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Research Article

An Intervention Study of Pharmacists' Knowledge and Patient Counseling on Metered Dose Inhalers and Nebulizers

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ABSTRACT

To carry out an intervention study on pharmacists' knowledge on metered dose inhalers (MDIs) and nebulizers, and patient counseling on MDIs in a tertiary hospital in South-Western Nigeria. A pre-post interventional study conducted among pharmacists in the University College Hospital, Ibadan. Semi-structured questionnaire was administered to the participants to obtain data for background assessment of the pharmacists' knowledge and patient counseling *vis-à-vis* metered dose inhalers and nebulizers. A seminar was organized to update the pharmacists' knowledge and patient counseling on MDIs and nebulizers. Post-intervention assessment was done a month after the intervention. Data was summarized using descriptive statistics and inferential statistics at $p<0.05$. Response rate was 81% (85/105). Pharmacists knowledge on MDIs and nebulizers improved significantly from 5.19 (SD=1.92) pre-intervention, out of 12 to 7.47 (SD=1.88) post-intervention ($p<0.001$). Assessment of pharmacists' patient counseling on MDIs increased significantly from 4.17 (SD=2.83) pre-intervention, out of 11, to 7.19 (SD=3.52) post-intervention ($p<0.001$). At least 50% of MDI administration steps was correctly stated by 33.1% and 71.7% of the pharmacists pre- and post-intervention, respectively. Only 2.4% and 23.5% of the pharmacists stated all the MDI administration steps correctly, pre-intervention and post-intervention, respectively. Pharmacists' additional educational qualifications, previous personal use of asthma inhalation medication and years of hospital pharmacy work experience influenced their assessment scores. The intervention carried out among the hospital pharmacists improved their knowledge on MDIs and nebulizers and also increased their patient counseling on MDIs.

Keywords: *Pre-post intervention study, metered dose inhaler, nebulizers, hospital pharmacists, knowledge and patient counseling.*

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INTRODUCTION

According to the Global Initiative for Asthma, the prevalence of asthma, which is a chronic lung ailment, is 5 – 10% worldwide (GINA, 2012). A recent study reported asthma prevalence of 6.4% in Nigeria (Ozoh *et al*., 2019). In spite of compliance to stipulated evidence-based management guidelines together with effective drugs, asthma remains poorly controlled among many asthma patients**.** Inappropriate inhalation medication device technique is a major reason for this (Basheti *et al*., 2011). Misuse of metered dose inhalers on account of poor technique was estimated to be prevalent in 14-90% of cases (Giraud and Roche, 2002). Moreover, inadequate inhaler technique has been allied with an increased risk of hospital admission, emergency department visits, and courses of oral steroids and antimicrobials (Al-Jahdali *et al*., 2013).

In spite of the fact that inhalation medication device is the preferred method of medication delivery to the lungs, evidence suggests that many patients are unable to use their inhalers effectively (Sanchis *et al*., 2016). Although study results vary, estimates of inhaler errors include up to 90% of patients using pressurized metered dose inhalers (Hardwell *et al*., 2011; Sanchi *et al*., 2016). Regular review of correct asthma inhalation medication technique by patients is vital. Some guidelines advise that inhaler technique should be regularly assessed at each clinic visit (NICE, 2010; BTS, 2014).

However, several studies have shown that healthcare professionals also lack adequate knowledge on appropriate

use of inhalers technique (Kishore *et al*., 2008; Valarmathi *et al*., 2011; Nduka *et al*., 2016; Poudel *et al*., 2016; Amorha *et al*., 2019; Belachew *et al*., 2019). On account of this, studies have examined educational interventions designed to "train the trainer" and improve healthcare professional inhaler competence. One of such studies demonstrated a significant improvement in pharmacists' knowledge and skills after participating in a single-session workshop (Basheti *et al*., 2009).

Pharmacists are in an excellent position to identify patients whose asthma may not be well controlled due to poor inhalation technique (Cordina *et al*., 2001). However, many pharmacists lack the skills needed to adequately demonstrate correct inhaler technique (Amorha *et al*., 2019: Belachew *et al*., 2019). In addition, inhaler technique tends to decline without routine review, highlighting the importance of periodic follow-up and reinstruction (Onyedum *et al*., 2013). Despite the potential for pharmacists to have a positive impact on asthma management, previous studies have shown that pharmacists rarely review or educate asthma patients on correct inhaler technique (Basheti *et al*., 2005; Mehuys *et al*., 2006).

