Omdurman Journal of Pharmaceutical Sciences

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Impact of a Pharmacist-led Educational Intervention on Inhalation Technique among Sudanese Patients with Asthma

Elham Khaled[1*], Imad Eldeen M. Taj Eldeen[1], Mirghani Yousif [2],Hamed Fadlallah Hamed[3]

1-Department of pharmacology, Faculty of Pharmacy, University of Gezira, Wad Medani, Sudan,

2-Department of clinical pharmacy and pharmacy practice, Faculty of Pharmacy, University of Gezira, Wad Medani, Sudan

3-Department of Chest Diseases, Wad Medani Teaching Hospital, Ministry of Health, Wad Medani, Sudan

***Corresponding Author:** Elham Khaled

Email:Elham29.ek@gmail.com

DOI: 10.52981/ojps.v2i3.2869 ISSN: 1858-506X

Abstract:

The proper use of inhaler devices can improve medication efficacy while decreasing dose and adverse effects. The main objective of this study was to investigate the effect of pharmacist-led asthma education interventions on inhaler techniques. This study was a controlled, randomized, prospective intervention, in Wad Medani Teaching Hospital outpatient clinic, between March and June 2021.Structured questionnaire with validated checklists of inhaler techniques were used to collect data, from patients at baseline and at three months of follow-up, for both intervention and control groups. Paired and independent t-tests were used to monitor the effectiveness of the interventions. A total of 130 asthmatic patients were enrolled in this study. The intervention group contains 70 patients (53.8%), while the control group contains 60 patients (46.2%). The mean score for the inhaler techniques of Pressurized metered-dose inhalers(PMDIs) was (3.50±1.43) for the intervention group at baseline and increased after the intervention to (6.78±0.515), this result was significant at the (P = 0.05) level, and the mean score of the dry powder inhaler technique at the initial of this study in the intervention group was (4.72 ±1.50) this means were improved after the intervention to (6.83± 0.44) this result was statistically significant. There was no significant difference between the control group before and after intervention (P=0.321).This study has shown that the pharmacist-led educational

intervention improved the inhalation technique of asthmatic patients. It is important to consider these programs as routine health care to enhance inhaler techniques.

Keywords: Asthma, Pharmacist, Inhaler Techniques, Outpatient clinics, Sudan.

Introduction:

Respiratory disease is the leading cause of death, direct health-care expenses, and indirect costs associated with lost productivity [1].Inhalation is the preferred method of administration, for the delivery of medications to treat respiratory illnesses like asthma and chronic obstructive pulmonary disease (COPD) [2-3].The right use of inhaler devices can improve medication efficacy while decreasing dose and adverse effects [4]. It's essential to identify the patient's inhaler techniques before beginning a treatment strategy as the proper medication delivery represents the first step toward effective pharmacological treatment [5]. The majority of asthmatic patients do not handle the inhaler correctly [6-8]. Inhalers require different steps for efficient and precise drug administration, and education on the inhaler techniques has been shown to increase adherence, illness control, and also enable dose reduction over time[9]. In Sudan, the most prescribed drugs for asthma are the pressurized metered-dose inhalers (PMDIs) and dry powder inhalers (DPIs) [10]. PMDIs are commonly the cheap inhalers devices and are considered the first choice, although their efficacy is highly dependent to use them correctly. It requires the coordination of actuation to deliver the drug by slow inhalation [11]. DPIs need little coordination between the patient and the device and easy to handle compared with PMDIs [7,12].When the proper technique is repeated frequently, good results can be obtained[13-14]. Since educational programs that exclusively used written materials weren't efficient[15].Pharmacists play an essential role in education programs and are easily available and frequently patient interaction, allowing them to monitor medication compliance and disease control [16-18]. Furthermore, patients require support and education not only to identify the necessity of effective disease control but also to establish appropriate inhaler technique [19]. Patient choice and satisfaction, for a specific inhalers devices, have been correlated to better adherence to therapy regimens, evidence recently confirmed that all devices assessed performed equally in individuals who recognized how to use them properly [20]. The major objective of this study was to investigate the effect of pharmacist-led asthma education interventions on inhaler techniques.

