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St. Paul Hospital Millennium Medical College

Department of Intensive Care Medicine, Respiratory Therapy Program

**Assessment of Competency of Metered Dose Inhaler Technique and
Associated Factors Among Nurses Working at Saint Paul's Hospital
Millennium Medical College, Addis Ababa, Ethiopia, 2024**

Principal Investigator: Addis Dereje (Bsc)

Addis Ababa, Ethiopia

July 10, 2024



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Advisors

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- 2. Mr. Simachew Abebaw (Bsc, Msc RT)**

A thesis to be Submitted to Intensive Care Medicine, Department of Respiratory Therapy for the Partial Fulfillment of the Requirements for Degree of Masters in Respiratory Therapy; Saint Paul's Hospital Millennium Medical College.

Addis Ababa, Ethiopia

July 10, 2024

Saint Paul's Hospital Millennium Medical College

Department of Intensive Care Medicine

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Summary

Background: Inhaled medications are the cornerstone of asthma therapy. Metered dose inhaler technique is a widely used technique to administer medications like corticosteroids. Meanwhile, the health professionals and patients knowledge and practice towards this metered dose inhaler is quite deficient but arguably understood by policy makers or education expertise.

Objectives: this study aimed to assess the competence of metered dose inhaler technique and associated factors among nurses working at Saint Paul's Hospital Millennium Medical College from November 2023 to June 2024.

Methods: An institution-based cross-sectional study design was used to conduct at Saint Paul's Hospital Millennium Medical College from June 1 to 30, 2024, involving quantitative data. The sample size was determined using single population proportion formula, The National Asthma Education and Prevention Programs of America (NAEPP) step criteria for the demonstration of a metered dose inhaler was used to rate the competency of using the inhaler. Data entered into Epi data 3.1 and exported to SPSS version 26 for descriptive and statistical analysis in relation to the study objectives. Analysis performed in two stages: in the first stage a bivariate logistic regression conducted to identify candidate covariates for multivariate analysis at p-value less than or equal to 25 percent then a multivariate logistic regression was performed to see the independent effect of different covariate on the outcome variable. Variables with p-value 0.05 in this stage considered as significant factors.

Result: Out of 270 participants only 32.2% of the study participants had an adequate level of competency in the MDI technique. However, the odds of having an adequate level of competency in MDI technique was less likely among nurses with experience <5 years [(AOR=.186, 95% CI: .071–.488)] and nurses didn't received training on MDI [(AOR=.134, 95% CI: .025-.711)] compared to their counterparts.

Conclusion and recommendations: nurses' competence in MDI techniques was poor, experience and training were found to be significant predictor of their competence. To integrate nurse into the future MDI administration establishing and providing capacity building education and training has to be made by all responsible organizations.

Keywords: Metered dose inhaler, Competence, Health Care professionals

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List of Abbreviation and Acronyms

ADV	Advisors
BLH	Black Lion Hospital
COPD	Chronic Obstructive Lung Disease
DC	Data Collector
MDI	Metered Dose Inhaler
NRAD	National Review of Asthma Deaths
PI	Principal Investigator
SP	Supervisor
SPHMMC	Saint Paul's Hospital Millennium Medical College
WHO	World Health Organization

1. Introduction

1.1. Background

Asthma is a chronic inflammatory airway disease that affects approximately 358 million people worldwide (1). Asthma has been defined as a chronic disease characterized by recurrent attacks of breathlessness and wheezing, which vary in severity and frequency from person to person, whose symptoms may occur several times in a day or week and may become worse during physical activity or at night (2).

According to World Health Organization, greater than 3 million people die each year from chronic obstructive pulmonary diseases, an estimated 6% of all death worldwide and greater than 90% of these deaths occur in low-income and middle-income countries where as asthma alone is responsible for affecting 235 million lives currently throughout the world (3).

In Ethiopia the prevalence of asthma accounted 9.1% (6). This is consistently increasing in sub Saharan countries particularly in urban regions. According to the latest WHO data published in April 2011 Asthma deaths in Ethiopia reached 7,309 or 0.89% of total deaths (4). The age adjusted Death Rate was 18.42 per 100,000 of population that puts Ethiopia rank 25th in the world (5, 6). According to the Global Initiative for Asthma, prevalence of clinical asthma in Pakistan is 2.5-5.0% (7).

Appropriate management is required to improve asthma. For such reasons; use of inhalational corticosteroids are remarkably higher. One of the commonest delivery system for those inhalational drugs is Metered Dose Inhaler (MDI) (8). Good inhaler technique and adequate adherence are important. With regard to technique, specific steps and good coordination are necessary for the proper use of this device. A less than optimal technique can result in decreased drug delivery and potentially reduced efficacy (9). Even though Metered dose inhalers are widely used among Asthma patients; many of patients have difficulty in utilizing the device. Hence knowledge of such delivery method is mandatory for all nurses, dispensers and consumers (4).

Poor control of asthma is mainly related to under diagnosis and inappropriate or inadequate management. The contribution of poor understanding of patients about the disease and treatment, non-adherence and incorrect use of devices are innumerable (4).

Among health care providers, nurses are played a pivotal role in imparting a correct knowledge and use of MDI technique. But the reverse is true in most studies which seem to have suboptimal knowledge and skill on metered dose inhaler technique. It is evident that if nurses are unable to demonstrate MDI technique correctly, educating patients would be ineffective (10, 11). In most cases, it is the pharmacist's responsibility to ensure that patients know how to make the best use of their medication.

