J Young Pharm, 2022; 14(3) : 327-332
A multifaceted peer reviewed journal in the field of Pharmacy
www.jyoungpharm.org | www.phcog.net

Original Article

The Impact of Theoretical and Practical Guidance Regarding Metered Dose Inhaler Technique on Asthma Patients

Sara Shahid[1,2,*], Fahad Ahmed[3], Gul Shahnaz[1], Muhammad Saqlain[1], Muhammad Ans[4], Anosh Sana[1], Abdul Nazer Ali[5], Ahmad Kamal Ariffin Abdul Jamil[6], Asma Fareed Khan[7,8], Saba Naeem[9], Shakeel Ahmad[9], Aiman Mahmood[4,9], Qandeel Rafi[9], Asifa Anwar[2], Rabeel Khan[2], Naeem Mubarak[2]

[1]Department of Pharmacy, Faculty of Biological Sciences, Quaid-i-Azam University, Islamabad, PAKISTAN.
[2]Department of Pharmacy Practice, Lahore Pharmacy College, Lahore Medical and Dental College, University of Health Sciences, Lahore, PAKISTAN.
[3]Faculty of Pharmacy, University of Sargodha, Sargodha, PAKISTAN.
[4]University College of Pharmacy, University of the Punjab, Lahore, PAKISTAN.
[5]Department of Pharmacy Practice, Geethanjali College of Pharmacy, Hyderabad, Telangana, INDIA.
[6]Department of Clinical Pharmacy & Pharmacy Practice, Faculty of Pharmacy, UniSZA, Besut, Terengganu, MALAYSIA.
[7]Disciplines of Clinical Pharmacy, School of Pharmaceutical Sciences, Universiti Sains Malaysia, MALAYSIA.
[8]Children's Hospital & University of Child Health Sciences, Lahore, PAKISTAN.
[9]Department of Pharmaceutics, Lahore Pharmacy College, Lahore Medical and Dental College, University of Health Sciences, Lahore, PAKISTAN.

ABSTRACT

Background: Asthma is rapidly increasing globally. Inhalation therapy is the backbone for asthma management due to localized delivery and rapid onset of action. Currently, metered dose inhalers (MDIs) are the most widely prescribed and dispensed inhaler devices worldwide due to the advantage of portability, multiple dose delivery and better efficacy. **Objectives:** The current study aimed to access the effect of educational intervention on asthma patients' competency regarding pressurized metered dose inhaler (pMDI) technique. **Methods:** Asthma patients were recruited from Pakistan Institute of Medical Sciences (PIMS) Islamabad, Pakistan. Inhaler technique steps based upon "National Asthma Education and Preventive Program" (NAEPP) criteria was set as evaluating tool to evaluate competency of asthma patients regarding MDI appropriate technique. Intervention involved educating study subjects (asthma patients) practically through placebo inhaler and theoretically through inhaler technique directed literature brochures. Pre intervention and post intervention inhaler technique competency was accessed and evaluated statistically. **Results:** Among 207 asthma patients, majority were never instructed by healthcare professional regarding inhaler technique (78.8%). However, most of the patients were observed to have inadequate inhaler technique (76.3%) at baseline. As the result of educational intervention, the competency of patients regarding inhaler technique was significantly enhanced from 11.6% pre-intervention to 34.8% post-intervention ($p<0.001$), statistically analyzed by McNemar testing. **Conclusion:** Originally, inhaler technique competency of majority of asthma patients was observed to be inappropriate. However, educational intervention proved to be effective in substantially enhancing the competency of study subjects regarding MDI technique.

Keywords: Asthma, Inhalation therapy, Metered-dose inhalers, Educational intervention, National Asthma Education and Preventive Program.

Correspondence

Dr. Sara Shahid,

Department of Pharmacy Practice, Lahore Pharmacy College, Lahore Medical and Dental College, University of Health Sciences, Lahore, PAKISTAN.