Methods:

Study design and Setting:

The following research was controlled, randomized, prospective intervention (Figure. 1)[21]. In the out-patients clinic of Wad Medani Teaching Hospital, Gezira State, Sudan. Wad Medani Teaching Hospital had 350 bed capacity and the number of specialists was 40 [22]. Every Sunday, patients were seen at the outpatient chest clinic. Appropriate subjects were enrolled randomly into one of two arms intervention group (n=70) patients and control one a usual routine care (n=60) patients within the time frame of study (three-months).Education of patients was individualized during face-to-face inhaler technique education for at least 30 minutes session after that patient was given written education materials in the form of a booklet [23-24] and they watched videos. The language of book was Arabic. Every month patients were checked for inhaler use by the researcher pharmacist during the period of study from March to June 2021.All study participants had an initial evaluation interview at the start of the study, and during that patient-specific data were collected. Firstly, patients were requested to use the inhaler and the researcher pharmacist had checklists for an initial assessment. All patients' information was kept confidential. Standardized checklists for optimal inhaler technique have been used to measure efficiency in the use of inhalers at baseline and during follow-up interviews for three months [25-26].

Study Population:

Asthmatic patients with confirmed diagnosis of physician, aged more than 18 years, could fill out the follow-up form and can also be contacted by telephone. Patients with other respiratory medical problems and patients with cognitive, psychiatric problems were excluded.

Sample size:

All asthmatic patients who fulfilled the inclusion criteria during three months of enrolment and provided their agreement to participate were engaged in current research. Patients selection either in control group or intervention one was simply random. The researcher pharmacist that conducted the study selected starts and end dates that were individualized to each asthmatic patient. The first patient was included on 1/3/2021 each participant was expected to finish a three-month follow-up time. Despite that, the starting point date was not at all the same, every patient was provided the required instruction in each group. One hundred thirty patients were involved.

Data collection:

Demographic data were collected using a structured interviewing questionnaire, and standardized checklists for optimal inhaler techniques had been used to measure efficiency of patients' use of inhalers at baseline and during follow-up interviews, for three months, the inhaler techniques of participants were compared to the proper checklists for the form of inhalers they were using. Each correct step was awarded one point, and incorrect steps were given a score of zero [27]. If the patients made any mistakes that could have led to dosage loss or a reduction in medication delivery to the lung, the inhaler use skill was poor. Error-free use of the inhalers was considered good [28]. For measuring the outcome, patients scores were measured before and after of the education program. Data were analyzed to reveal significant changes in the score of data.