1.2. Statement of the problem

Despite the availability of effective treatment options, asthma control is often inadequate (12) and one of the main reasons for inadequate disease control is inappropriate inhaler use (13, 14). Some estimates suggest that about half of patients do not receive enough benefit from their inhaler due to improper inhaler technique (15). The most common problems experienced by patients using pMDI technology are: poor coordination between inhalation and inhaler use, cessation of breathing immediately after pMDI activation, and nasal inhalation (16).

According to studies, about 90% of patients with asthma and COPD do not use inhalers (17, 18). The National Assessment of Asthma Mortality (NRAD) reported in 2014 that lack of awareness and inappropriate use of inhalers caused a large proportion of 195 asthma deaths (19). Improper use of asthma inhalers is associated with poor asthma control and increased emergency room visits, as well as several risk factors such as poor patient education and counseling (13).

For example, professionals should properly educate patients using metered-dose inhalers on inhalation technique, as this improves compliance and disease control. Therefore, the expertise of healthcare professionals is critical to educating patients about inhaler technology. However, most studies around the world show that pharmacists, nurses and GPs do not have optimal knowledge and skills in metered-dose inhaler technology, suggesting that training programs. Inhaler technology care providers should include not only specialists but also general practitioners and accident and emergency physicians, nurses, pharmacists, and health educators (19-21).

According to a survey conducted in various public hospitals in Karachi, the survey results showed that the nurses surveyed had a serious lack of knowledge about the correct technique of using inhalers (3). Based on existing research, training and experience significantly influence healthcare providers' skills in metered-dose inhaler technology (3). In Ethiopia, there is little information about nurses' expertise in metered-dose inhaler technology. Although research has been conducted on the MDI technology skills (skills) of healthcare professionals, information on the MDI technology skills of nurses is limited.

Therefore, this study aimed to evaluate the professional level (skills) of nurses on metered-dose inhalation techniques and related factors at Millennium Medical College, Saint Paul, and Addis Ababa, Ethiopia.

1.3 Significance of the study

The finding of this research will play a crucial role in various aspects of healthcare. For hospitals, the study will offer valuable insights into the competency of nurses in metered dose inhaler technique and related factors, serving as a foundational resource for enhancing inhaler techniques. Clinicians will benefit from the contribution to nursing knowledge, aiding in the improvement of proper inhaler use.

Researchers and other stakeholders will utilize the study as a reference point for further investigations in the field. Moreover, the community and customers stand to gain from targeted interventions aimed at improving patient education and training on inhaler use, ultimately leading to better disease management, reduced healthcare expenses, and enhanced quality of life for patients.

Hence, the objective of this research is to assess the competency (skill) in metered dose inhaler technique and associated factors among nurses in Saint Paul's millennium medical college, Addis Ababa, Ethiopia.

2. Literature Review

2.1. Magnitude of metered dose inhaler technique

MDIs are one of the main systems available for local administration of drugs to the airways to treat respiratory diseases and it was introduced many years ago (22). The study conducted in Karachi Hospital, Jinnah Postgraduate Medical Centre revealed that out of the 12 steps of the inhaler technique, only 3 steps were followed by a majority of the study participants i.e. taking the cap off (64.2%), putting the metered dose inhaler in mouth with lips sealed (59.2%) and breathing in slowly by pressing down the metered dose inhaler (62.5%). The mean inhaler technique score of the study participants was 3.18 ± 2.34 out of 12 and only 1 (0.8%) of them had correct inhaler technique, 88 (73.4%) had incorrect inhaler technique whereas 31 (25.8%) did not know about it at all (3).

A study conducted at Chitwan Medical College found that none of the nurses had adequate competency in use of MDI because none of them neither demonstrated essential steps nor all the 9 steps required in the correct use of MDI (23). But a study in Pakistan showed, 71% of nurses demonstrated correct inhaler technique before intervention(24).

A study conducted in Nigeria on fifty-five Pediatric senior registrars revealed that only 14.5% of them had good knowledge scores on inhaler use, while 85.5% had poor scores (21). Furthermore, a report on the competency of pharmacists in Nigeria indicated that the mean checklist scores for the MDI and Diskus were 5.3 ± 3.0 and 2.3 ± 3.3 (out of a maximum score of 11), respectively, for the use of the MDI, Diskus, Turbuhaler, and the MDI with a spacer (25).

2.2. Factors associated with competency in metered dose inhaler technique

A study conducted at Chitwan Medical College on fifty-five nurses revealed that the majority (94%) of respondents belonged to the age group of 19-22 years, while 4% were aged between 23-26 years and only 2% were between 27-30 years old. Shockingly, none of the participants performed all the steps of MDI as per guidelines (21).

In another cross-sectional study conducted in three general hospitals in Mexico among 244 healthcare workers, no significant difference was observed between gender, labor category, schedule, service, age, seniority, and education degree among the three hospitals (26).

A cross-sectional study was carried out among nurses from four randomly chosen government hospitals of Karachi namely National Institute of Cardiovascular Diseases, Sindh Institute of Urology and Transplantation, Jinnah Postgraduate Medical Centre and Civil Hospital Karachi, the mean inhaler technique score was significantly higher for higher education level ($p=0.001$) and greater experience than those with lower education level and experience ($p<0.001$) (3).

According to a study conducted in five Midwestern community teaching hospitals of health care providers regarding to profession for metered dose inhaler technique, there were no significant differences in performance scores among the emergency medicine house staff (42%), attending emergency physicians (34%), and ED nurses (45%)(27). Similarly study carried out at the Manipal Teaching Hospital, Pokhara, Nepal ,none of the professionals could initially demonstrate all the ten steps involved in the correct use of MDI (8).