Email id: sarashahid498@gmail.com

DOI: 10.5530/jyp.2022.14.64

INTRODUCTION

Asthma is a chronic inflammatory disease of airways that is characterized by hyper-reactivity of airways that results in bronchial obstruction.[1] Asthma is diagnosed and differentiated from other respiratory conditions based upon previous medical history of patients and measurement of lung functions through spirometry and pulmonary function tests. However, some other medical features for asthma diagnosis include; physical examination for airflow limitation, evidence of wheezing with shortness of breath, airway limitation and allergic status of patient.[2]

The prevalence of asthma has enhanced immensely over the past few years. Currently, about 334 million adults are expected to be suffering from asthma globally. Whereas, it is estimated that further 100 million would be affected by 2025, worldwide.[3] In Pakistan, the prevalence of asthma is approximately 5-10% in adults.[4]

Inhalation therapy plays an integral role in the management of asthma and other respiratory diseases. As compared to systemic administration of medication, inhalation therapy delivers drug right at the site of action, which results in quicker and more efficient onset of action with minimal adverse effects.[5] According to European Respiratory Society and American Thoracic Society guidelines for asthma management, inhaled bronchodilators are the first line treatment for asthma management. Whereas, inhaled corticosteroids (ICS) are most commonly prescribed for long term management of chronic asthma.[6]

Numerous inhalation devices are available worldwide including nebulizers, dry powder inhalers and pressurized meter dose inhalers (pMDIs). Currently, MDIs are the most preferable inhaler devices worldwide due to minimal side effects, greater portability, reduced cost and better efficacy with enhanced lung deposition of active agents.[7] Around 3 million adult asthmatic patients globally, are estimated to be using MDIs.[8]

An optimal inhaler technique is crucial to acquire desired pharmacological effects for effective management of asthma. Use of inappropriate metered dose inhaler technique results in treatment failure.[9] Patients following suboptimal inhaler technique are observed to have poor disease control and are most likely to misuse inhalers, since they tend to gain control over their exacerbated symptoms.[10] Due to increased hospitalization, treatment becomes more expensive, imposing an economic burden to

patients and society. Inappropriate MDI technique in patients result due to the absence of guidance or inadequate MDI technique instruction by health care providers.[11]

Metered dose inhalers are the most frequently prescribed and dispensed dosage form in inhalation therapy due to localized delivery of pharmaceutical agent to bronchioles, hence bypassing the first pass effect and reducing systemic adverse effects.[12] Since inhaler technique plays a crucial role in disease management, therefore proper inhaler technique knowledge should be emphasized and delivered to patients.[13] Every patient requires personalized information and skill regarding adequate management and techniques for therapy. Instead of verbally instructing patients regarding inhaler technique, physical demonstrations along with pictorial leaflets should be provided to patients.[14] Therefore, to ensure adequacy, inhaler technique should be monitored regularly and periodically since inadequate inhaler technique is an important factor associated with asthma-related morbidities.[15] Patients without guidance regarding the use of inhaler devices are 5 times more likely to misuse or improperly use inhalers.[17] It is observed that appropriateness in inhaler technique is declined with time, if not accessed on regular intervals.[16] This employs the need of regular evaluation as well as guidance of inhaler technique to patients. Therefore, it is recommend that inhaler technique should be verbally described and physically demonstrated to patients repeatedly and their procedure should be observed at each visit.[17]

The National Asthma Education and Preventive Program (NAEPP) was commensed in March, 1989 by the United States of America (USA) for the management of rapidly enhancing heath problem of asthma. It is regulated by the National Heart, Lung and Blood Institute (NHLBI). The purpose of NAEPP is to improve the quality of life of asthma patients and to decrease morbidity and mortality related to asthma. The NAEPP raise awareness among patients and healthcare professionals regarding management of asthma through educational programs.[15]

According to the guidelines presented by NAEPP, the adequate MDI usage technique involves 11 steps which are:

"Step 1: Shake the contents well

Step 2: Remove the cap

Step 3: Hold the inhaler upright

Step 4: Tilt the head back slightly

Step 5: Breath out slowly

Step 6: Open mouth with inhaler 1-2 inches away with lips tightly sealed around it

Step 7: Breathe in slowly through the mouth and actuate the canister once

Step 8: Hold the breath for 10-20 sec

Step 9: Exhale and wait 1 min before the second dose

Step 10: Shake again before second dose

Step 11: After use, replace mouthpiece cover."