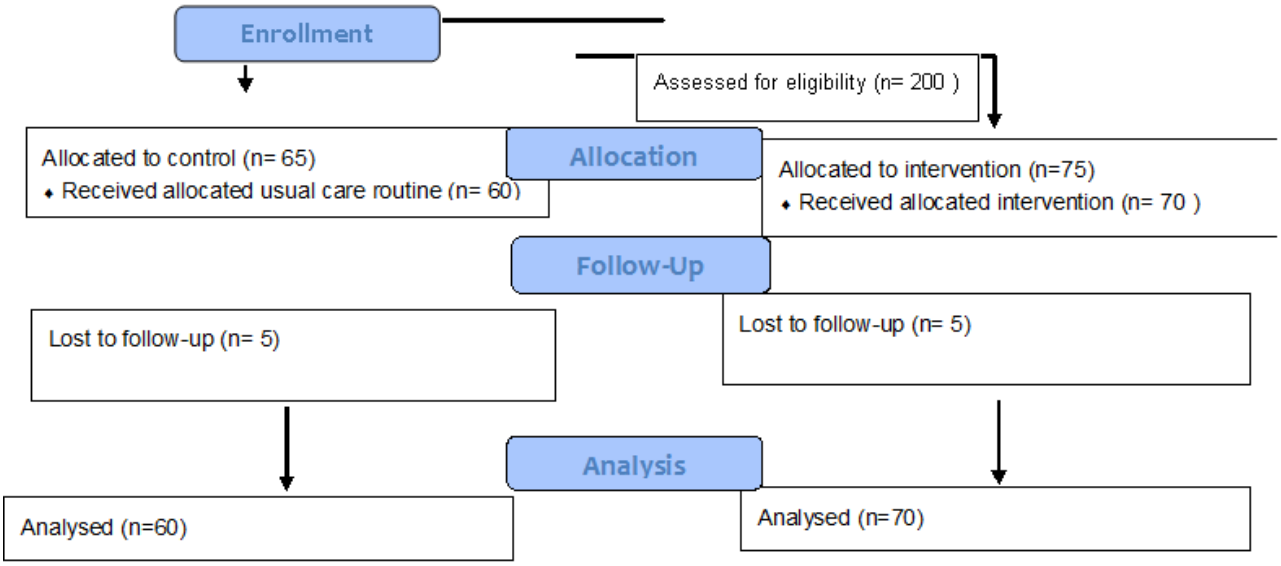

Figure 1: Flowcharts of Study Design

Data analysis:

Descriptive statistical analysis was performed, to generalize the findings of quantitative data and

hypothesis testing like independent t-test, paired t-test to test whether the mean difference between groups of measurement, and Pearson's Chi-Square test, for testing relationships between categorical variables were done. Significance level was set as $P < 0.05$.

Ethical Approval:

Ethical approval for this research was obtained from the Research Ethical Committee, Faculty of Medicine, and University of Gezira (Serial Number: NO.12-20). Approval was obtained from the Ministry of Health, Gezira State, Sudan. Before enrolling, Participants provided verbal and written consent. Privacy was respected.

Results:

Demographic characteristics of participants:

A total of one hundred and thirty (130) patients were enrolled in the study. The intervention group contains 70 patients (53.8%), while the control group contains 60 patients (46.2%). The mean age of the study participants was 35years (±14), more than half of the participants university graduated (58.5%), half of the participants (51%) were from the rural origin, females predominated (68.5%), half of them (50%) were married, the current occupation of the participants was either housewife (29.2%) or students (28.5%) and (23.1%) were employed.

Table 1 illustrates an association of demographic characteristics of participants and inhaler technique of patients. The improper inhaler use appeared obviously in patients aged more than 36 years (68.4%), in the female's gender (60%).

It is apparent from Table2 the inhaler techniques of metered-dose inhaler when compared with a validated checklist, at baseline assessment. The majority of participants (90%) did not breathe out gently away from the inhaler, about (26%) of them, put a mouthpiece between their teeth (without biting) and closed lips, furthermore (57%) of participants holding breath for 10 seconds.

Table 3 shows that Patients' assessment of dry powder inhaler (Turbuhaler) at baseline. Most patients (88%), did not breath out gently (away from the inhaler), (26%) of them put the mouthpiece between their teeth (without biting) and closed lips and breath in strongly and deeply, a high percentage of patients (70%) did not hold their breath for about 10 seconds.

The mean score of inhaler techniques of PMDIs was 3.50±1.43 for the intervention group at baseline and increased after the intervention to 6.78±0.515, this result was significant at the P= 0.05 level, while in the control group none of these differences were statistically significant. As shown in Table 4.

From Table 5. The mean score of the dry powder inhaler techniques at the initial of the study in that intervention group was 4.72 ±1.50, this mean was improved after the intervention to 6.83± 0.44.This result was statistically significant (P value = <0001). In the control group there was no significant difference before and after intervention (P value = 0.321).