Whereas study conducted in Iran revealed that, a total of 173 healthcare providers (35 (20.2%) were physicians and 138 (79.8%) were nurses), Physicians performed essential steps significantly better than nurses (85.7% vs. 63.8%, $P < 0.05$) (4).

Regarding training and MDI relationship a study in 2014 from Jordan after providing training for healthcare professionals including nurses have shown that the mean score of the participants was found to be 7.64(28).

This literature review illustrates that the health care professionals' specifically nurses competence in MDI is too poor. It further explains socio demographic factors, year of experience and, type of profession have no significant impact on competence MDI technique, whereas, the available data is conflicting about the relationship between theoretical knowledge and skill. It also pointed out training has significant impact on the competence.

In addition to this in our country as well as overall the world there is no enough study conducted on competence MDI technique among Nurses. Therefore this study aimed to assess the competency (skill) in metered dose inhaler technique and associated factors among nurses in Saint Paul's millennium medical college, Addis Ababa, Ethiopia.

2.3. Conceptual Framework

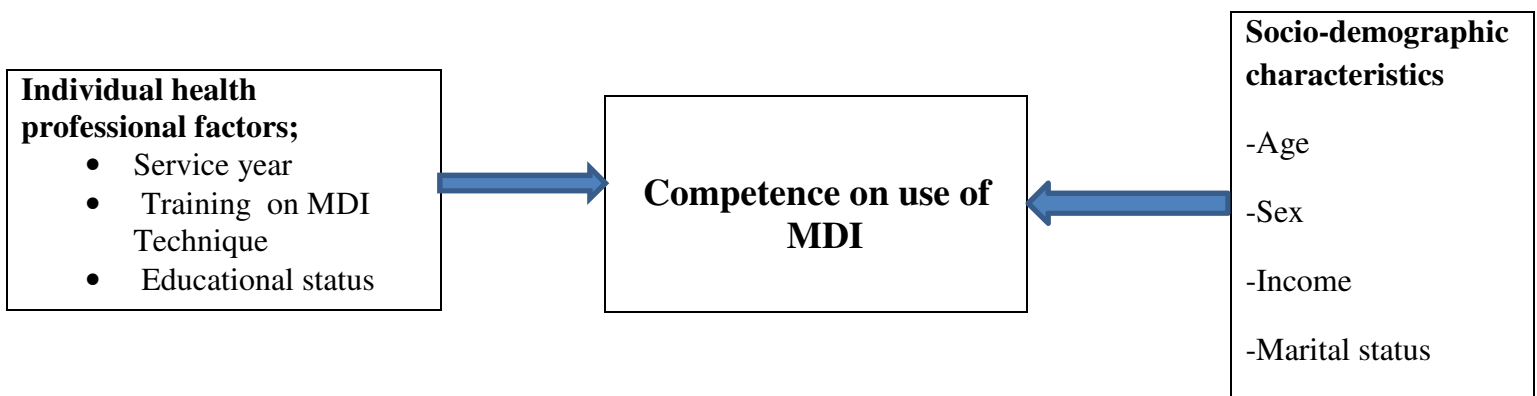


Figure 1. The concept of this frame work is shows the relationship of associated factors and competency in metered dose inhaler technique (adopted from (3, 23) and adapted)

3. Objective

3.1. General objective

To assess the competence of metered dose inhaler technique and associated factors among nurses working at St. Paul's Hospitals Millennium Medical College, Addis Ababa, Ethiopia from November 2023 to Jun 2024.

3.2. Specific objective

- To determine the level of nurses' competency on use of metered dose inhaler (MDI) technique in St. Paul's Hospitals Millennium Medical College
- To identify factors associated with competence of metered dose inhaler technique among nurses working at St. Paul's Hospitals Millennium Medical College

4. Methods and Materials

4.1. Study area and period

This study was conducted in Saint Paul's Hospital Millennium Medical College at Addis Ababa Ethiopia. Addis Ababa is the capital city of Ethiopia. Data will be collected from April 1- 30, 2024.

Saint Paul's Hospital Millennium Medical College is a specialty hospital providing care to the underserved population in the outskirts of Addis Ababa. It currently has 580 beds, with an annual average of 200,000 patients and a catchment population of more than 5 million. There is over 3578 clinical and non-clinical staff in over 13 departments, most recently launching its new hemodialysis unit. There are 846 total nurses in the Hospital. Currently there are 1597 under graduate and post graduate students in different departments(702 medical students, 42 sub-specialty medicines, 150 under graduate specialty nurse, 665 specialty medicines and nowadays 38 post graduate specialty program(MSC in critical care, Respiratory therapist, Paramedics) given.

4.2. Study Design

Institution based cross-sectional study was used to conduct this study.

4.3. Population

4.3.1. Source population

All nurses working at St. Paul's Hospitals Millennium Medical College

4.3.2. Study population

The study populations were nurses working at St. Paul's Hospitals Millennium Medical College during data collection period that fulfilled the inclusion criteria.

4.3.3. Eligibility criteria

4.3.3.1. Inclusion criteria

The inclusion criteria were nurses working greater than 6 month in the hospital were included in study.

4.3.3.2. Exclusion criteria

Those nurses who had seriously ill and nurse on annul leave.

