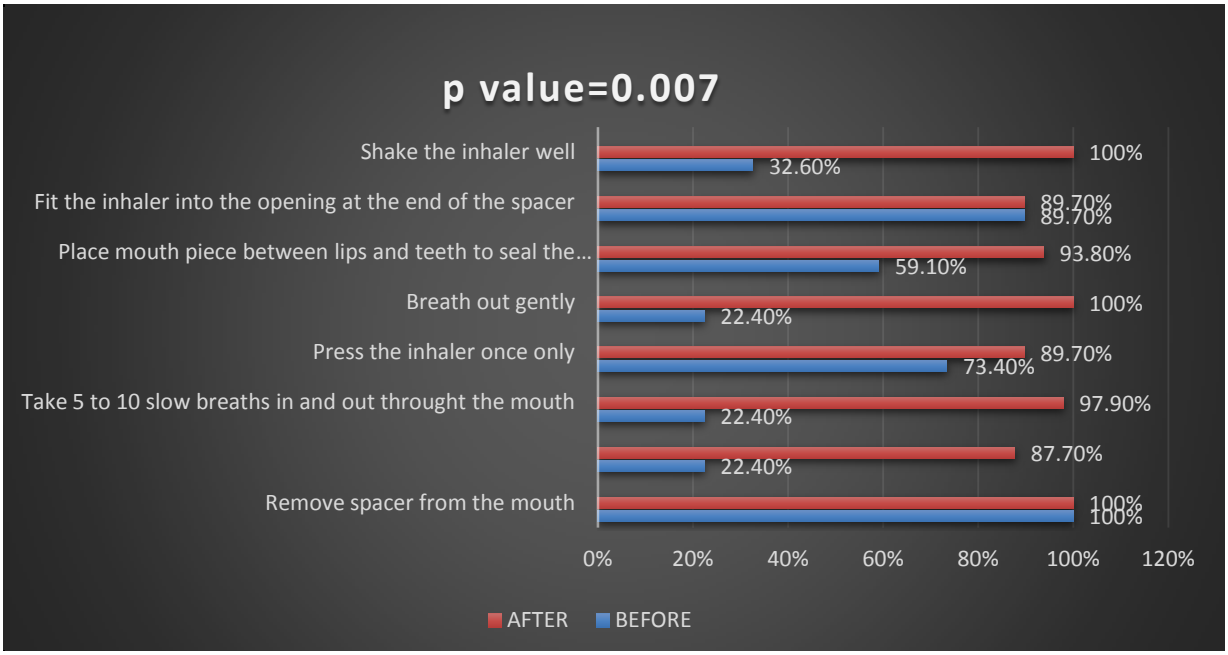

Figure 8: pMDI + Spacer (% of subjects doing correct steps before and after follow up)

In pMDI+spacer the most common error done by the patient was take 5 to 10 slow breaths in and out through the mouth, do not remove the spacer from the mouth between breaths, breath out gently, shake the inhalers before face to face training. After educating and demonstrating the good inhaler technique they gradually increased the correct use of inhaler and have been show to improve symptoms. The study which is like Linda Bryant of adequacy of inhaler technique used by people with asthma and COPD, shows that 58% of participants using a pMDI+spacer were over 60yrs of age, indicating that medical practitioners are appropriately selecting inhaler devices for this group. Hence the *p value =0.007, so it is statistically significant.