Table 1: Association of demographic characteristics of participants and inhaler techniques

Characteristic		**Inhaler Technique Classification**		
		Proper Use n (%)	**Improper Use n (%)**	**P-Value**
Age	18-25	25(50.0)	25(50.0)	0.131
	26-35	12(36.0)	21(64.0)	
	36-50	9(21.0)	33(79.0)	
	51-65	11(27.5)	29(72.5)	
Gender	Male	21(51.0)	20(49.0)	0.25
	Female	36(40.0)	53(60.0)	
Residence	Rural	29(43.0)	38(57.0)	0.894
	Urban	28(44.0)	35(56.0)	
Education level	Illiterate	1(100.0)	0(00.0)	0.613
	Primary school	9(47.0)	10(53.0)	
	Secondary school	16(47.0)	18(53.0)	
	University. Graduate	31(4.0)	45(59.0)	
Current Occupation	Employed	17(57.0)	13(43.0)	0.323
	Housewife	16(42.0)	22(58.0)	
	Free worker	8(32.0)	17(68.0)	
	Student	16(43.0)	21(53.0)	
Social Status	Married	28(43.0)	37(57.0)	0.86

	Single	28(44.0)	36(56.0)	

.

Table 2: Patients assessment of metered-dose inhaler techniques at baseline

	Control group Yes n (%)	**Intervention group Yes n (%)**
1-Remove duster cap	60(100-0)	70(100.0)
2-Keep inhaler in the upright position	53(88.3)	62(88.6)
3-Shake inhaler thoroughly	36(60.0)	39(55.7)
4-Breathe out gently (away from the inhaler).	8(13.3)	4(5.7)
5-Put mouthpiece between teeth (without biting) and close lips	12(20.0)	23(32.9)
6- Start to breathe in slowly through your mouth and, at the same time, press down. Firmly on the canister	13(21.7)	15(21.4)
7- Holding breath for 10 seconds and breathe out Gently (away from the inhaler).	27(45.0)	35(50.0)

Table 3: Patients assessment of dry powder inhaler (Turbuhaler) at baseline

	Control Yes n (%)	**Intervention Yes n (%)**
Unscrew and remove the cover	29(100.0)	37(100.0)
Hold the sprayer vertically until the turntable is at bottom	27(93.1)	31(83.8)

Keep inhaler upright while twisting grip at the base: Twist around and then back until the click is heard.	23(79.3)	27(73.0)
Breathe out gently (away from the inhaler).	7(24.1)	8(21.6)
Put the mouthpiece between teeth (without biting) and close lips to form a good seal and breathe in strongly and deeply	16(55.2)	18(48.6)
Hold the breath for about 10 seconds or as long as comfortable	13(44.8)	22(59.5)
Replace cover.	23(79.3)	33(89.2)

Table 4: Effect of pharmacist-led intervention on inhalation technique of Turbuhaler

		Assessment at baseline	**After Intervention**	**P-value**
Patients Group	**Number**	**Mean**	**Mean**	
Intervention Group	37	4.72±1.50	6.83±0.44	<0001
Control Group	29	3.77±2.14	3.74±2.09	0.326
Intervention Group ***vs.*** Control Group		P value =<0001		

Table 5: Effect of pharmacist-led intervention on inhalation technique of PMDI

Discussion:

The current study showed that the individualized intervention for asthmatic patients improved the inhaler techniques in the intervention group compared with the control group in the three-month period. More than half of the patients were females (68.5%).This emphasizes the theory said that Asthma and allergic conditions gradually shifted from becoming more common in males to being more common in girls. Prevalence of asthma varies by gender and alters as a person progresses through the biological stages of life. Women get asthma at a higher rate than men by maturity [29-30]. Poor inhalation use was apparent at the baseline. The majority of patients didn't breathe out gently away from the inhaler, and almost, patients did not put a mouthpiece between their teeth and closed lips while performing metered-dose inhaler. Inappropriate asthmatic inhalation device use had been linked to poor asthma management and more visits to the emergency department[31].Poor inhalation performance is a key issue in asthma management since individual doesn't really obtain the recommended dose of medication, resulting in decreased treatment effects and poor disease control [32-33]. The pressurized metered-dose inhalers are the most common inhaler devices and this may be responsible for better handling by the patients compared to the dry powder inhalers [34]. Asthmatic patients in this study were one hundred thirty, all of these used metered-dose inhalers as reliever medication, or in form of controlled medication, but the half of patients used dry powder inhalers with a metered-dose inhaler. At the time of the study there was a medication shortage of dry powder inhalers, also this device was costly compared with a metered-dose inhaler [35].In considering inhalation procedures, one of the most common errors patients made when using metered-dose inhalers and dry powder inhalers were as follows: “did not breathe out gently away