There is increasing evidence to suggest that correct inhaler technique plays an important role in improving medicine adherence, clinical outcomes, quality of life, and use of healthcare resources (Melani *et al*., 2011; Goris *et al*., 2013; Darba *et al*., 2016). Pharmacists can improve the quality of life of asthmatic patients through education and information sharing on the use of their inhaler medication devices (Souza *et al*., 2009). Many studies have substantiated that the pharmacists' care of asthma patient, in different settings, has a positive impact on clinical and humanistic asthma outcomes in the long term (Hämmerlein *et al*., 2011; Saini *et al*., 2011; Nduka *et al*., 2016; Amorha *et al*., 2019). In Nigeria, research on evaluation of pharmacists' practice as regards asthma inhalation medication devices is scarce. It is needful to have such data to strategize better for the improvement of the quality of life of asthma patients.

The mainstay of asthma pharmacotherapy is the use of inhalation medications (Virchow *et al*., 2008). However, accurate inhalation technique with appropriate use of the delivery device is a *sine qua non* to adequate disease control. This study therefore aimed to evaluate the knowledge and patient counseling of the hospital pharmacists on metered dose inhalers and nebulizers with a view to carrying out an educational intervention to bridge gaps discovered.

METHODS

Study design: A pre-post intervention design was used for the study.

Study location: The study was carried out at the Pharmacy Department of the University College Hospital, Ibadan, Nigeria. The University College Hospital (UCH), Ibadan is a Federal Teaching Hospital affiliated with the University of Ibadan. It is involved with undergraduate training and postgraduate residency programs for healthcare professionals. It serves as a major referral center in Nigeria with specialists in many medical fields.

Inclusion and exclusion criteria: Pharmacists working at the Pharmacy Department in UCH who consented to participate in the study were recruited. Pharmacy students undergoing industrial attachment were excluded from the study.

Data collection instrument: A 24-item semi-structured questionnaire was developed for the study after consulting literature. The questionnaire was divided into three sections. Section A was for the socio-demographic data. Section B was for the assessment of the participants' knowledge on metered dose inhalers and nebulizers. The section had four questions for nebulizers and eight questions for metered dose inhalers (MDIs). Section C had questions on patient counseling on the use of MDIs.

The questionnaire was pretested for face validity. The questionnaire was adjusted based on the pretest responses. The questionnaire was reviewed by two Faculty members in the Department of Clinical Pharmacy and Pharmacy Administration, Faculty of Pharmacy, University of Ibadan, Nigeria for content validity.

Sample size: Total sampling of the entire pharmacists in Pharmacy Department, UCH who gave their consent to participate in the study was done.

Intervention: This consisted of a seminar with didactic lecture and demonstration on MDIs and nebulizers which lasted for about an hour.

Data analysis: Data was summarized using descriptive statistics, such as, frequency count, percentage, mean (standard deviation). Knowledge on MDIs and nebulizers, as well as patient counseling on MDIs was scored based on the number of correct response to questions asked. Each correct answer scored one point while each incorrect one scored zero point. The expected maximum score for knowledge on MDIs and nebulizers was 12 points, while patient counseling on the use of MDIs was 11 points, which comprised 10 points for MDI administration steps and 1 point for the question on patient counseling to prevent of oral thrush. The mean scores for the pharmacists' MDIs and nebulizer knowledge as well as their patient counseling on MDIs were divided by the expected total scores and multiplied by 100 to convert the scores to percent. It was categorized as follows: 0 - 49.9 % = Poor, 50.0 - 69.9 % = Fair, 70.0 - 89.9 % = Good and 90.0 - 100.0 % = Optimal.

The participants' assessment scores was compared with the years of professional experience using analysis of variance. Independent-samples t-test was conducted to compare the participants' assessment scores with gender and also with educational qualification. McNemar's test was carried out to compare participants' categorical responses, pre- and post-intervention. The pre-post intervention MDI and nebulizer knowledge and counselling assessment mean scores was evaluated using paired-samples t-test. The level of significance was set at $p < 0.05$.