4.4. Sample Size determination

The actual sample size for the study is determined by using single population proportion formula. For single proportion population, $n = \frac{(Z_{\alpha/2})^2 p(1-p)}{(d)^2}$

Where: n= Estimated sample size

d= is the desired level of precision (i.e. the margin of error),

p= is the (estimated) proportion of the population which has the attribute in question

Z = Confidence level (alpha, α)

The prevalence of competence of metered dose inhaler technique among nurses is assumed as 50% since there is no previous related study conducted among nurses and this value is given large enough sample size in order to narrow the confidence interval and to assess the prevalence. The level of confidence 95%, ($Z_{\alpha/2} = 1.96$), margin of error between the sample and the population 5%. The final calculated sample size is 384. By using 10% non-response rates;

$$\frac{(384 \times 10)}{100} = 38.4$$

So the total sample size is $384 + 38.4 = \underline{422}$

Since the sample size is less than 10000 i use correctional formula $n = \frac{n^o}{1 + ((n^o - 1) / N)}$ by using this formula n is 282.

4.5. Sampling Technique

After selecting the hospital purposively, Systematic sampling method was used to select the sampled nurses in. The sampling interval is determined as 3 ($k = N/n$, $K = 846/282 = 3$). Of the three subjects, one sample being randomly at 3 select by lottery method; and then every three nurses were selected to participate on the study.

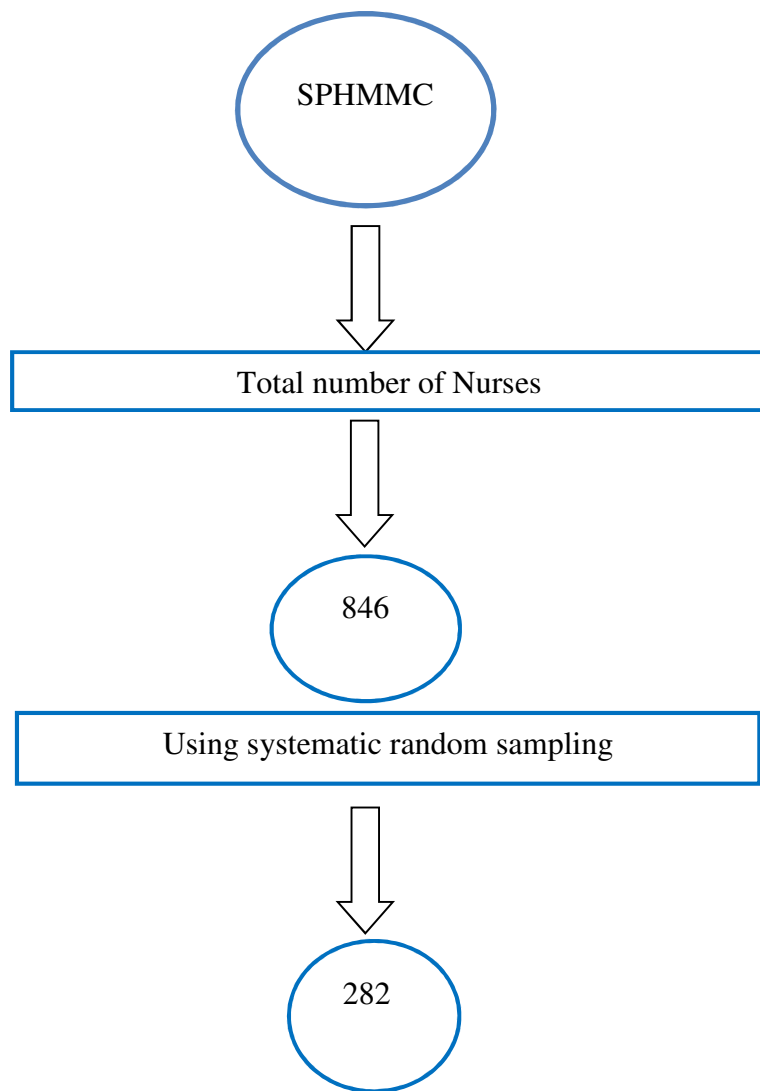


Figure 2: Schematic Presentation of Sampling Procedure, Public Referral Hospitals of SPHMMC

4.6. Study variable

4.6.1. Dependent variables

Competence of metered dose inhaler technique

4.6.2. Independent variable

Age, sex, marital status, educational level, income, service experience and training.

4.7. Data Collection technique and tools

Data was collected using questionnaire at SPHMMC. The questionnaire was adopted from a research conducted at (3,23), and modified after intensive literature reviews. The questioner prepared in English after review of different literatures. Pre-test was done at BLH before actual data collection. To collect data two trained BSc nurses for data collection and two BSc nurses for supervisor recruited and participated throughout the data collection and training given for two days by principal investigator on the study instrument and data collection procedures. The participants initially given metered dose inhaler device and asked to show steps for standard metered dose inhaler technique. No Intervention or critique was given to the participant while she /he is showing the steps. The principal investigator and the supervisors collect the filled questionnaire and checked for missed values and completeness on daily basis.

4.8. Operational Definitions

Metered dose inhaler (MDI) _ a small device that delivers a measured amount of medication to your lungs(29).

Adequate competence –if essential steps are performed correctly and a total score of seven and above(5).

Inadequate competence- if any of the essential steps are missed and a total score of below seven(5)

4.9. Data quality assurance

Structured questioner which fit with the context was prepared using expert in English. Training was given for both data collectors and supervisors. To ensure the validity of the data collection, pre-test was done on 5% of the total sample size calculated in order to assure the data is clearly filled or not by the collector before the actual data collection and the questioner revised and reformatted based on the inputs and comments generated by seniors.

