

Ndukwu CI
Elo-Ilo JC
Mbachu C
Ayuk A
Ugwu N
Ngonadi S

CC –BY **Assessment of Paediatric resident doctors' knowledge of metered dose inhaler (MDI) device technique and use**

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Ndukwu CI (✉)
 Elo-Ilo JC, Ugwu N, Ngonadi S,
 Mbachu C
 Department of Paediatrics,
 Nnamdi Azikiwe University, Awka,
 Nnewi campus and Nnamdi
 Azikiwe University Teaching
 Hospital, Nnewi, Anambra state
 Nigeria.
 Email: ifeyc@yahoo.com,
 ch.ndukwu@unizik.edu.ng

Ayuk A
 Department of Paediatrics,
 University of Nigeria, Nsukka,
 Enugu campus and University of
 Nigeria Teaching Hospital, Ituku
 Ozalla, Enugu, Nigeria.

Abstract: *Background:* Inhalational therapy is a major component of asthma management, with efficacy dependent on the patient's inhalation technique. Proper patient education determines technique mastery and inhalation outcomes. Every paediatrician may be faced with the need to either prescribe or reinforce the technique of inhaler therapy in asthmatic patients. This study was thus embarked upon to ascertain the depth of inhaler technique knowledge of Nigerian paediatricians in training.

Objectives: To ascertain the knowledge of senior registrars in paediatrics about the technique and use of MDIs.

Materials and methods: This was a cross-sectional and descriptive survey in which all consenting paediatric senior registrars, who were present at the 2016 Health Resource management course organized by both Postgraduate Medical colleges in Nigeria, were recruited. Knowledge of critical steps of Metered Dose Inhaler (MDI) device technique was as-

sessed via a self administered questionnaire. Data entry and analysis was done using SPSS version 21.

Results: Fifty five Paediatric senior registrars (21 males, 34 females) were recruited. Their ages ranged from 24 to 44years with modal age of 32years. Inhaler prescription had been made by up to 74.5% of them within the past 6 months, with 51.2% of these prescribing within the past month. Basic knowledge on inhaler use was obtained from postgraduate training in 32.7% and medical school in 23.6%. The knowledge score was good in 14.5% of them and poor in 85.5%.

Conclusion: This study has shown that many Nigerian paediatricians in training lack the basic knowledge of MDI technique.

Recommendations: There is need to reinforce training on basic inhaler technique skills of paediatric resident doctors as this will positively impact on asthma control.

Key words: Metered dose inhaler, knowledge, paediatric residents

Introduction

Inhalational therapy is a major component of asthma management.^[1,2] This is primarily because of the effectiveness of delivery of inhaled medication to the target site, their rapid onset of action and few systemic adverse effects.^[1,3] Metered-dose inhalers (MDIs) are the most commonly prescribed inhaled medications for asthma, with proven efficacy in the management of childhood asthma, when appropriately delivered.^[3-6] Poor application technique amongst patients can partly explain the continued global high burden of asthma in terms of both acute exacerbations and asthma complications.^[1,3,7-9] As a result, current international guidelines on inhaler use strongly recommend that 'the physician should demon-

strate to the patient at initial visit how to use the various inhaler devices and then determine during regular follow-up visits if the preferred device is used properly.^[1]

Paediatricians, who are the mainstay of child health and asthma management, may need to either prescribe or reinforce the technique of MDI use in asthmatic patients, in regular or emergency practice. There is no documented study on the knowledge of the technique of MDI use amongst Nigerian paediatricians. Paediatricians in training (resident doctors) form a major bulk of the work force involved in the management of Nigerian children with bronchial asthma. Adequate knowledge of inhaler technique amongst them is critical towards achieving good asthma control in these children. This study thus set out to ascertain the level of knowledge of Nigerian

senior paediatric residents, on the correct technique of MDI use and possible factors associated with their knowledge.

Methods

This was a cross-sectional analytical survey. All consenting paediatric senior registrars attending the National and West African post graduate medical college management courses in Lagos and Ibadan, Nigeria, in July and August 2016 were recruited. A self-administered, structured and validated questionnaire adapted from a similar study done in Spain by Vicente *et al.* was distributed amongst all the consenting senior registrars and the ones filled by paediatric residents were analysed for the purpose of this study.¹⁰

Information obtained included socio-demographic data like age, gender, region of practice; date of last inhaler prescription and familiarity with basic steps of MDI device technique. The steps included removing the cap and shaking the inhaler, holding the inhaler upright and tilting the head slightly back, appropriate placement of the inhaler in the mouth, actuating the device as patient breathes in, continued breathing in, holding of breath for about 10 seconds, removing the inhaler from the mouth and breathing out slowly, rinsing the mouth if using inhaled corticosteroid, and priming of a new inhaler.