Ethical approval: Ethical approval was obtained from the joint University of Ibadan/University College Hospital Ethics Committee.

RESULTS

Response rate was 81.0 %; out of the 105-questionnaire administered, 85 were retrieved for analysis. A larger proportion of the participants were females 55 (64.7 %). The mean age of the pharmacists was 37.89 (SD=8.83) years while their mean years of professional experience was 11.73 (SD=8.53). Sixteen (18.8 %) of the pharmacists were below 31 years of age. Details of the sociodemographic characteristics of the pharmacists is as presented in Table 1.

Table 1:
Demographic characteristics of the pharmacists (n=85)

Variables	Frequency	Percent
Age (years)		
≤ 30	16	18.8
31 - 40	42	49.4
> 40	27	31.8
Gender		
Females	55	64.7
Males	30	35.3
Marital Status		
Married	65	76.5
Single	19	22.4
Widow	1	1.2
Religion		
Christianity	77	90.6
Islam	8	9.4
Educational Qualification(s)		
B.Pharm only	44	51.8
M. Sc.	14	16.5
FPCPharm	14	16.5
PharmD	3	3.5
M. Sc. and FPCPharm	6	7.1
M. Sc. and PhD	2	2.4
M. Sc. and MBA	1	1.2
PharmD and FPCPharm	1	1.2
Years of Experience as Hospital Pharmacist		
≤ 10	60	71.4
11 - 20	15	17.9
> 20	9	10.7

FPCPharm= Fellow of West African Postgraduate College of Pharmacists
PharmD = Doctor of Pharmacy,
B. Pharm = Bachelor of Pharmacy,
MBA = Master of Business Administration,
M. Sc. = Master of Science

Fifty-seven (67.1 %) pharmacists never had any of their relatives placed on any inhalation asthma medication. Seventy-eight (91.8 %) pharmacists had never been on any inhalational asthmatic medication. Thirty-four (40.0 %) pharmacists reported being previously instructed on the use of asthma inhalation device: 24 (70.6 %) by pharmacists, 6 (17.5 %) by physicians, 3 (8.82 %) by relations and 1 (2.94 %) by a nurse. Figure 1 reveals the number of the metered dose inhaler administration steps stated by the pharmacists pre- and post-intervention. The number of pharmacists who knew that nebulizer can be used for unconscious patients was 39 (45.9 %) pre-intervention and 69 (81.2 %) post-intervention. Twenty-one (24.7 %) and 53 (62.4 %) pharmacists knew the waiting time before the administration of a second dose with metered dose inhaler, pre- and post-intervention, respectively. Details of the assessment of the hospital pharmacists' knowledge and patient counseling on metered dose inhalers and nebulizer is as presented in Table 2.

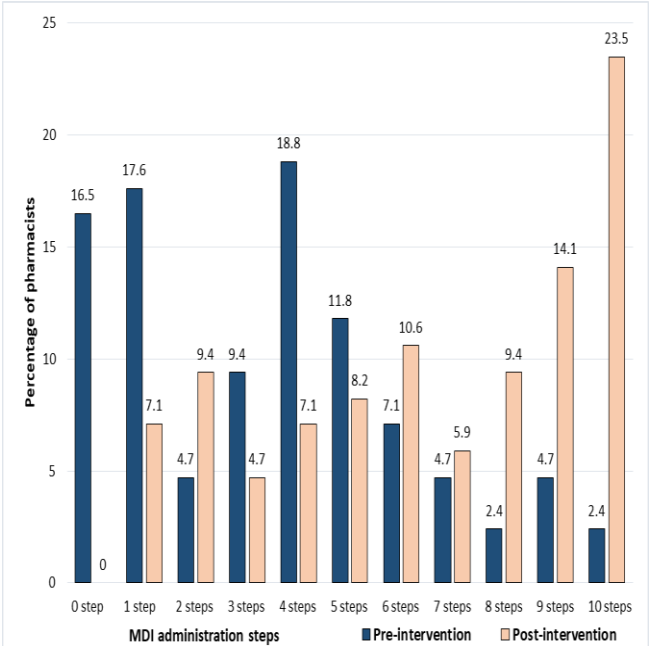

Figure 1
MDI administration steps started by the pharmacists pre- and post-intervention

Pharmacists with additional educational qualifications aside from Bachelor of Pharmacy had a significantly higher pre-intervention MDIs and nebulizer knowledge score than their counterparts with only Bachelor of Pharmacy. Pharmacists with over 20 years of work experience as hospital pharmacists had a higher score on patient counseling on MDIs than those with 20 years or less of work experience as hospital pharmacists. Further details on the comparison of pharmacists' MDIs and nebulizer knowledge and patient counseling mean scores with their educational qualification, gender and years of experience pre- and post-intervention is shown in Table 3.