The filled questioners were presented to the principal investigator and checked for its completeness to assure the quality of data. Both the principal investigator and recruited supervisors were responsible for supportive supervision on the spot and on reviewing all filled questioner on daily basis.

4.10. Data Management and analysis

Responses in each questioner were coded for simplicity of data entry. Then the coded data was entered in to Epi data 3.1 and exported to SPSS version 26 statistical software for data analysis. Data entry errors and any missing values were checked and corrected before conducting the data analysis. In the first steps descriptive analysis, such as, percentages, frequency distribution and measure of central tendency computed to describe study variables. Binary regression model fitted to identify the association between independent versus out-come variable. Then the assumptions of multi co-linearity, and outliers was checked and considering the $p < 0.05$ cut off point as significant for all the independent variables before fitting the model. All independent variables that associated with outcome variable at p-value of 0.25 and less in bivariable analysis entered into multivariable logistic regression models in order to identify independent predictors of competence of metered dose inhaler technique. Crude and adjusted odd ratio computed with their corresponding 95% confidence interval. P-value of 0.05 used to declare statistical significance of the results.

4.11. Ethical Consideration

Ethical approval and clearance was obtained from Saint Paul's Hospital Millennium Medical College Institutional Review Board. After obtaining permission from the Review Board, a letter of permission secured from the administrative bodies of the Hospitals. Then written informed

consent obtained from all participants before data collection. Participants' confidentiality ensured during the study period as individuals' scores won't be disclosed to participants or other staff members. This study doesn't involve any potentially harmful intervention to participants. Coding and aggregate reporting used to ensure anonymity.

4.12. Dissemination plan

The finding of the study will be submitted and presented to Saint Paul's Hospital Millennium Medical College. Finally the finding will be published in national and international journals for further use and also be presented in different conferences like health related seminars.

5.0 Results

In this study from 270 nurses were involved which makes the response rate 95.7%. 72.6% participant were 21-30 years age group, the mean age of respondent was 29.49 (SD±3.615). More than half of the study participants were females 60.7%. About 182(67.4%) and 88(32.6%) of the study of participant had degree and (master and above) respectively. Regarding their experience majority of the nurses 59.3% have 5-10 years' experience. (Table 1)

Table 1: Frequency distribution of participant nurses at SPHMMC 2024.

Age	21-30	196	72.6%
	31-40	74	27.4%
	>40	0	0
Sex	Males	106	39.3%
	Females	164	60.7%
Marital status	Single	136	50.4%
	Married	118	43.7%
	Divorce	16	5.9%
Educational levels	Diploma	0	0
	Degree	182	67.4%
	Master and above	88	32.6%
Monthly income	5000-10,000	242	89.6%
	>10000	28	10.4%
Work experience	<5 years	84	31.1%
	5-10 years	160	59.3%
	>10 years	26	9.6%
Previous training	Yes	8	3%
	No	262	97%

5.1 Practical level

The study found that 32.2% of participants practiced the MDI technique steps, scoring 7 out of 11 steps. However, only 1.5% practiced the technique with a score of 9 which was the highest. The mean $\pm$ SD practice score for all participants was 5.91 ± 1.32 . 100% of participants' correctly practicing step 2 (removing the cap), 94.8% wrongly practicing step 8.

Table 2: Evaluation of each step practice of the MDI technique among SPHMMC nurses 2024.

		Competency	
		Inadequate %	Adequate %
Shake 4 or 5 times if suspension formulation	incorrect	39.3	.7
	correct	28.5	31.5
Take the cap off the inhaler mouthpiece	incorrect	0	0
	correct	67.8	32.2
Hold the inhaler upright	incorrect	15.6	0
	correct	52.2	32.2
Breathe out completely as far as comfortable (to empty the lungs)	incorrect	44.4	0
	correct	23.3	32.2
Place inhaler 2 - 4 cm away from mouth or place the inhaler mouthpiece between the lips and the teeth; with the tongue flat under the mouthpiece	incorrect	13.7	1.5
	correct	54.1	30.7
Inhale slowly and activate the inhaler (MDI)	incorrect	7.1	2.6
	correct	60.7	29.6
Continue to inhale deeply until the lungs are full. This should take an adult 4-5 seconds	incorrect	64.4	17.8
	correct	3.3	14.4
At the end of the inhalation, take the inhaler out of the mouth and close the lips	incorrect	7.4	0
	correct	60.4	32.2
Hold breath for 10 seconds or as long as possible	incorrect	67.8	32.2
	correct	0	0
Breathe out slowly (normally)	incorrect	67.8	32.2
	correct	0	0
Wait at least 1 minute before repeating steps 4 through 10	incorrect	67.8	27.0
	correct	0	5.2

5.1.1 Assessment of competency

Depending on the assessment performed using MDI tool the magnitude of competency among SPHMMC nurses was found to be 32.2%.