Among 12 questions asked, 4 specific questions according to American Thoracic Society specifications on MDI use in children, assessed objective knowledge: knowledge of priming of MDIs and additional use of spacer device in children, administration technique for multiple MDI doses and frequency of reassessment of patient MDI technique.¹¹ Scoring was done using a modification of the Inhaler Device Assessment Tool (IDAT) validated scoring system.¹² Correct and wrong answers were scored 1 and zero respectively. Maximum and minimum obtainable scores were four and zero respectively. Scores less than or equal to two were graded as poor while scores above two were graded as good. Factors which may affect knowledge of MDI use were assessed and these included age, gender, region of practice, period of most recent MDI prescription and major source of knowledge on MDI use.

Data analysis was done using Statistical Package for Social Sciences (SPSS) version 21. Relevant means and percentages were computed with tabular and graphical representation of data. Chi square statistical test was used to check for significant associations between categorical variables. A $p < 0.05$ was regarded to be statistically significant.

Results

General data

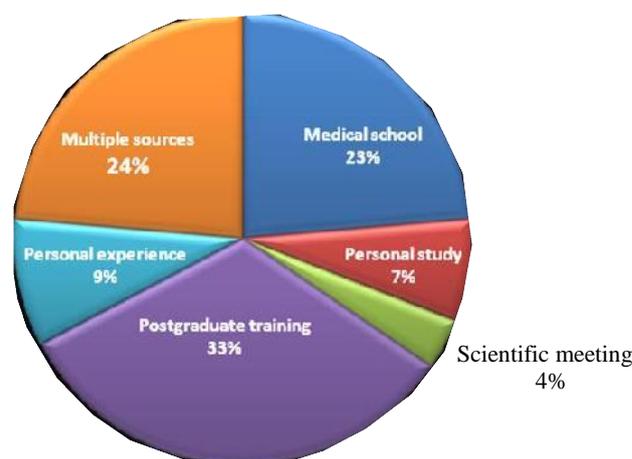
Fifty five of up to two hundred questionnaires distrib-

uted during the update courses were filled by paediatric senior resident doctors, and all were analysed for the purpose of this study. There were twenty one (38.2%) males and thirty four (61.8%) females giving a male to female ratio of 0.6:1. The ages of the respondents ranged from 24 to 44 years with a mean age of 34 ± 3 years. The respondents were from 5 out of the 6 geo-political zones in Nigeria and all worked in tertiary institutions. None of them was from the North Eastern geo-political zone of Nigeria. Up to 87.3% (48) of them graduated from medical school within five to ten years of this study, with the mean number of years of graduation being $8.6 \text{ years} \pm 2.2$ (table 1). The source of knowledge of MDI use was mainly from postgraduate training. Fig 1.

Table 1: Sociodemographic characteristics of respondents

Categories	Frequency	Percentage (%)
<i>Age group (years)</i>		
24 -34	24	49
35-45	25	51
<i>Gender</i>		
Male	21	38.2
Female	34	61.8
<i>Region</i>		
North	12	21.8
South	43	78.2
<i>Post-graduation duration (years)</i>		
0-5	1	1.8
6-10	47	85.5
>10-15	6	10.9
>15	1	1.8

Fig 1: Source of knowledge of inhaler technique



MDI technique familiarity and reassessment of patients

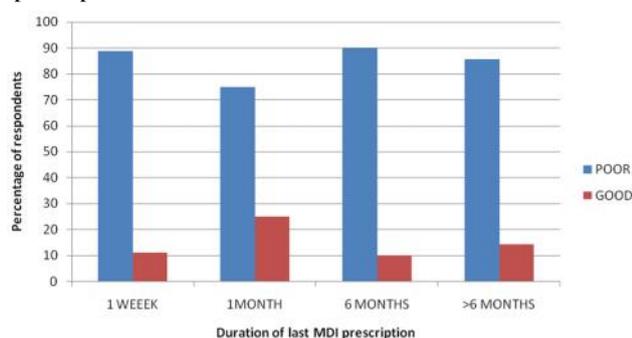
Familiarity with at least six of the nine listed steps in MDI technique was acknowledged by 43 (78.2%) of the respondents. Only 17 of them (30.9%) were familiar with all the nine listed steps and 6 of these had prescribed MDI within the preceding month. Twelve of them (21.8%) were familiar with only 5 or less steps, and out of these, 7 had prescribed MDI within the preceding month. Altogether, twenty one (38.2%) of the respondents had consulted a patient with bronchial

asthma and prescribed MDI in the preceding 1 month, while an additional 20 (36.4%) had prescribed MDI within six months of the study. See table 2. Of the respondents, 98.2% (54) were aware that it was their duty to train patients on inhalation technique while 76.4% (34) actually did engage in patients training on correct MDI technique in their institutions. Five (9.1%) of them combined this responsibility with pharmacists in their institutions. Regular reassessment of patient's skill at MDI use was done by 34 (61.8%) of the respondents while 18 of them (32.7%) sometimes assessed and 3 (5.4%) hardly or never assessed patient's skill at MDI use.