DISCUSSION

The study showed a statistically significant improvement in the hospital pharmacists' knowledge on metered dose inhalers (MDIs) and nebulizers and patient counseling on MDIs. The pharmacists' assessment score was influenced by their educational qualifications, previous personal use of asthma inhalation medication, being previously counseled on use of asthma inhalation medication device and years of hospital pharmacy work experience.

The score categorization of knowledge assessment showed a positive trend of migration from poor knowledge category, which was the category of majority of the participants before the intervention to fair knowledge, which was the major category after the intervention.

Table 2:
Pharmacists' MDIs and nebulizer knowledge and patient counseling through the study period (n=85)

Questions	Pre-intervention	Post-intervention	p value[a]
	Frequency (%) of correct responses		
Knowledge on MDIs and nebulizer			
Can a nebulizer be used for unconscious patients?	39 (45.9)	69 (81.2)	<0.001*
Can a metered dose inhaler be used for patients who are ill and without proper breath coordination?	46 (54.1)	70 (82.4)	<0.001*
Can metered dose inhalers be used for children less than 3 years of age?	21 (24.7)	33 (38.8)	0.038*
Explanation for use of MDI in children less than 3 years of age	18 (21.2)	34 (40.0)	0.005*
A patient is expected to take a deep breath, release the puff and hold his breath for a while in metered dose inhaler administration	9 (10.6)	17 (20.0)	0.014*
How many puffs can be administered per time with a metered dose inhaler?	41 (48.2)	82 (72.9)	0.001*
Administration of medication using a nebulizer has a faster onset of action than using a metered dose inhaler	66 (77.6)	72 (84.7)	0.263
How long is the waiting time before administration of the second dose using a metered dose inhaler?	21 (24.7)	53 (62.4)	<0.001*
Metered dose inhalers delivers the medication through the nostrils	63 (74.1)	73 (85.9)	0.089
Nebulizers can deliver the medication through the nostrils	62 (72.9)	76 (89.4)	0.245
Nebulizers are only used on emergency cases to administer acute relief medications	18 (21.2)	17 (20.0)	0.750
Mention a disadvantage of using a metered dose inhaler in asthma management	63 (74.1)	65 (75.3)	0.359
Total MDIs and nebulizer knowledge mean score	5.19 (1.92)[c]	7.47 (1.88)[c]	<0.001*[b]
Patient counseling on use of asthma inhalational devices			
List the stepwise procedure involved in the administration of a metered dose inhaler	3.49 (SD=2.75)[c]	6.33 (SD=3.38)[c]	<0.001*[b]
How will you counsel your patient to avoid the oral thrush that usually results from use of asthma inhalational medications?	58 (68.2)	73 (85.9)	0.184
Total MDIs patient counseling mean score	4.17 (SD=2.83)	7.19 (SD=3.52)	<0.001*[b]
Total assessment mean score (MDIs and nebulizer knowledge score + MDIs patient counseling score)	9.36 (SD=4.06)	14.66 (SD=4.46)	<0.001*[b]
Expected total score	23	23	
MDIs and nebulizer score category[d]			
Poor knowledge (0.0 – 49.9 %)	45 (52.9)	9 (10.6)	
Fair knowledge (50.0 – 69.9 %)	36 (42.4)	52 (61.2)	
Good knowledge (70.0 – 89.9 %)	3 (3.5)	20 (23.5)	
Optimal knowledge (90.0 – 100.0 %)	1 (1.2)	4 (4.7)	
Patient counseling on MDI score category[d]			
Poor counseling (0.0 – 49.9 %)	57 (67.1)	24 (28.2)	
Fair counseling (50.0 – 69.9 %)	16 (18.8)	16 (18.8)	
Good counseling (70.0 – 89.9 %)	6 (7.1)	13 (15.3)	
Optimal counseling (90.0 – 100.0 %)	6 (7.1)	32 (37.6)	