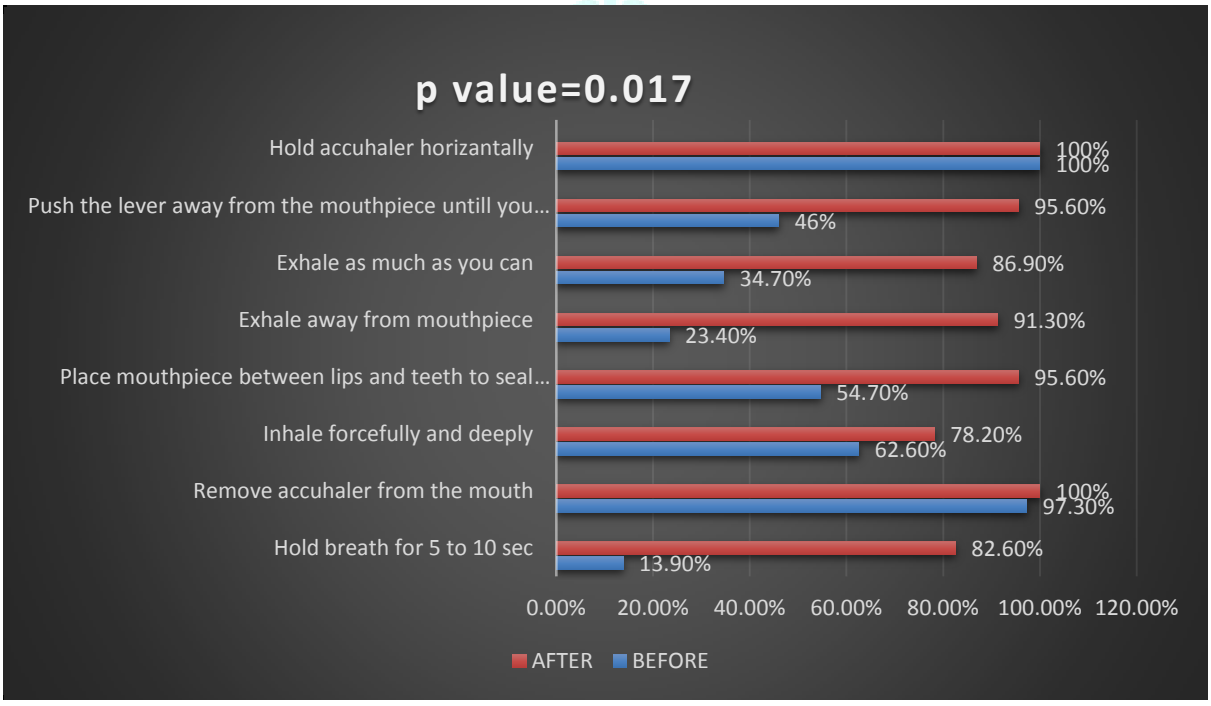

Figure 9: Accuhaler (% of subjects doing correct steps before and after follow up)

In accuhaler the most common error done by the patient was not holding the breath for 5 to 10 sec, and not exhaling away from the mouth, exhales. After educating and demonstrating the good inhaler technique they gradually increased the correct use of inhaler and have been show to improve symptoms. Hence the *p value =0.017, so it is statistically significant.