Table 2: Last time Inhaler prescription was made

Duration	Gender		Total. N=55[%]
	Male N=21[%]	Female N=34[%]	
≤1 week	5(23.8)	4(11.8)	9(16.4)
>1 week but ≤1 month	5(23.8)	7(20.6)	12(21.8)
>1 month but < 6months	7(33.3)	13(38.2)	20(36.4)
> 6 months	4(19.1)	10(29.3)	14(25.5)

Fig 2: Knowledge score based on duration of latest MDI prescription



MDI knowledge score and associated factors

Knowledge score was good in only 8 (14.5%) of the respondents (3 males and 8 females) with a larger proportion- 47 (85.5%) having poor knowledge. Two factors which comprised two of the four objective questions used to derive the knowledge score were significantly associated ($p < 0.05$) with a good knowledge score- namely, knowledge of what was meant by priming an inhaler and knowledge of how to administer multiple prescribed doses of MDI. See table 3. None of the socio demographic characteristics was significantly associated with knowledge score, although 6 of those with a good knowledge score were aged between 35 to 45 years ($X^2 = 1.36$, $p = 0.24$) and with the same number having graduated from school between 6 to 10 years of this study ($X^2 = 2.75$, $p = 0.52$). See figure 2. Acknowledgement of familiarity with basic steps in MDI technique was also not significantly associated with knowledge score ($X^2 = 2.613$, $p = 0.106$). Other factors included the source of knowledge and time of latest prescription and these were not significantly associated with knowledge score. See table 4

Table 3: Response to key questions and knowledge score

Objective Questions	Good Knowledge N=8	Poor Knowledge N=47	Total N=55	Statistics
<i>1. What is MDI priming?</i>				
Correct	6(75)	3(6.4)	9(16.4)	$X = 23.52$
Wrong	2(25)	44(93.6)	46(83.6)	$P = 0.00$
<i>2. Administering multiple doses at a time or separately</i>				
Correct	7(87.5)	26(55.3)	33(60)	$X = 2.95$
Wrong	1(12.5)	21(44.7)	22(40)	$P = 0.09$
<i>3. Assessment of patients' knowledge of MDI at clinic visits</i>				
Correct	6(75)	28(59.6)	34(61.8)	$X = 0.77$
Wrong	2(25)	19(40.4)	21(38.2)	$P = 0.68$
<i>4. Mention of use of spacer device in children</i>				
Yes	1(12.5)	6(12.8)	7(12.7)	$X = 0.00$
No	7(87.5)	41(87.2)	48(87.3)	O
				$P = 0.983$

Table 4: Association between MDI technique knowledge with sociodemographic and other variables

Variable	Knowledge Score			Statistic (X^2)	P-Value
	Good N=8	Poor N=47	Total N=55		
<i>Age</i>					
22-34	2	25	27	1.36	0.24
35-45	6	22	28		
<i>Gender</i>					
Male	3	18	21	0.002	0.97
Female	5	29	34		
<i>Region of practice</i>					
North	2	10	12	0.16	0.69
South	6	37	43		
<i>Years of graduation</i>					
5 years	0	1	1	2.75	0.52
6-10 years	6	41	47		
> 10 years	2	5	7		
<i>Knowledge source</i>					
Medical school	1	12	13	$F^* = 2.3$	0.82
Personal study	0	4	4		
Scientific meetings	0	2	2		
Postgraduate training	3	15	18		
Personal experience	1	4	5		
Multiple sources	3	10	13		
<i>Duration of latest prescription</i>					
≤1 month	4	17	21	1.47	0.69
>1 but ≤ 6 months	2	18	20		
>6 months	2	12	14		

*F = Fischer's exact test

Discussion

Paediatric senior residents in Nigeria were found in this study, to be deficient in their knowledge of MDI technique and use based on the objective knowledge based questions used to aggregate the knowledge score. This is similar to findings in studies on paediatric residents in other countries and amongst other specialties and health workers, in various countries including Nigeria.^[13-16] About 84% of Nigerian doctors in Owo, Ondo state Nigeria and 85.8% of Spanish physicians had poor knowledge of inhaler technique.^[10,16] The Nigerian study however, required practical demonstration of the basic steps in MDI technique while the Spanish study was a similar questionnaire based study where the knowledge score

was based on responses to certain knowledge based questions. When asked to assess themselves, only 18.5% of doctors in Turkey felt they had adequate knowledge of inhaler use, and this was also a questionnaire based study involving mainly paediatricians and pulmonologists. The reasons for such global low scores on physician inhaler use and technique knowledge have not been reported. However, over two decades ago, a massive nationwide education campaign amongst Spanish physicians managing obstructive lung diseases was embarked on to train them on proper inhaler technique and use.¹⁰ Despite this, the study done recently to assess their knowledge still revealed a paucity of knowledge.¹⁰