The steps of inhaler technique should be performed correctly and in coordination for desired results.[15]

This study aimed to access the competency of adult asthma patients regarding MDI technique as well as the impact of educational intervention on improving their inhaler technique in Islamabad, Pakistan.

MATERIALS AND METHODS

Study Approval and Design

The study protocol was approved by an Ethical review board of Shaheed Zulfiqar Ali Bhutto Medical University (SZABMU)- Pakistan Institute of Medical Sciences (PIMS) hospital with protocol approval number ERB/SZABMU/229.

A prospective interventional study was conducted on adult asthma patients from outpatient department (OPD) of pulmonology department "Pakistan Institute of Medical Sciences" (PIMS) Islamabad, Pakistan. It is a research oriented hospital located in the heart of capital and has increased patient load with great diversity, which contributed to its selection for this study. The study duration was of 9 months.

Inclusion and exclusion criteria

Asthma diagnosed non-smoker adult patients with age greater than 10 years, currently using pMDIs and willing to participate in this research project were included in this study. However, patients using MDI with spacers, nebulizer and other devices were eliminated from this study. Patients who were unable to self-administer their inhaler and the patients who did not give conset to participate in this study were excluded.

Study Sample

The sample size was determined by using G-Power calculator via employing McNemar test to detect difference in proportion of respondent with improved technique after intervention. McNemar test was used to determine the differences on a dichotomous dependent variable between two related groups. However, 207 adult asthma patients were recruited based upon G-Power calculations with two tails proportion, err prob = 0.05, Power (1- err prob) = 0.80, total odd ratio of 2.089 with a confidence interval (CI) of 95%.

Data collection method

The study was conducted in two phases; the baseline and the post-intervention phase. After baseline assessment, intervension was provided. While the gap between the intervention and post-interventional assessment was of 1 month i.e. almost 4 weeks based on Kishore P.V. methodology.[17] After the enrollment of patients for this study, they were asked to complete data collection form that included; demographic information, disease and medication related data. Patients were asked to fill in the questionnaire individually and in the supervision of researcher at waiting area of pulmonology department. Inhaler technique was assessed by researcher by asking the patient to demonstrate his/her inhaler technique with a placebo inhaler. A checklist of inhaler technique steps by NAEPP guidelines, were used as a criteria for inhaler technique evaluation. The principal investigator asked the patients to demonstrate the way they use their inhaler. The inhaler technique was evaluated and recorded as correct, incorrect and skipped steps, as performed by patients. Afterwards, educational intervention was provided to patients individually, by principal investigator.

Educational Intervention

Educational intervention involved theoretical education and practical guidance with placebo inhaler to study subjects at individual level. Brochures designed in accordance with NAEPP guidelines, having inhaler technique instructions (in English and Urdu- native language) along with related infographic, were distributed in patients after verbal guidance and practical demonstration of inhaler technique.

Evaluation of optimal MDI technique- Study tool

Inhaler using technique of patients was evaluated individually through placebo inhaler device.

Patient's demonstration of inhaler technique was recorded as correct, incorrect and skipped steps, based on 11 step criteria according to NAEPP guidelines. Out of total 11 steps of inhaler technique, each correctly demonstrated step was scored 1. While, incorrect or skipped steps were scored 0. Sum of combined scores were recorded out of

total 11 scores, based upon which the technique was classified as; good technique, moderate technique and poor technique.

However, based upon Al-worafi criteria,[18] inhaler technique of patients was categorized as;

Good technique; patients having scores ≥7/ 11

Moderate technique; patients having scores 5 or 6, out 11 scores

Poor technique; patients having scores ≤ 4

After educational intervention provision, the post intervention evaluation was assessed with a gap of 1 month. The post intervention evaluation of inhaler technique was performed in the same manner as baseline evaluation.

Ethical Considerations

Informed consent from patients was obtained after providing them the written information as well as verbal explanation of the study. Participants were informed beforehand that participation is totally voluntary and written consent was obtained before proceeding with the study.