		Assessment at baseline	After intervention	P-value
Patients Group	**Number**	**Mean**	**Mean**	
Intervention Group	70	3.50±1.43	6.78±.515	<0001
Control Group	60	3.53±.133	3.51±1.29	0.321
Intervention Group ***vs.*** Control Group		P- value	231	<0001

from the inhaler" and "did not hold their breath for about 10 seconds" which is same to study done by Akhoon and Brashier [36]. Patients that used dry powder inhaler also had common errors in step (4), step (5), and step (6), did not breathe out away from inhaler, and did not breathe strongly and deeply. In Sudan short-acting B- agonist (SABA) was accessible as PMDI. All of the patients used the PMDI as recommended to carry their rescue inhalers with them at all times. Patients could use the metered-dose inhaler alone or in conjunction with other inhaler devices depending on the Step in the management of chronic asthma. Controller inhalers are accessible as PMDI and Turbuhaler [37].

The metered-dose inhaler techniques in the intervention group improved compared to the control one, a study conducted by Elkhansa*et a.l* and Farrage *et a.l* reported an improvement of the inhalation technique in the intervention arm compared with the control arm, within a period of follow-up of two-month and six-month [38-39]. Another previous study revealed that intervention by pharmacists enhanced the inhaler techniques in patients with asthma, with a follow-up period [40-41].

Asthma management and inhaler use can all benefit from better pharmacist-patient communication or consultation. Asthmatic patients may benefit from regular consultation to improve their inhaler techniques and, as a result, their quality of life [42-43].

When compared to those with effective inhaler techniques, asthmatic patients that have poor inhaler techniques had much worse symptom control. As a result, patients' training on the use of suitable inhaler techniques would help to reduce symptoms, enhance self-control and therapeutic adherence. Poor inhaler techniques was a preventable component to asthma's burden [44-45].Asthma patients that were instructed on proper inhaler techniques have a greater rate of correct use of both DPIs and PMDIs[46].One of the most important aspects of good asthma control was proper inhaler technique, physical presentation of inhaler techniques was more effective than using educational brochures in enhancing inhaler technique [47].

Limitation of study:

This study had three limitations affecting the final finding. Because the data was collected during the second wave of the COVID-19 period, it was challenging to find patients on a regular basis at outpatient clinics. Additionally, due to low sample size for statistical analysis, there was no statistically significant correlation between participants' demographic features and their use of inhalers, despite previous studies showed such a

correlation. In this study the measurement of outcome limited only in the difference of scores between patients who used inhalers. Asthma control level and hospital visits were not taken into consideration.

Conclusion:

The pharmacist-led educational intervention improved the inhaler techniques in the intervention group, compared with usual routine care one. At three-month period of follow up. It is important to consider these programs as routine health care to enhance the inhaler techniques of patients.

Funding

There is no funding to report.

References:

[1] Ermolov, V. A. "Correlation ultrasonic system for materials and articles nondestructive testing using memory type of magneto-acoustic correlator," Defektoskopiya.,1997,1,32–40.

[2] Borghardt, J. M. Kloft, C., and Sharma,A., "Inhaled Therapy in Respiratory Disease: The Complex Interplay of Pulmonary Kinetic Processes," Can. Respir. J., 2018,2018,1-11.