With the efficacy of inhaled medication being largely dependent on the right technique of use by patients for deposition of the appropriate drug dose at the target site, this paucity of knowledge of physicians is inimical to the achievement of optimal asthma control. This is because the prescribing physician according to guidelines should educate the patient, and this cannot be effectively done if the physician has poor knowledge of the technique.¹ Poor prescribing physician's knowledge of MDI technique may partly explain why studies on asthma control in patients in and outside Nigeria have consistently not been optimal.^{3,9} Onyedum *et al.* in Enugu, Nigeria found that only 22.1% of asthmatic patients used their inhalers adequately and related this to poor knowledge of the providers who should educate them.¹⁹ With the high cost of these devices added to the cost of misuse which may not be quantifiable, especially uncontrolled airways disease, such incorrect use should be avoided especially in developing countries like Nigeria where intensive care is not readily available. Fink and Rubin in the United States noted that poor inhaler technique would lead to increased morbidity, mortality, frequent acute exacerbations with continued "step up" of drug dose without realizing that the initially prescribed dose was not being received further increasing cost with more wasted medication.³

In this index study, there was no defined source of knowledge of MDI technique with the vast majority stating different sources. This is not surprising because education on inhaler technique is not part of the academic curriculum of many medical schools since this is considered a relatively easy procedure.^{3,10} The highest percentage of the respondents got their knowledge from postgraduate training with few being taught in the medical school. Other studies observed different sources of knowledge. The source of knowledge as observed by Vincente *et al.* in Spain and from the study carried out by the Turkish Respiratory Society Inhalation Therapy Group (INTEDA-1 study) in Turkey was however mainly from personal study of literature (34% and 74% respectively).^{10,15} This is contrary to our finding of only 7% from personal study. The source of knowledge however did not significantly impact their knowledge score on correct use of the MDI.

Of all the questions used to assess the knowledge score, only knowledge of priming was consistent with a good knowledge score with the difference being statistically

significant. Although priming is one of the critical steps in MDI use, there have been very few studies on knowledge of priming amongst doctors.^{2,3,11,12} Priming which is the process of actuating the MDI prior to inhalation, to ensure dose consistency, is recommended prior to first use and after a specific number of days have elapsed between actuations. Priming is a necessary step for all MDIs, though the number of puffs and frequency differ for specific manufacturers.⁵ Prior to first use, an MDI should be shaken, followed by some actuations wasted to the atmosphere. The number of actuations depends on the drug, formulation, propellants, and manufacturer. Most of the respondents with the knowledge of priming which was asked as an open ended question in the study, had a good knowledge score.

The response to the regularity of assessment of patient's skill, though said to be done always by the greater percentage of the respondents, and familiarity with most of the basic skills as ticked by the greater majority, may not actually reflect actual clinical practice since most of those that answered in the affirmative could not respond to the basic question on method of administration of multiple doses and priming of inhalers. These are steps that should form a part of what the patients are taught. In Spain, only 27.7% of the respondents claimed to always assess patient's inhalation technique.¹⁰

The duration of last prescription of MDI was found not to significantly affect knowledge score. This is similar to the finding on paediatric residents in the US who had been regularly prescribing.¹⁴ The sparse mention of the use of spacer device in children amongst these paediatric residents may be as a result of its relative unavailability in many parts of the country thus making its use infrequent. However, studies have shown that homemade spacer devices are equally effective and its use should be encouraged especially amongst paediatricians whose primary role is the welfare and health of children.³

Conclusion

There is poor knowledge of proper skills required for MDI use amongst paediatricians in training especially knowledge of priming an MDI device and method of administering multiple doses.

Recommendation: There is need to reinforce adequate knowledge and practice of the use of metered dose inhaler device among paediatric residents in Nigeria. This should not be taken for granted during their postings in respiratory paediatrics.

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Limitations

The sample size was small comprising only the paediatric senior residents present at the course. The low skill demonstrated by the respondents in the present study may be attributed to the fact that the subjects were senior residents who are already narrowed in their scope of paediatric training by the default design of the training programme. Most of them may not be in pulmonology training and might have forgotten the basic training about the use of the MDI acquired during junior residency rotations. Junior residents who are more likely to rotate through pulmonology units and attend to children

with bronchial asthma may have been more appropriate as respondents in this study.

Authors' contributions

Concept- NC; Design-NC, EJ, MC, UN; Definition of intellectual content-EJ, AA, NC, MC; Literature search-NC, MC; Data acquisition-MC, NS; Data analysis-NC; Manuscript preparation- NC,MC; Manuscript editing and review-EJ, AA, NC

Conflict of interest: None

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