Data collected from patients was kept confidential in such a way that study subjects could not be identified. Assessment results were not disclosed to study subjects under evaluation. Written consent was obtained from asthmatic patients, prior to data collection. Moreover, demographic data of patients was strictly kept confidential.

Statistical analysis

The collected data was analyzed by using Statistical Package for Social Sciences program software (SPSS Inc., version 21.0, IBM corp., Armonk, NY, USA). Descriptive and inferential statistics were applied to summarize outcome variables. Categorical variables were presented as percentages and frequencies whereas quantitative variables were presented as mean and standard deviations. McNemar test was applied for pre and post-intervention intragroup comparisons to further access categorical variables. McNemar test access the statistical association between paired data that should be categorical as well. *P*-values *<0.05* were considered as statistically significant.

Table 1: Demographic data of patients.

Variables	Categories	Frequency (N)	Percentage (%)
Gender	Male	103	49.8
	Female	104	50.2
Age	18-24 years	32	15.5
	25-44 years	58	28.0
	45-64 years	78	37.7
	65 and above	39	18.8
Duration of Disease	0-5 years	43	20.8
	6-10 years	80	38.6
	11-15 years	33	15.9
	>15 years	51	24.6
Duration of using MDIs	0-5 years	83	40.1
	6-10 years	68	32.9
	11-15 years	38	18.4
	> 15 years	18	8.7
Instruction Method	Never Instructed	163	78.7
	Verbally Instructed	43	20.8
	Verbally Instructed + Written material provided	01	0.5

RESULTS

Demographic Characteristics of Study Subjects

Table 1 demonstrates the demographic characteristics of asthma patients included in the present study. A total of 207 asthma patients were recruited for this study. Majority of the patients (78.7%) were never instructed by healthcare providers regarding appropriate inhaler technique.

Patient's inhaler technique assessment

Table 2 presents the effect of educational intervention on MDI technique of patients before and after the provision of intervention.

Adequacy of inhaler technique of patients

Table 3 presents the adequacy of inhaler technique of patients pre and post intervention.

Originally, at baseline majority of the patients (76.3%) demonstrated poor inhaler technique. However, post intervention evaluation presented that majority of the patients (42.0%) exhibited moderate technique. Inhaler technique of patients presented a statistically significant improvement after provision of educational intervention (*p< 0.001*).

DISCUSSION

The introduction of inhalation therapy along with oral therapy for treatment of respiratory diseases was a major innovation in medical sciences.[19]

This study revealed that majority of the asthma patients' demonstrated poor efficiency in inhaler technique at baseline (76.3%). But, it was substantially improved as the result of educational intervention i.e., from 11.6% to 34.8%. Thus, signifying the feasibility and effectiveness of inhaler technique education based intervention on inhaler technique of asthma patients.

Similarly, A cross-sectional study conducted on asthma patients of Gondar, North-West Ethiopia,[20] presented that majority of the patients i.e. 71.4% presented improper inhaler technique at baseline,[17] which could be related to lack of guidance and instructions provided to them by their health care providers.

But, the findings of this current study are much lower than a study performed at Malaysian pharmacy setups, where 58% asthmatic patients demonstrated an efficient technique that could be directly related to their pharmacists having efficient inhaler techniques.[21]

Moreover, the results of this study comply with the research study conducted in South Carolina, United States of America; where only 6% participants presented appropriate inhaler technique at baseline. While improper inhaler technique was demonstrated by majority of the patients i.e. 94% of study subjects.[6] These results might be because of lack of guidance provided to patients by healthcare providers.

However, a cross sectional study conducted on Yemeni population presented analogous results demonstrating that majority i.e. 77.6% patients demonstrated poor inhaler technique originally. The poor inhaler technique of Yemeni patients could be due to lack of MDI instructions provided to patients by community pharmacists upon dispensing.[18]

The present study indicated that majority of the patients (80.7%) were using MDIs as needed, whereas, merely 19.3% patients were using MDIs as prescribed. These results lie in conformity to a research study conducted

Table 2: Effect of educational intervention on MDI technique of Patients.