**p < 0.05, [a] Test statistics = McNemar's test, [b] Test statistics = Paired-samples t-test, [c] Mean (standard deviation), [d] % score = (Total obtained score/Expected total score) x 100 %, SD = Standard deviation, MDIs = Metered dose inhalers*

For the counseling assessment, the migration was from majority in the below average category to majority in the excellent category. In this study, 33.1% and 71.7% of the pharmacists had at least 50% MDI administration steps correctly stated pre- and post-intervention, respectively. The pre-intervention finding was similar to the findings in a study done among community pharmacists in Gondar town, Northwest Ethiopia where only 35.4% pharmacists demonstrated at least 50% of the MDI steps accurately (Belachew *et al*., 2017). In another study done among hospital pharmacists in a tertiary hospital in South-Eastern Nigeria, only 22 (26.5 %) pharmacists were able to demonstrate more than 50% of the MDI steps correctly (Amorha *et al*., 2013).

Unlike the 2.4% of pharmacists observed in our study, 7.3% (Adnan *et al*., 2015), 1.0% (Osman *et al*., 2012), and 0.0% (Ali *et al*., 2014), completely demonstrated the proper technique for MDIs in other studies carried out in Saudi Arabia, Sudan and Ethiopia, respectively. Several factors could be responsible for the inability of pharmacists to completely know the MDI administration steps, such as, lack of training on the use of MDIs, infrequent dispensing of MDIs leading to forgetting the steps, lack of interest in that field of hospital pharmacy practice. It is however important for hospital pharmacists to be well grounded on patient counseling on MDI use to improve patients' quality of life.

Table 3:
Comparison of pharmacists' MDIs and nebulizer knowledge and patient counseling mean scores with their educational qualification, gender and years of experience pre- and post-intervention

Variables		Mean (SD)	p value	Mean (SD)	p value
		Pre-intervention		**Post-intervention**	
MDIs and nebulizer knowledge mean score					
Educational qualification	B. Pharm only (n = 44)	4.50 (1.61)	< 0.001*[a]	7.36 (1.94)	0.590[a]
	Additional qualifications (n = 41)	5.93 (1.98)		7.59 (1.83)	
MDIs patient counseling mean score					
Educational qualification	B. Pharm only (n = 44)	2.95 (2.29)	0.061[a]	5.82 (3.89)	0.145[a]
	Additional qualifications (n = 41	4.07 (3.09)		6.88 (2.68)	
MDIs and nebulizer knowledge mean score					
Gender	Female (n = 55)	5.47 (1.74)	0.652[a]	7.35 (1.73)	0.410[a]
	Male (n = 30)	4.67 (2.16)		7.70 (2.14)	
MDIs patient counseling mean score					
Gender	Female (n = 55)	3.89 (2.71)	0.071[a]	6.40 (3.37)	0.259[a]
	Male (n = 30)	2.77 (2.71)		6.20 (3.46)	
MDIs and nebulizer knowledge mean score					
Previous use of asthma inhalation medications	Yes (n = 7)	6.71 (1.60)	0.028*[a]	7.71 (1.80)	0.723[a]
	No (n = 78)	5.05 (1.90)		7.45 (1.90	
MDIs patient counseling mean score					
Previous use of asthma inhalation medications	Yes (n = 7)	6.14 (2.41)	0.007*[a]	6.14 (2.19)	0.880[a]
	No (n = 78)	3.26 (2.67)		6.35 (3.48)	
MDIs and nebulizer knowledge mean score					
Ever counseled on use of asthma inhalation device	Yes (n = 34)	5.91 (1.80)	0.004*[a]	7.74 (1.80)	0.292[a]
	No (n = 51)	4.71 (1.87)		7.29 (1.93)	
MDIs patient counseling mean score					
Ever counseled on use of asthma inhalation device	Yes (n = 34)	4.15 (2.68)	0.074[a]	6.15 (3.49)	0.687[a]
	No (n = 51)	3.06 (2.74)		6.45 (3.34)	
MDIs and nebulizer knowledge mean score					
Years of hospital pharmacy	< 11 (n = 28)	4.66 (1.64)	0.102[b]	6.91 (1.84)	0.032*[b]
	11 - 20 (n = 32)	5.52 (1.65)		8.22 (1.78)	
	> 20 (n = 25)	5.59 (2.34)		7.56 (1.85)	
MDIs patient counseling mean score					
Years of hospital pharmacy	< 11 years (n = 28)	2.49 (2.09)	0.006*[b]	5.34 (3.92)	0.078[b]
	11 - 20 years (n = 32)	3.61 (2.82)		7.00 (3.00)	
	> 20 years (n = 25)	4.70 (3.01)		7.04 (2.65)	