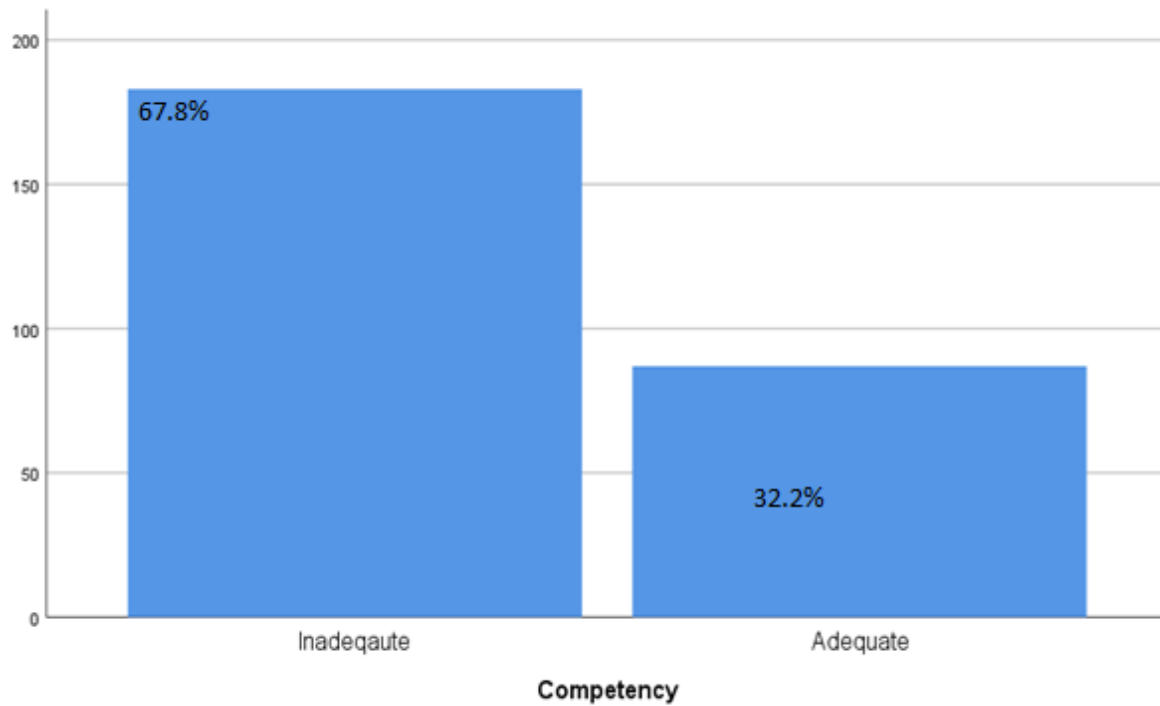


Figure 3: MDI competency magnitude among nurses at SPHMMC 2024.

5.1.2 Associated factors

From listed variables on the binary logistic regression educational status, work experience and previous training on MDI were found to be associated with competency of nurse.

Table 3: Variables on bivariate logistic regression analysis among nurses at SPHMMC 2024.

Variables	p-value	(COR CI=95%)
Gender	.120	.395-1.113
Age	.226	.801-2.475
Marital status	.252	.504-1.196
Current salary	.992	.431-2.302
Educational level	.017	1.123-3.267
Work experience	.000	1.507-3.756
Previous training	.021	1.325-33.929

From these variables on multivariate logistic regression analysis two factors work experience < 5 years and previous training on MDI were found to be highly significant variables with [AOR=.201 (.075, .545)] and [AOR=.146 (.027,.787)] respectively which Implies that the odds of being competent among nurses having experience < 5 years is 20.1% whereas the odds of being competent among nurses who have previous training on MDI is 85.4%.(table 4)

Table 4: Associated factors on multivariate logistic regression analysis with competency of nurses in SPHMMC 2024.

		Competency		COR	P-VALUE CI 95%	AOR
		Inadequate	Adequate			
Work experience	<5 years	70	14	.200 (.077,.522)	.001	.186 (.071,.488)
	5-10 years	100	60	.600 (.261,1.830)	.171	.558 (.242,1.287)
	>10 years	13	13	Ref.	-	Ref.
Previous training on MDI	No	181	81	6.704 (1.325,33.929)	.018	.134 (.025,.711)
	Yes	2	6	Ref.	-	Ref.

6.0 Discussion

On this study the adequate competency among nurses were found to be 32.2% the result is lower compared to the studies conducted in Iran 63.8%, Mexico 67.6 % and Pakistan 71.0% the result is higher compared to the study done in A.A, this might be due to that sociodemographic and economic and educational difference exist in those different areas.

Regarding the factors the odds of being competent among nurses with experience of < 5 years were found to be lower compared to those having experience >10years this might be due to that having short experience explained the high magnitude of medication administration errors(30). Similar studies on this topic didn't find experience as related factor for their competency results.

Additionally, the odds of being competent among nurses who have previous training on MDI were found to be 86.6%, this might be due to that consistent training, education and evaluations keep workers competent and create safer workplace. This result was consistent with the study done in Jordan 2014(28).

Considering the steps performed even though 50% of the participant performed 9 steps correctly the competency level among nurses were found to be low. According to this study the most frequently performed steps on MDI techniques were shaking the canister, take the cap off the inhaler mouthpiece and holding the inhaler upright. This result is comparable to a study done in southern Ethiopia. However, two steps 9 (Hold breath for 10 seconds or as long as possible) and 10 (Breathe out slowly (normally)) were least performed steps on MDI inhaler techniques by all study participants this result was consistent with the study conducted in Nepal 2016. This might be due to that the majority of medical errors originated from communication failures (31).

6.1 Conclusion and Recommendation

This study has identified a low competency among nurses, work experience above 10 years and training on MDI among nurses were found to be significant variables for the competency. Development of drugs administration manual, continuous training to improve nurses' knowledge and practice by responsible bodies can enhance the competency and decrease patient deaths which are caused by inappropriate MDI administration plus further investigations can be performed to identify the causes and effect of failure to administer MDI on patients or nurses knowledge, attitude and practice levels.