*Steps	Pre Intervention N (%)			Post Intervention N (%)			*P*** Value
	Correct	In-correct	Skipped	Correct	In-correct	Skipped	
1. Shake the contents well.	25.1	00	74.9	73.9	00	26.1	<0.001
2. Remove the cap.	8.7	1.0	90.3	44.4	0.5	55.1	<0.001
3. Hold the inhaler upright.	7.3	15.0	77.8	52.2	1.9	45.9	<0.001
4. Tilt the head back slightly.	6.8	22.7	70.5	68.6	1.9	29.5	<0.001
5. Breathe out slowly.	5.8	29.0	65.2	78.3	1.0	20.8	<0.001
6. Open mouth with inhaler 1-2 inches away/ in mouth with lips tightly sealed around it.	70.0	27.5	2.4	91.8	5.8	2.4	<0.001
7. Breathe in slowly through mouth and actuate the canister once.	38.6	60.9	0.5	97.6	1.9	0.5	<0.001
8. Hold breath for 1-2 sec.	19.3	49.3	31.4	92.8	3.9	3.4	<0.001
9. Exhale and wait 1 min before 2nd dose.	4.3	16.4	79.2	60.4	4.3	35.3	<0.001
10. Shake again before 2nd dose.	01	0.5	98.6	24.6	0.5	74.9	<0.001
11.After use replace mouth piece cover.	0.5	0.5	99.0	18.4	0.5	81.2	<0.001

*Inhaler technique steps according to NAEPP guidelines.[16] **McNemar Test. *P<0.05* considered statistically significant.

Table 3: Adequacy of MDI technique of Patients (Pre and Post-intervention).

MDI Technique	MDI scores	Pre-Intervention N (%)	Post-Intervention N (%)	*P** value
Poor Technique	Less than or equal to 4	158 (76.3%)	48 (23.2%)	<0.001
Moderate Technique	5-6	25 (12.1%)	87 (42.0%)	
Good Technique	Greater than or equal to 7	24 (11.6%)	72 (34.8%)	

*McNemar Test. *P<0.05* considered significant.

in Egypt, 2022; where 92% patients presented non-compliance by using MDI as needed.[22] Similarly, a study conducted in Vietnam presented that majority of the patients (50%) use inhalers as needed, presenting poor adherence with inhalation therapy.[23] These results might be due to lack of treatment instructions to patients and pharmacoeconomic barriers in complying with prescribed treatment therapy.

This current study has suggested that 78.7% patients subjected for this study were never verbally instructed by healthcare providers. These results lie in conformity to another study conducted in France where 25% of patients never received verbal instructions for the use of inhalers prescribed to them.[24] Similarly a cross sectional research on Serbian population reported non provision of inhaler instructions in majority of study population.[25] This might be due to increased work load of pharmacists in community pharmacy setups and consequently decreased time to educate patients individually. Thus, presenting the importance of educational programs and trainings on latest inhaler technique on a regular basis keep the knowledge of health care professionals refreshed and up to date.[26]

Among asthma patients, step 5 (exhale slowly) was the least correctly demonstrated essential step i.e. 5.8%. Whereas, a huge amount of 60.9% patients incorrectly demonstrated step 7 "Breathe in slowly through mouth and actuate the canister once". Similarly, according to the research conducted on Swedish primary and secondary care patients, "No exhalation before inhalation" was the most incorrectly demonstrated step.[27] While according to the study conducted in Mekelle; Ethiopia, step 7 was the least correctly demonstrated step.[21] However, two different studies from Hamedan, Iran concluded that step 7 (actuating the canister) was most repeatedly occurred error.[28] Since, step 7 and step 5 are technical steps that need to be correctly performed for appropriateness, lack of physical demonstration and instructions by pharmacists to patients might have resulted in poor competency.

This present study revealed that step 9 was skipped by 79.2% of respondents, but as the result of educational intervention it was improved to 60.4%. Similar results were obtained from a prospective study conducted in Pokhara, Nepal.[17] These results signify the importance of inhaler technique education.