[3] Lavorini, F.M.a, Antoine,C.D., Jean V., Thomas C., Lorenzo B., Marielle D., Richard S., Joaquin V., Jose L. B., Peter C., Chris L., Mark C., Graham K., "Effect of incorrect use of dry powder inhalers on management of patients with asthma and COPD," Respir. Med.,2008,102, 593–604.

[4] Jahedi,L. Downie,S., R., Saini,B., Chan,H., K., and Bosnic-Anticevich,S., "Inhaler Technique in Asthma: How Does It Relate to Patients' Preferences and Attitudes Toward Their Inhalers?," J. Aerosol Med. Pulm. Drug Deliv., 2017,30, 42–52.

[5] Baqai H. Z. Saleem, M. A. and Abair-ul-Haq ,M., "Assessment of metered dose inhaler technique in patients with chronic lung disease at government hospitals of Rawalpindi.," J. Ayub Med. Coll. Abbottabad,2011,23, 37–39.

[6] Rootmensen, G. N. Van Keimpema, A. R. J. Jansen, H. M. andDe Haan, R. J. "Predictors of incorrect inhalation technique in patients with asthma or COPD: A study using a validated videotaped scoring method," J. Aerosol Med. Pulm. Drug Deliv., 2010, 23, 323–328.

[7] Khassawneh, Basheer Y. Al-Ali, Musa K. Alzoubi, Karem H. Batarseh, Morad Z. Al-Safi, Saafan A. Sharara, Abdelmonem M. Alnasr, Hatem M. "Handling of inhaler

devices in actual pulmonary practice: Metered-dose inhaler versus dry powde inhalers," Respir. Care., 2008, 53, 324–328.

[8] Tajes-González, Y. M. Gulín-Dávila,J., and Castellano-Copa, P., "Evaluación de la técnica inhalatoria y valoración de la necesidad de intervención farmacéutica en pacientes con patología respiratoria," Farm. Hosp., 2019, 43,202–207.

[9] Arora, P. K., Lokender V., Vikram S., Rohit J., Anand P., M. M. Rathee, Deepti C., Pitambar., "Evaluating the technique of using inhalation device in COPD and Bronchial Asthma patients," Respir. Med., 2014,108, 992–998.

[10] Sony, A I El ,Chiang, C-y, Malik, E, Hassanain, S A, Hussien, H, Khamis, A H Bassilli, A F, Enarson, D A., "Standard case management of asthma in Sudan: a pilot project," Public Heal. Action, 2013, 3, 247–252.

[11] McDonald, E., and Ram,F., "Effectiveness of Asthma Inhaler Pharmacotherapy must take into consideration both the device and drug and which is guided by clinically meaningful outcomes," Arch. Pulmonol. Respir. Care., 2017, 3, 044–

[12] Schreiber, J., Sonnenburg, T., and Luecke, E., "Inhaler devices in asthma and COPD patients - A prospective cross-sectional study on inhaler preferences and error rates," BMC Pulm. Med., 2020, 20,1–12.

[13] Global Initiative for Asthma, "Global Strategy for Asthma Management and Prevention Updated 2020," Global Initiative for Asthma, 2020.

[14] Klijn, M. S. L. Hiligsmann, S. M. A. A. Evers, M. Román-Rodríguez, T. Van Der Molen, and J. F. M. Van Boven, "Effectiveness and success factors of educational inhaler technique interventions in asthma & COPD patients: A systematic review," npj Prim. Care Respir. Med., 2017,27,1–10.

[15] Crane, M. A. Jenkins, C. R.. Goeman, D. P and Douglass, J. A. "Inhaler device technique can be improved in older adults through tailored education: Findings from a randomised controlled trial," npj Prim. Care Respir. Med., 2014, 24,1–5.

[16] Castel-Branco, M. M. ,Fontes,A., and Figueiredo, I. V. "Identification of inhaler technique errors with a routine procedure in Portuguese community pharmacy," Pharm. Pract. (Granada).,2017, 15,3–7.