*[a] Test statistics = Independent-samples t-test, [b] Test statistics = One-way analysis of variance * p < 0.05, SD = Standard deviation*

The pharmacists MDI administration steps only increased from 3.49 (SD=2.75) to 6.33 (SD=3.38), out of 10 maximum points, one month after intervention. This is comparable to findings from a research done among hospital pharmacists in Jordan which showed an increase from 3.50 (SD=0.94) to 8.93 (SD=0.27) in the MDI technique after a single educational intervention (Basheti *et al*., 2014). In an intervention study carried out in a Nepalese teaching hospital, mean scores for all the expected ten steps for correct use of MDI was 5.8 pre-intervention and 7.1 post-intervention (Kishore *et al*., 2008). Intervention studies on healthcare practice helps to improve the competency of pharmacists in their day-to-day pharmaceutical care activities. This will eventually improve the quality of care received by patients.

The two-week post-intervention MDI demonstration skill assessment carried out among 5th-year pharmacy students yielded a mean score of 2.69 (SD=1.76), out of 8 maximum points (Basheti *et al*., 2015). In spite of the instruction, demonstration and self-practice with dummy MDIs in the study by Basheti and others, the mean demonstration skill was low. A skill that is not frequently put into practice may easily be forgotten. It is important for hospital pharmacists to specialize in their practice, such that they can master details of their chosen area of specialization, rather than possess scanty and unconvincing information in so many areas of practice.

Pharmacists who had additional qualifications aside from Bachelor of Pharmacy had significantly higher knowledge of MDIs and nebulizers. Undergraduate training in pharmacy schools only serves as a foundation but is insufficient to sustain the healthcare practice requirements. Some of the pharmacists may either not have been taught in school or may have forgotten the details of MDIs and nebulizers. It is imperative that hospital pharmacists get trained and retrained through postgraduate education to improve the quality of their service delivery.

As expected, pharmacists who had either personally used and/or who were counseled on asthma inhalation medication previously had significantly higher scores on knowledge of MDIs and nebulizers as well as patient counseling on MDIs. Such pharmacists should have been properly counseled on its use and they are likely to have mastered a lot as regards asthma inhalation medication device, since it directly had to do with their own health. Some of them may even be on such devices currently, and it is easier to recall what one does regularly.

Years of hospital pharmacy work experience significantly influenced the MDI counseling of the pharmacists.

Pharmacists who had spent over 10 years as hospital pharmacists are more likely to have completed postgraduate studies, attended national and international conferences and would also have had more on-the-job training exposures than those with one to ten years of work experience. Experience on the job goes a long way as regards practice skills on the use of asthma inhalation medication devices.

Most of the pharmacists had poor knowledge of MDIs and nebulizers pre-intervention, however, most of the pharmacists had fair knowledge post-intervention. Majority of the pharmacists had poor patient counseling on MDIs, however, most of the pharmacists had optimal patient counseling post-intervention. About one quarter of the pharmacists still had poor patient counseling on MDIs post-intervention.

The study has some limitations which include the fact that a one-time intervention may not be able to guarantee a sustainable implementation of the required practice skills. Another limitation was the absence of a control group to provide comparative assessment of the impact of the intervention. The study focused majorly on nebulizers and metered dose inhalers, but other asthma inhalation medical devices were not included.

In conclusion, the intervention carried out among the hospital pharmacists improved their knowledge on MDIs and nebulizers and also increased their patient counseling on MDIs. There is need for regular training for hospital pharmacists to improve the quality of pharmaceutical care service delivery.

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