Competency of patients regarding inhaler technique is observed to improve with the provision of an educational intervention but still, despite of individual educational guidance, the majority of patients could not demonstrate adequate inhaler technique. These results might be because repeated and group-based training sessions play a comparatively better role in enhancing inhaler technique competency as compared to individual, short duration guidance. As presented by randomized controlled parallel group research from Sydney, Australia that suggested that repeated physical demonstrations improve inhaler technique in a better way as compared to verbal, short duration, single time instructions.[29]

The findings of this present study comply with the study from the United Kingdom that concluded that training programs do not improve the majority's inhaler technique.[30] On contrary, a similar interventional study involving informational leaflets conducted at Nepal demonstrated significant improvement in inhaler technique post-intervention.[17] Likewise, inhaler technique of pediatricians from Brazil was significantly improved post-intervention ($p<0.001$).[31]

In this research, relatively low competency rate of study subjects regarding inhaler technique might be directly associated with the lack of inhaler technique instructing training sessions and educational programs. Since, such educational programs influence inhaler technique significantly.[32] Educational seminars and training programs are very helpful at keeping the knowledge of patients updated. However, lack of such programs might be the reason for inadequate MDI technique of majority of the patients.[33] A cross sectional observational study conducted in Italy on asthma patients concluded that inappropriate inhaler technique is among the most common reasons of reduced disease management, pressing on the importance of inhalers appropriate technique.[5]

Provision of inhaler technique education to patients greatly enhances the ability of patients to use their inhalers with appropriate inhaler technique resulting in more effective treatment outcomes and consequently better asthma control.[34] Therefore, it is observed that improvement in inhaler technique of patients, leads to improved asthma control.

CONCLUSION

Majority of asthma patients recruited for this study, presented poor inhaler technique during baseline survey. These results lead to the conclusion that patients are inadequately instructed about inhaler usage technique by healthcare providers. Educational intervention involving theoretical and practical guidance, successfully improved the inhaler technique of patients. Thus, pressing the need for periodic and repeated educational trainings and seminars.

LIMITATIONS

This study was conducted in a single medical complex of Islamabad; therefore; the results from this study cannot be extrapolated and generalized nationwide.

In patients, short term memory might have influenced results. Post-interventional assessment was evaluated with a gap of merely one month; such short duration evaluation might have influenced positive results. Long term, periodic monthly follow-up assessments might have presented better evaluation results.

RECOMMENDATIONS

This study depicts the results of a single city. Further studies with larger sample sizes should be conducted in other cities of Pakistan as well, to conclude these results nationwide. Moreover, patient's inhaler technique should be assessed on a routine basis to ensure correct inhaler technique that will directly accentuate the quality of life of patients. Long term and periodic educational programs and seminars on inhaler technique education should be conducted to keep patient's knowledge updated. Regular follow-up studies should be conducted following these educational programs based on cross-sectional approach to identify barriers in educating patients.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

MDI: Metered-dose Inhalers; **NAEPP:** National Asthma Education and Preventive Program; **NHLBI:** National Heart, Lung and Blood Institute; **ICS:** Inhaled corticosteroids.