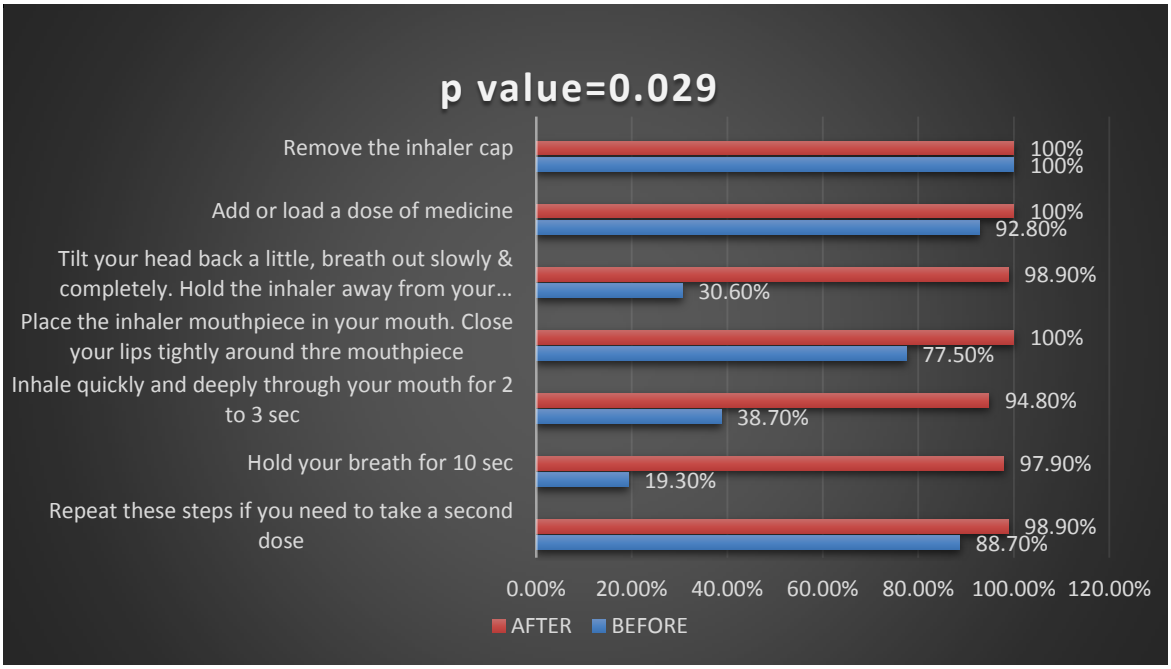

Figure 10: Dry powder inhaler (% of subjects doing correct steps before and after follow up)

In rotahaler the most common error done by the patient was not holding the breath for 5 to 10 sec, and not exhaling, not tilting head back a little, not breathing out gently, not inhaling quickly and deeply through mouth before face to face training. After educating and demonstrating the good inhaler technique they gradually increased the correct use of inhaler and have been show to improve symptoms. Hence the *p value =0.029, so it is statistically significant.

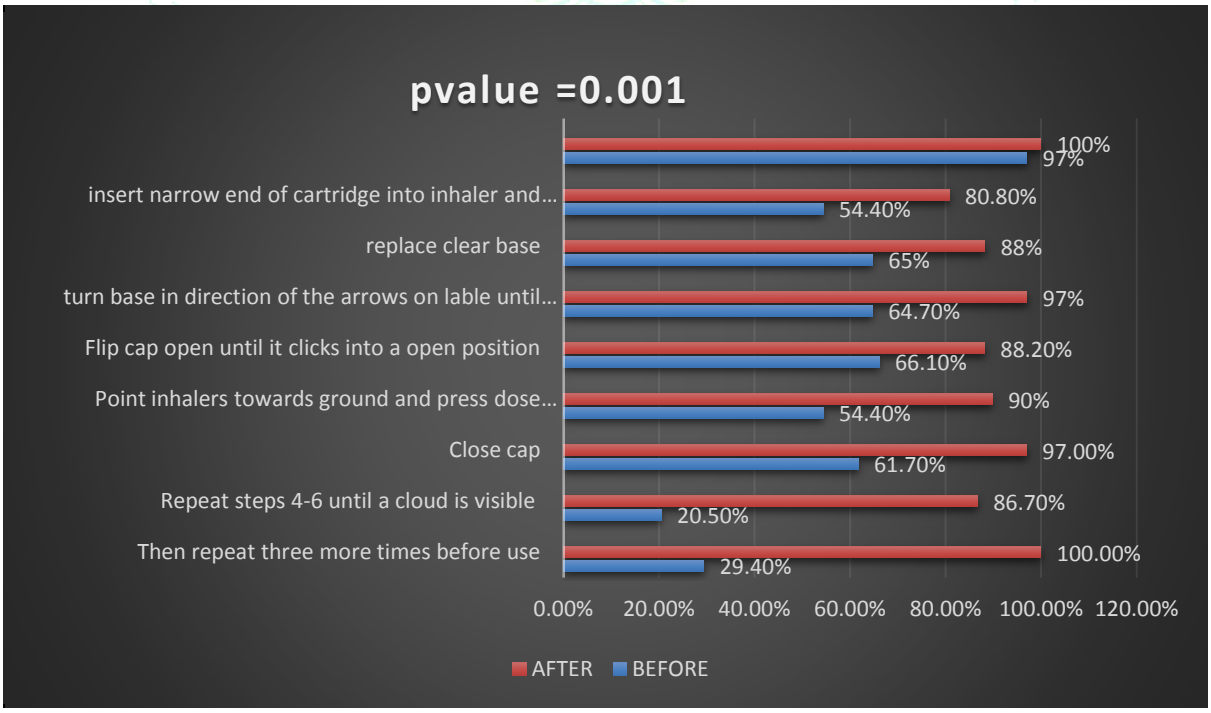

Figure 11: Nebuliser (% of subjects doing correct steps before and after follow up)