6.2 Strength and Limitations

Standard tool was used to assess the MDI competency among nurses; the study used a representative sample from different and multiple units that the result can be generalized to nurses at SPHMMC. However, the study has some limitations only the prevalence and associated factors was assessed rather than its level additionally the research design was cross sectional observational study which doesn't determine cause and effect, more prone to bias that further investigations are required to address the gap.

7. Reference

1. James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*. 2018;392(10159):1789-858.
2. Cragg L, Williams S, Chavannes NH. FRESH AIR: an implementation research project funded through Horizon 2020 exploring the prevention, diagnosis and treatment of chronic respiratory diseases in low-resource settings. *NPJ Primary Care Respiratory Medicine*. 2016;26(1):1-5.
3. Sahitia S, Jafry SIA, Naqvi SMZH, Anjum N, Anwar A. Assessment of pressurised metered dose inhaler technique of nursing staff in different government hospitals of Karachi. *ANNALS OF ABBASI SHAHEED HOSPITAL AND KARACHI MEDICAL & DENTAL COLLEGE*. 2018;23(2):105-6.
4. Zeraati ENF. Evaluation of the metered-dose inhaler technique among healthcare providers. *Acta Medica Iranica*. 2005:268-72.
5. Ali HD, Worku GS, Alemayehu AA, Gebrehiwot WaH. Competence in metered dose inhaler technique among dispensers in Mekelle. *Allergy, Asthma & Clinical Immunology*. 2014;10:1-5.
6. Van Gemert F, van der Molen T, Jones R, Chavannes N. The impact of asthma and COPD in sub-Saharan Africa. *Primary Care Respiratory Journal*. 2011;20(3):240-8.
7. Masoli M, Fabian D, Holt S, Beasley R, Program GfA. The global burden of asthma: executive summary of the GINA Dissemination Committee report. *Allergy*. 2004;59(5):469-78.
8. Kishore P, Palaian S, Alam K, Shankar P, 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. 2008.
9. Roy A, Battle K, Lurslurchachai L, Halm EA, Wisnivesky JP. Inhaler device, administration technique, and adherence to inhaled corticosteroids in patients with asthma. *Primary Care Respiratory Journal*. 2011;20(2):148-54.
10. Lee-Wong M, Mayo P. Results of a programme to improve house staff use of metered dose inhalers and spacers. *Postgraduate medical journal*. 2003;79(930):221-5.
11. Odili V, Okoribe C. Assessment of Pharmacists' knowledge on correct inhaler technique. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*. 2010;1(3):768-72.
12. Mahon J, Fitzgerald A, Glanville J, Dekhuijzen R, Glatte J, Glanemann S, Torvinen S. Misuse and/or treatment delivery failure of inhalers among patients with asthma or COPD: a review and recommendations for the conduct of future research. *Respiratory medicine*. 2017;129:98-116.
13. Al-Jahdali H, Ahmed A, Al-Harbi A, Khan M, Baharoon S, Bin Salih S, et al. Improper inhaler technique is associated with poor asthma control and frequent emergency department visits. *Allergy, asthma & clinical immunology*. 2013;9:1-7.
14. Haddad RM, Al-Momani JA, AlSuleihat AS, Alnadi KM, Obeidat LK. Poor inhaler technique in patients with bronchial asthma treated in King Hussein Medical Center (KHMC): Rates and effects. *Middle East Journal of Internal Medicine*. 2020;12(1).
15. Virchow J, Crompton G, Dal Negro R, Pedersen S, Magnan A, Seidenberg J, Barnes PJ. Importance of inhaler devices in the management of airway disease. *Respiratory medicine*. 2008;102(1):10-9.
16. Lee SM, Chang Y-S, Kim C-W, Kim T-B, Kim S-H, Kwon Y-E, et al. Skills in handling turbuhaler, diskus, and pressurized metered-dose inhaler in Korean asthmatic patients. *Allergy, asthma & immunology research*. 2011;3(1):46-52.