REFERENCES

1. Shamkuwar CA, Kumari N, Meshram SH, Dakhale GN, Motghare VM. Evaluation of Knowledge, attitude and medication adherence among asthmatics outpatients in tertiary care teaching hospital-A questionnaire based study. J Young Pharm. 2016 Jul 8(1):39-43.
2. Iqbal MS, Al-Saikhan FI, Ahmed NJ, Iqbal MZ. Pharmacoeconomic Analysis of Acute Exacerbation of Chronic Obstructive Pulmonary Disease. Int. J. Pharm. Investig. 2020 Apr; 32(4): 59-66.
3. Dharmage SC, Perret JL, Custovic A. Epidemiology of asthma in children and adults. Front Pediatr. 2019 Jun 18;7:246.
4. Arsalan MH, Khan IA, Mehdi MR, Qureshi S, Jamil S, Kazmi H, *et al.* Exploring the Awareness of Asthma in the Context of Socio-Economic Disparities: a Case Study of Karachi-Pakistan. Int J Biol Biotech. 2021;18(3):537–46.
5. Turan O, Turan PA, Mirici A. Parameters affecting inhalation therapy adherence in elderly patients with chronic obstructive lung disease and asthma. Geriatrics & gerontology international. 2017 Jun;17(6):999-1005.
6. Shealy KM, Paradiso VC, Slimmer ML, Campbell DL, Threatt TB. Evaluation of the prevalence and effectiveness of education on metered-dose inhaler technique. Respir Care. 2017 Jul 62: 882–887.
7. Al-jahdali H, Ahmed A, Al-harbi A, Khan M, Baharoon S, Salih S Bin. Improper inhaler technique is associated with poor asthma control and frequent emergency department visits. Allergy Asthma Clin. Immunol 2013 Feb 1–7.
8. Mubarak N, Hatah E, Khan TM, Zin CS. A systematic review and meta-analysis of the impact of collaborative practice between community pharmacist and general practitioner on asthma management. J Asthma Allergy 2019 May12; 109-153.
9. Iqbal MS, Al-Saikhan FI, Ahmed NJ, Iqbal MZ. How Do Out-of-Pocket Expenditures Affect Healthcare: A Qualitative Insight of Acute Exacerbation among Asthma Patients. J Pharm Res Int. 2020 Apr 32(4):67–73.
10. Muchão FP, Silva Filho LVRF da, Pastorino AC, Rodrigues JC, Muchão FP, Silva Filho LVRF da, *et al.* Metered-dose inhaler for asthma patients: knowledge and effects of a theoretical and practical guidance for pediatricians. Einstein (São Paulo). 2011 Aug 9: 337–342.
11. Onyedum C, Ukwaja K, Desalu O, Ezeudo C. Challenges in the management of bronchial asthma among adults in Nigeria: A systematic review. Ann Med Health Sci Res. 2013 Sep 3: 324.
12. García-Cárdenas V, Sabater-Hernández D, Kenny P, Martínez-Martínez F, Faus MJ, Benrimoj SI. Effect of a pharmacist intervention on asthma control. A cluster randomised trial. Respir Med. 2013 Sep 1;107(9):1346-55.
13. Bousquet J, Clark TJ, Hurd S, Khaltaev N, Lenfant C, O'byrne P, Sheffer A. GINA guidelines on asthma and beyond. Allergy. 2007 Feb;62(2):102-12.
14. Houts PS, Witmer JT, Egeth HE, Loscalzo MJ, Zabora JR. Using pictographs to enhance recall of spoken medical instructions II. Patient education and counseling. 2001 Jun 1;43(3):231-42.
15. Urbano FL. Review of the NAEPP 2007 Expert Panel Report (EPR-3) on Asthma Diagnosis and Treatment Guidelines. J Manag Care Spec Pharm. 2008 Jan 14(1):41-49.
16. Krishnan JA, Cloutier MM, Schatz M. National Asthma Education and Prevention Program 2020 guideline update: where do we go from here?. Am J Respir Crit Care Med. 2021 Jan 15;203(2):164-7.
17. Kishore PV, Palaian S, Alam K, Shankar PR, Bajracharya B, Van den Ende J. Correct use of a metered dose inhaler: A prospective interventional study among healthcare professionals in a Nepalese Teaching Hospital. J. Clin. Diagnostic Res. 2008 Apr 2: 720–726.
18. Al-worafi, Yasser M. Evaluation of inhaler technique among patients with asthma and COPD in Yemen. J Taibah Univ Med Sci. 2018 Oct 13(5): 488–490.
19. Belachew SA, Tilahun F, Ketsela T, Ayele AA, Netere AK, Mersha AG, *et al.* Competence in metered dose inhaler technique among community pharmacy professionals in Gondar town, Northwest Ethiopia: Knowledge and skill gap analysis. PLoS One. 2017 Nov 12: 1–10.
20. Iqbal MS, Al-Saikhan FI, Iqbal MZ, Ahmed NJ. The Burden of Illness of Acute Exacerbation of Asthma. Asian J Pharm. 2020 Sep 14(2):183–7.
21. Loh LC, Teng CL, Teh PN, Koh CN, Vijayasingham P, Thayaparan T. Metered-dose inhaler technique in asthmatic patients-A revisit of the Malaysian scene. Int. Med. J. Malays. 2004 Aug 1;59(3):335-41.
22. Khan TM, Azhar S. A study investigating the community pharmacist knowledge about the appropriate use of inhaler, Eastern Region AlAhsa, Saudi Arabia. Saudi Pharm J. 2013 Aug 21: 153–157.
23. Ngo CQ, Phan DM, Vu GV, Dao PN, Phan PT, Chu HT, Nguyen LH, Vu GT, Ha GH, Tran TH, Tran BX. Inhaler technique and adherence to inhaled medications among patients with acute exacerbation of chronic obstructive pulmonary disease in Vietnam. Int J Environ Res Public Health. 2019 Jan;16(2):185.
24. Lavorini F, Magnan A, Dubus JC, Voshaar T, Corbetta L, Broeders M, Dekhuijzen R, Sanchis J, Viejo JL, Barnes P, Corrigan C. Effect of incorrect use of dry powder inhalers on management of patients with asthma and COPD. Respir Med. 2008 Apr 1;102(4):593-604.
25. Ilic AD, Zugic V, Zvezdin B, Kopitovic I, Cekerevac I, Cupurdija V, Perhoc N, Veljkovic V, Barac A. Influence of inhaler technique on asthma and COPD control: a multicenter experience. Int J Chronic Obs Pulmon Dis. 2016;11:2509.
26. Klijn SL, Hiligsmann M, Evers SMAA, Román-Rodríguez M, Van Der Molen T, Van Boven JFM. Effectiveness and success factors of educational inhaler technique interventions in asthma & COPD patients: A systematic review. npj Prim Care Respir Med. 2017 Sep 27: 1–10.
27. Hardwell A, Barber V, Hargadon T, McKnight E, Holmes J, Levy ML. Technique training does not improve the ability of most patients to use pressurised metered-dose inhalers (pMDIs). Prim Care Respir J. 2011 Mar;20(1):92-6.
28. Ali HD, Worku GS, Alemayehu AA, Gebrehiwot W. Competence in metered dose inhaler technique among dispensers in Mekelle. Allergy, Asthma Clin Immunol. 2014 Dec 10(1):1-5.
29. Nadi E, Zeraati F. Evaluation of the metered-dose inhaler technique among