[17] Milosavljevic,A., Aspden,T., and Harrison, J., "Community pharmacist-led interventions and their impact on patients' medication adherence and other health outcomes: a systematic review," Int. J. Pharm. Pract., 2018, 26, 387–397.

[18] Jia, X., Zhou,S., Luo,D., Zhao,X., Zhou, Y., and Ymin Cui, "Effect of pharmacist-led interventions on medication adherence and inhalation technique in adult patients with asthma or COPD: A systematic review and meta-analysis," J. Clin. Pharm. Ther.,2020, 45, 904–917.

[19] Usmani, O. S. "Choosing the right inhaler for your asthma or COPD patient" Ther. Clin. Risk Manag.,2019, 15, 461–472.

[20] Anderson, P., "Patient preference for and satisfaction with inhaler devices," Eur. Respir. Rev.,2005, 14, 109–116.

[21] Falci, S. G. M. and Marques, L. S. Consort: When and how to use it. Dental Press Journal of Orthodontics. 2015, 20(3): 13–15.

[22] Sudan Federal Ministry of Health, "Annual Health Statistical Report 2019," Available from: http://www.sho.gov.sd/controller/ knowledge_hub.php?mid=110&sm_id=132&lid=1. [Last accessed on 2022 Jul. 28].

[23]Ministry of Health – Kingdom of Saudi Arabia "asthma "Available from: https://www.moh.gov.sa/en[Last accessed on 2020 Jul. 28].

[24]National Asthma Council Australia Ltd "Australian Asthma Handbook" Available from:https://www.asthmahandbook.org.au/ [Last accessed on 2020 Jul. 28].

[25] Hussain F. N. and Paravattil,B., "Assessment of Educational Inhaler Technique Interventions Among Community Pharmacists: A Systematic Review" Integr. Pharm. Res. Pract.,2020, 9,23–31

[26] Basheti, I. A. Bosnic-Anticevich, S. Z.. Armour, C. L and Reddel, H. K. "Checklists for powder inhaler technique: A review and recommendations," Respir. Care., 2014,59,1140–1154.

[27] Yadav,A., and Thapa, P., "Pharmacist Led Intervention on Inhalation Technique among Asthmatic Patients for Improving Quality of Life in a Private Hospital of Nepal," Pulmonary Medicine., 2019, 2019 1-9.

[28] Ngo, C. Q.; Phan, D. M.; Vu, G. Van; Dao, P. N.; Phan, P. T.; Chu, H. T.; Nguyen, L. H.;

Vu, G. T.; Ha, G. H.; Tran, T. H.; Tran, B. X.; Latkin, C. A.; Ho, C. S. H. and Ho, R. C. M. Inhaler technique and adherence to inhaled medications among patients with acute exacerbation of chronic obstructive pulmonary disease in Vietnam. International Journal of Environmental Research and Public Health. 2019, **16**(2): 185.

[29] Shah,R., and Newcomb, D. C. "Sex Bias in Asthma Prevalence and Pathogenesis," Front. Immunol.,2018, 9,1–11.

[30] Y. Chen, P. Stewart, H. Johansen, L. McRae, and G. Taylor, "Sex difference in hospitalization due to asthma in relation to age," J. Clin. Epidemiol., 2003,56, 180–187.

[31] AL-Jahdali, H, AL-Harbi, A, Khan, M, Baharoon, S, Bin Salih, S, Ahmed, A, Halwani, R, Al-Muhsen, S. "Improper inhaler technique is associated with poor asthma control and frequent emergency department visits," Allergy, Asthma Clin. Immunol., 2013, 9,1-7.

[32] Fink J. B. and. Rubin, B. K "Problems with inhaler use: A call for improved clinician and patient education," Respir. Care, 2005, 50,1360–1374.

[33] Giraud V. and Roche, N. "Misuse of corticosteroid metered-dose inhaler is associated with decreased asthma stability," Eur. Respir. J., 2002, 19, 246–251.