In nebulizer, the most common error done by the patient was not repeating steps 4-6 until a cloud is visible, then not repeating three more times before use; before face to face training. After educating and demonstrating the good inhaler technique they gradually increased the correct use of inhaler and have been show to improve symptoms. Hence the *p value =0. 001. Hence it is statistically significant.

Medications

Mono therapy: 111 subjects
Combination therapy: 267 subjects
Total: 378

Out of 500 subjects, 122 subjects could not tell the medication they take.

Monotherapy: 111 subjects

Table 10: Number of subjects who took mono therapy

Medications	No. of subjects
Asthalin	40 (36%)
Ipratropium bromide	30 (27.02%)
Fluticasone proprionate	26 (23.40%)
Budesonide	15 (13.51%)

Out of 500 subjects 111patients were used monotherapy in which asthalin was the most commonly used drug followed by ipratropium bromide was the least drug.

Table 11: Combination therapy: 267

Medications	No. of subjects
Levosalbutamol + ipratropium bromide	98 (36.70%)
Beclomethasonl+ levosalbutamol	74 (27.70%)
Fluticasone + valanterol	40 (14.90%)
Fluticasone + fprmeterol	36 (13.40%)
Formeterol + budesonide	11 (4.11%)
Salmeterol + fluticasone	19 (7.11%)