17. Crompton G, Barnes P, Broeders M, Corrigan C, Corbetta L, Dekhuijzen R, et al. The need to improve inhalation technique in Europe: a report from the Aerosol Drug Management Improvement Team. *Respiratory medicine*. 2006;100(9):1479-94.
18. 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). *Primary Care Respiratory Journal*. 2011;20(1):92-6.
19. Baverstock M, Woodhall N, Maarman V. P94 Do healthcare professionals have sufficient knowledge of inhaler techniques in order to educate their patients effectively in their use? *Thorax*. 2010;65(Suppl 4):A117-A8.
20. Baddar SA, Al-Rawas OA, Al-Riyami KA, Worthing EA, Hanssens YI, Taqi AM, Al-Riyami BM. Metered-dose inhaler technique among healthcare providers practising in Oman. *SQU Journal for Scientific Research-Medical Sciences*. 2001;3(1):39.
21. Ndukwu C, Elo-Ilo J, Mbachu C, Ayuk A, Ugwu N, Ngonadi S. Assessment of Paediatric resident doctors' knowledge of metered dose inhaler (MDI) device technique and use. *Nigerian Journal of Paediatrics*. 2017;44(3):168-72.
22. Vaswani SK, Creticos PS. Metered Dose Inhaler: Past, Present, and Future. *Annals of Allergy, Asthma & Immunology*. 1998;80(1):11-23.
23. Rajbanshi L, Kc S. Nurses' competency on use of metered dose inhaler. *Journal of Chitwan Medical College*. 2016;6(2):33-7.
24. NS L. < A> study of knowledge assessment and competence in asthma and inhaler technique of nurses employed at university teaching hospital. 2012.
25. Ozoh OB, Omogie H, Obaseki DO, Dosu AO. The competence of community pharmacists in Lagos, Nigeria, on correct inhaler techniques. *Journal of Clinical Sciences*. 2018;15(4):207-12.
26. Pérez-Malagón CD, Barrera-Rodríguez R, Medina-Casillas NG, Muñoz JPC, Silva-Sánchez G, Macías-Limón C. Competence in metered-dose inhaler technique among healthcare workers of three general hospitals in Mexico: it is not good after all these years. *Advances in Respiratory Medicine*. 2021;89(1):8-14.
27. Jones JS, Holstege CP, Riekse R, White L, Bergquist T. Metered-dose inhalers: do emergency health care providers know what to teach? *Annals of emergency medicine*. 1995;26(3):308-11.
28. Basheti IA, Qunaibi EA, Hamadi SA, Reddel HK. Inhaler technique training and health-care professionals: effective long-term solution for a current problem. *Respir Care*. 2014;59(11):1716-25.
29. de Boer AH, Thalberg K. Metered dose inhalers (MDIs). *Inhaled Medicines: Elsevier*; 2021. p. 65-97.
30. Mohammed T, Mahmud S, Gintamo B, Mekuria ZN, Gizaw Z. Medication administration errors and associated factors among nurses in Addis Ababa federal hospitals, Ethiopia: a hospital-based cross-sectional study. *BMJ Open*. 2022;12(12):e066531.
31. Topcu I, Turkmen AS, Sahiner NC, Savaser S, Sen H. Physicians' and nurses' medical errors associated with communication failures. *J Pak Med Assoc*. 2017;67(4):600-4.

8. Annexes

Annex I. Consent form

INFORMATION TO THE PARTICIPANT

Greeting and self-introduction and consent

Greeting: - Good morning/afternoon.

My name is _____. I am a Nurse working in SPHMMC. We are conducting a scientific research on assessment of competence in metered dose inhaler technique and associated factors among Nurses. Therefore, I would like to inform you that you are one of the potential participants in this study. Your participation is entirely based on your willingness and your refusal doesn't affect you in any way. If you are willing to participate in the study, we will interview you and see your skill on MDI technique.

The information gathered will be used for writing a proposal for partial fulfillment of a specialty certificate in Respiratory therapy at SPHMMC. Your participation is only determined by you. Here, I want to assure you that any information obtained from you will remain confidential indefinitely. You can dropout any time during the study and also you have full right to ask us questions. If, at any time, you have questions about the study, you may contact me at following address

Do you wish to participate in the study?

If the participant agrees to participate in the study, proceed with interview after the nurses has signed the consent.

I, _____ have been told about the contents of this research form and I have adequate information about the research and understood it; and I do agree to participate in this Research study.

Address of investigator: phone no- +251937914173

Email: addisdereje0937@gmail.com

THANK YOU!!!

Annex II: Questionnaires

Questionnaire designed to assess competence on inhaler techniques and associated factors
Nurses working at SPHMMC, Addis Ababa, Ethiopia.

Part I – Identification and Socio demographic characteristics of the study participants

Part I: Socio demographic data	
Q101	Age _____
Q102	Gender ☐ Male ☐ Female
Q103	Marital status ☐ Single ☐ Married ☐ Divorced ☐ Widowed
Q104	Income ☐ <5000 ETB ☐ 5000-10000 ☐ >10000
Part II: Factors affecting inhaler techniques and individual factors	
Q201	Educational level ☐ Diploma ☐ Degree ☐ Msc
Q202	Work experience ☐ <5 years ☐ 5-10 years ☐ >10years
Q203	Previous training on MDI ☐ yes ☐ No
Part III: pMDI/MDI Inhaler technique check list (Steps)	
(Tick '√' for every correct move And 'X' for every incorrect move)	
Q301	Shake 4 or 5 times if suspension formulation ☐
Q302	Take the cap off the inhaler mouthpiece ☐
Q303	Hold the inhaler upright ☐
Q304	Breathe out completely as far as comfortable (to empty the lungs) ☐
Q305	Place inhaler 2 - 4 cm away from mouth or Place the inhaler mouthpiece between the lips and the teeth; with the tongue flat under the mouthpiece ☐
Q306	Inhale slowly and activate the inhaler (MDI) ☐
Q307	Continue to inhale deeply until the lungs are full. This should take an adult 4-5 seconds ☐
Q308	At the end of the inhalation, take the inhaler out of the mouth and close the lips ☐
Q309	Hold breath for 10 seconds or as long as possible ☐
Q310	Breathe out slowly (normally) ☐
Q311	Wait at least 1 minute before repeating steps 4 through 10 ☐

Assurance of Principal Investigator

I the undersigned agree to accept all responsibilities for the scientific and ethical conduct of the research project. I was providing timely progress report to my advisor and seek the necessary advice and approval from my advisors in the course of the research. I was communicating timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name of principal investigator: Addis Dereje

Signature:

Date:

Approval of the Primary Advisor:

Name of the primary advisor: _____

Signature: _____

Date: _____

Approval of co- Advisor:

Name of the co- advisor: _____

Signature: _____

Date: _____

Approval of examiner

Name of examiner_____

Signature

Date