[34] Basheti, I. A. Armour, C. L. eddel, H. K. R and Bosnic-Anticevich, S. Z. "Long- term maintenance of pharmacists' inhaler technique demonstration skills," Am. J. Pharm. Educ., 2009, 73,1–8.

[35] Liljas, B. Ståhl,E., and Pauwels, R.,A., "Cost-effectiveness analysis of a dry powder inhaler (Turbuhaler) versus a pressurised metered dose inhaler in patients with asthma.," Pharmacoeconomics., 1997, 12, 267–277.

[36] Akhoon N., and Brashier D. B. S., "A study to monitor errors in use of inhalation devices in patients of mild-to-moderate bronchial asthma in a tertiary care hospital in Eastern India," Perspect. Clin. Res.,2022,13,17–24.

[37] GINA, "Global Initiative for Asthma – GINA 2021. Bethesda: Global Strategy for Asthma Management and Prevention.," Ginasthma.org, 2021.

[38] Abdelhamid, E.; Awad, A. and Gismallah, A. Evaluation of a hospital pharmacy-based pharmaceutical care services for asthma

patients. pharmacypractice. 2008, **6**(1): 25–32

[39] Farrag, R. R. Zaki, M. A. El-Naggar, T., and El-Hamamsy, M., "Asthma Patient Care: The Pharmacist's Perspective," Pharmacol. & Pharm.,2014, 05,551– 559.

[40] Schulz, M. ,Verheyen, F., Mühlig, S., Müller, J. M., Mühlbauer, K., Knop- Schneickert, E., Petermann, F., Bergmann, K. C. "Pharmaceutical care services for asthma patients: A controlled intervention study," J. Clin. Pharmacol., 2001, 41, 668–676.

[41] Armour, Carol L., Reddel, Helen K., Lemay, Kate S., Saini, Bandana, Smith, Lorraine D., Bosnic-Anticevich, Sinthia Z., Song, Yun Ju Christine, Alles, M. Chehani, Burton, Deborah L., Emmerton, Lynne, Stewart, Kay, Krass, Ines "Feasibility and Effectiveness of an Evidence-Based Asthma Service in Australian Community Pharmacies: A Pragmatic Cluster Randomized Trial," J. Asthma,2013,50, 302–309.

[42] Onda,M., Sakurai, H.,Hayase,Y., Sakamaki, H., Arakawa,Y., and Yasukawa,H., "Effects of patient-pharmacist communication on the treatment of asthma,"

Yakugaku Zasshi,2009, 129.,427–433. 2

[43] Foot,H., La Caze.,A., Baker,P., and Cottrell ,N., "Better understanding the influence and complexity of beliefs on medication adherence in asthma," Patient Educ. Couns., 2019, 102, 564–570.

[44] Lewis, A. , Torvinen, S., Dekhuijzen, P. N.R., Chrystyn, H., Watson, A. T., Blackney, M., Plich, A. "The economic burden of asthma and chronic obstructive pulmonary disease and the impact of poor inhalation technique with commonly prescribed dry powder inhalers in three European countries," BMC Health Serv. Res., 2016, 16, 1–12.

[45] Giraud, V., Allaert, F. A. and Roche,N., "Inhaler technique and asthma: Feasability and acceptability of training by pharmacists," Respir. Med.,2011, 105, 1815–1822.

[46] Aydemir,Y., "Assessment of the factors affecting the failure to use inhaler devices before and after training," Respir. Med.,2015, 109, 451–458.

[47] Ilic, Aleksandra Dudvarski, Zugic, Vladimir, Zvezdin, Biljana, Kopitovic, Ivan, Cekerevac, Ivan, Cupurdija, Vojislav, Perhoc, Nela, Veljkovic, Vesna, Barac, Aleksandra "Influence of inhaler technique on asthma and COPD control: A multicenter experience," Int. J.

COPD,2016, 11, 2509–2517.