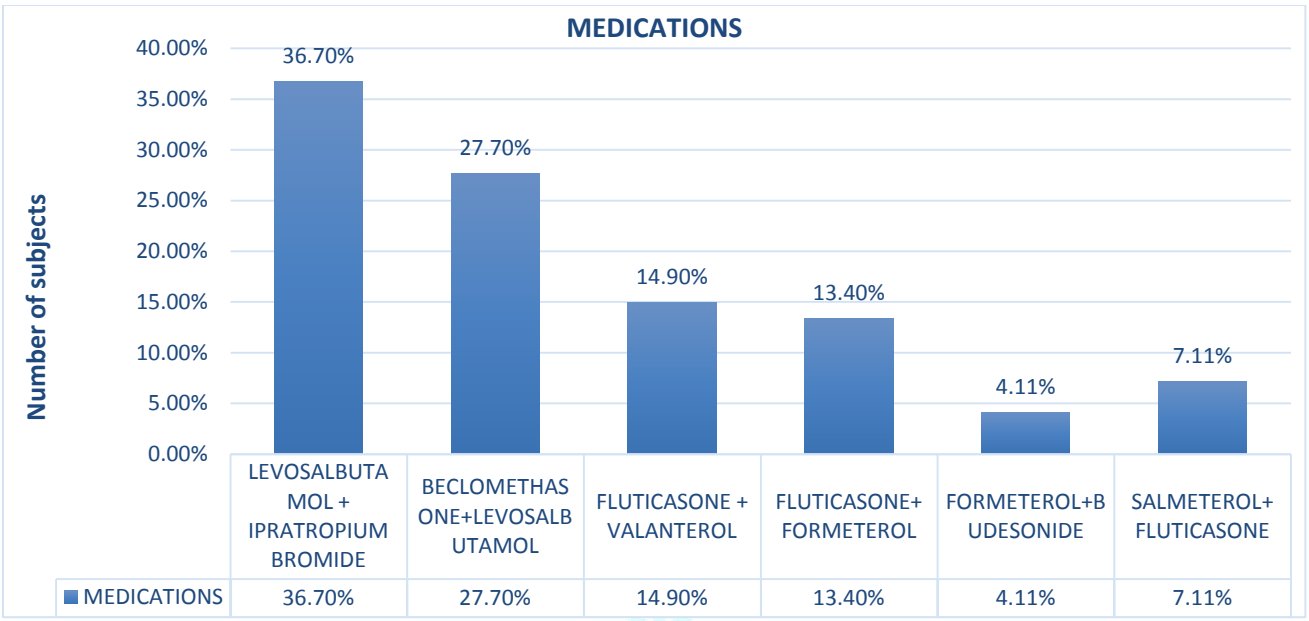

Figure 12: Percentage of subjects who took Combination Therapy

Out of 500 subjects 267 were used combination therapy levosalbutamol + ipratropium bromide was the most commonly used drugs.

DISCUSSION

During the study 572 patients with asthma and COPD were enrolled and only 500 were followed up. The total number of subjects enrolled in this study was 572 and the follow up obtained for 500 subjects out of which; 300 subjects had asthma and 200 subjects had COPD, out of which 311 (62.2%) were male and189 (37.8%) were female, as represented in above graph. Out of 300 asthma subjects 170 (56.6%) female population were affected by asthma, 130 (43.3%) male population were affected by asthma. whereas out of 200 COPD subjects 17 (8.5%) female population were affected by COPD and 183 (91.5%) were male population were affected by COPD. The overall age group of subjects ranged from 10-90 years old. The most of the patients were between the age ranges from 40-49 years i.e. 113 patients (22.6%) in both asthma and COPD. The least was found in 80-89 age i.e. 9 (1.8%) of patients.

Out of 500 subjects; 245 (49%) subjects had poor inspiratory lung capacity, 203 (40.6%) subjects had average inspiratory lung capacity, and 52 (10.4%) subjects had good inspiratory lung capacity. After a period of one month 62(12.4%) had poor inspiratory lung capacity, 281(56.2%) had average inspiratory lung capacity, 157(31.4%) has good inspiratory lung capacity. We have measured the lung capacities of subjects (inspiratory flow volume and expiratory flow volume) by using spirometer (3ball test) before and after the follow up. In spirometer, we have compared the results of the subjects before and after follow up (1 month) calculated p value using chi square test. Formal training of inhaler technique resulted in statistically significant increase in the inspiratory lung capacity before educating about inhaler use most of them had poor inspiratory lung capacity. After educating about correct technique of inhaler, which gradually increased their inspiratory lung capacity. Hence *p=0.00 which shows that the results were statistically significant. Hence there is an association between good inhaler technique and lung capacity. In peak flow meter test, we have compared the results of the subjects before and after follow up (1month) we have calculated the p value using one way Anova test. Formal training of inhaler technique resulted in statistically significant increase in the expiratory lung capacity. Out of 500 subjects; 386 (77.2%) subjects had poor expiratory lung capacity, 111(22.2%) subjects had average expiratory lung capacity, 3 (0.6%) subjects had good expiratory lung capacity.

After a period of one month 66(13.2%) had poor expiratory lung capacity, 358 (71.6%) had average expiratory lung capacity, 76 (15.2%) has good expiratory lung capacity. Before educating about inhaler use most of them had poor expiratory lung capacity. After educating about correct technique of inhaler which gradually increased their expiratory lung capacity. Hence p=0.00 which shows that the results were statistically significant. Hence there is an association between good inhaler technique and lung capacity. Out of 300 subjects

of asthma, 146 (48.6%) were exposed to allergies, 16 (5.33%) were exposed to smoking, 83 (27.6%) were exposed to family history, 48 (16%) were exposed to air pollution, 7 (2.33%) were exposed to occupational exposure. Increase in allergy (pollens, house dust mite, cooking fuels) is Associated with increased severity in asthma. Exposure to smoke while performing domestic work presents a greater risk of development of asthma and COPD than other fuels. The number of people who used L.P gas was found to be higher than other types of cooking systems in a study mixed fuel users were also found to experience more respiratory problems.