healthcare providers. Acta Med Iran. 2005 Aug 43: 268–272.

30. Watkins K, Trevenen M, Murray K, Kendall PA, Schneider CR, Clifford R. Implementation of asthma guidelines to West Australian community pharmacies : an exploratory , quasi-experimental study. bmjopen 2016. 012369
31. Clark NM, Gong M, Schork MA, Kaciroti N, Evans D, Roloff D, Hurwitz M, Maiman LA, Mellins RB. Long-term effects of asthma education for physicians on patient satisfaction and use of health services. European Respiratory Journal. 2000 Jul 1;16(1):15-21.
32. Capelo AV, de Fonseca VM, Peixoto MVM, de Carvalho SR, Guerino LG. Central obesity and other factors associated with uncontrolled asthma in women. Allergy, Asthma Clin Immunol. 2015 Sep 11: 1–8.
33. Bosnic-Anticevich SZ, Sinha H, So S, Reddel HK. Metered-dose inhaler technique: the effect of two educational interventions delivered in community pharmacy over time. J Asthma. 2010 Apr 1;47(3):251-256.
34. Chellammal HSJ, Arumugam D, Menon BV, Menon SMM, Mohd Faizal S Bin. Sociodemographic Factors and its Impact on Health Related Quality of Life (HRQoL) among Adult Asthma Patients in a Private Specialist Hospital in Malaysia. J Young Pharm. 2019 Aug 11: 404–409.

Article History: Received: 30-05-2022; Revised: 13-06-2022; Accepted: 14-07-2022.
Cite this article: Shahid S, Ahmed F, Shahnaz G, Saqlain M, Ans M, Sana A, *et al*. The Impact of Theoretical and Practical Guidance Regarding Metered dose Inhaler Technique on Asthma Patients. J Young Pharm. 2022;14(3):327-32.