In pMDI+spacer the most common error done by the patient was not taking 5 to 10 slow breaths in and out through the mouth, and failure to remove the spacer from the mouth between breaths and breath out gently, also observed not shaking the inhalers before face to face training. After educating and demonstrating the good inhaler technique they gradually increased to use of inhaler technique correctly and has been showed to improve symptoms. The study which is similar to Linda Bryant of adequacy of inhaler technique used by people with asthma and COPD shows that 58% of participants using a PMDI+spacer were over 60yrs of age, indicating that medical practitioners are appropriately selecting inhaler devices for this group. Hence the *P value =0.007 hence it is statistically significant. In accuhaler the most common error done by the patient was not holding the breath for 5 to 10 sec, and not exhaling away from the mouth, exhales. After educating and demonstrating the good inhaler technique they gradually increased the correct use of inhaler and have been show to improve symptoms. Hence the *P value =0.017 hence it is statistically significant. In rotahaler the most common error done by the patient was not holding the breath for 5 to 10 sec, and not exhaling, not tilting head back a little and breathing out gently, not inhaling quickly and deeply through mouth before face to face training. After educating and demonstrating the good inhaler technique they gradually increased the correct use of inhaler and have been shown to improve symptoms. Hence the *p value = 0.029 hence it is statistically significant.

In nebulizer, the most common error done by the patient was not repeating steps 4-6 until a cloud is visible, then not repeating three more times before use; before face to face training. After educating and demonstrating the good inhaler technique they gradually increased the correct use of inhaler and have been show to improve symptoms. Hence the *p value =0. 001. Hence it is statistically significant. Out of 500 subjects 111 patients were used monotherapy in which asthalin was the most commonly used drug followed by ipratropium bromide was the least drug. Out of 500 subjects 267 were used combination therapy levosalbutamol + ipratropium bromide was the most commonly used drugs.

CONCLUSION

The present study demonstrated that majority of patients with asthma and COPD were using incorrect inhaler techniques which is associated with poor disease control. That may be solved or prevented by pharmacist interventions. Our study showed that a high proportion (56%) of the participants had poor inhaler technique before counselling. which is consistent with the findings. Formal training resulted in a statistically significant increase in the percentage of correct techniques for all the devices. For pMDI (54.01% vs. 91.03%, *p=0.005 before & after training respectively). For pMDI+Spacer (52.75% vs. 94.85%, *p=0.007 before & after training respectively). For Accuhaler (54.07% vs. 91.27%, *p=0.017 before & after training respectively). For Rotahaler (63.94 vs. 98.64%. *p=0.029 before & after training respectively). For Nebuliser (56.97% vs. 91.88%, *p=0.001 before & after training respectively). The results were statistically significant.

The number of subjects doing correct steps gradually increased after the pharmacist led intervention. The most commonly used device was pMDI followed by DPIs, pMDI+Spacer, Nebuliser. So, review of the patient's inhaler technique by clinical pharmacist can positively influence the patient's outcomes and quality of life. In the present study majority of the patients with incorrect inhaler techniques were identified and counselled accordingly there by improved patient's outcomes and quality of life. pMDI inhaler was the most common inhaler device used. The most common error for all devices was failure to exhale adequately before administering the dose. This improper technique is associated with poor Asthma and COPD control. Educational intervention on inhaler technique in Asthma and COPD patients are effective on the short term. Key predictors for success are patient's initial technique and time elapsed since intervention. Hence pharmacist led intervention has the potential to improve patient inhaler technique compliance in control of asthma and COPD.

ACKNOWLEDGEMENT

The authors wish to thank the management of PES College of Pharmacy, Bengaluru, Karnataka, India for providing necessary equipment for research, constant encouragement, facilities and support. We personally thank Mr. Biswaranjan Patra, Biostatistician, Assistant Professor, PES College of Pharmacy, Bengaluru for his support.

CONFLICTS OF INTEREST

The author declares that there is no conflict of interest to disclose.

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