

JIMMA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF INTERNAL MEDICINE

ASSESSMENT OF COMPETENCE IN METERED DOSE INHALER
TECHNIQUE AND ASSOCIATED FACTORS AMONG HEALTH CARE
PROFESSIONALS OF NIGIST ELLINI MOHAMMED COMPREHENSIVE
SPECIALIZED MEMORIAL TEACHING HOSPITAL, SOUTHERN ETHIOPIA:

BY CHALA JIRU (3RD YEAR MEDICAL RESIDENT)

A RESEARCH THESIS SUBMITTED TO DEPARTMENT OF INTERNAL
MEDICINE, COLLEGE OF HEALTH SCIENCES, JIMMA UNIVERSITY IN
PARTIAL FULFILMENT OF THE REQUIREMENTS FOR SPECIALTY IN
INTERNAL MEDICINE

FEBRUARY 2022
JIMMA, ETHIOPIA

ASSESSMENT OF COMPETENCE IN METERED DOSE INHALER TECHNIQUE
AND ASSOCIATED FACTORS AMONG HEALTH CARE PROFESSIONALS OF
NIGIST ELLINI MOHAMMED MEMORIAL COMPREHENSIVE SPECIALIZED
HOSPITAL, SOUTH ETHIOPIA

ADVISORS;

MR.CHERNET HAILU (MPH, ASSISTANT PROFESSOR)

DR, AMARE HAILU (MD, ASSISTANT PROFESSOR OF
INTERNAL MEDICINE)

FEBRUARY 2022

JIMMA, ETHIOPIA

ABSTRACT

Background: Both asthma and COPD treatment rely heavily on inhaled medicines. Metered dose inhaler therapy is a commonly used method for administering drugs such as beta 2 agonists and corticosteroids. Meanwhile, health care professionals' (HCP's) and patients' knowledge and experience with this metered dose inhaler are critical for the accurate delivery of these medications, which has an impact on disease control and patient adherence. However, in Nigist Ellini Mohammed Memorial Comprehensive Specialized Hospital (NEMMCSH), no research has been done on health care professionals' competence in Metered Dose Inhaler (MDI) technique and associated factors previously.

Objective: This study aimed to assess competency (skill) in metered dose inhaler technique and its associated factors among NEMMCSH health care professionals.

Method: Cross sectional study was employed on 300 health care professionals working in NEMMCSH, southern Ethiopia from November 10, 2021, to January 10, 2022. 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 skill of using the inhaler and theoretical questions about MDI were used to assess the basic knowledge of HCPS. Collected data was first cleaned, edited, and entered into Epidata version 3.1 and exported to SPSS version 25 for analysis. First, descriptive data analysis was performed, and then bivariate logistic regression analysis was carried out to determine the association of different potential factors. Independent predictors were determined using an adjusted odd ratio with 95% CL at p-value < 0.05.

Results: Out of 314 health care professionals approached 300 (95.5%) were involved in the study. Only 22(7.3%) 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 more likely higher among pharmacists [(AOR=8.82, 95% CI: 2.59–30.07)] and General Practitioners (GP) [(AOR=3.89, 95% CI: 1.26 -11.87)] compared to nurses.

Conclusion and recommendations: Health care providers (nurses, pharmacy, and GP) competence in MDI techniques was poor, though qualification was found to be significant predictor of their competence. To integrate HCP into the future asthma care establishing and providing capacity building education and training has to be made by all stakeholders.

Keywords: Metered dose inhaler, Competence, HealthCare professionals

ACKNOWLEDGMENTS

I would like to acknowledge Jimma University for giving me this chance to conduct this study and for the financial support that was given. I would like also to thank the Department of Internal Medicine for helping me with topic selection. My sincere and deepest gratitude goes to my advisors, Dr. Amare Hailu, and Mr.Chernet Hailu, for their unreserved assistance, timely comments, and relevant guidance. Lastly I want to thank health care professionals of NEMMCSH.

CONTENTS

ABSTRACT.....	ii
ACKNOWLEDGMENTS	ii
LIST OF TABLES AND FIGURES.....	vi
ACRONYMS/ ABBREVIATIONS.....	vii
CHAPTER ONE: INTRODUCTION.....	1
1.1 Background.....	1
1.2 Statement of the problem.....	2
1.3 Significance of the study.....	3
2. LITERATURE REVIEW	4
2.1 Magnitude of inappropriate use of inhaler techniques among health workers	4
2.2 Factors associated with MDI technique among health care workers.....	5
2.2.1 Socio-demographic factors	5
2.2.2 Knowledge of inhaler techniques.....	5
2.2.3 Individual health professional’s factors (service year, qualification, type of	6
Profession, training on the use of the device)	6
2.3 Conceptual framework.....	8
CHAPTER THREE: OBJECTIVES.....	9
3.1. General objective	9
3.2. Specific objectives	9
CHAPTER FOUR: METHODS	10
4.1. Study area.....	10
4.2. Study period and study design	10
4.3 Population	10
4.3.1 Source population	10
4.3.2 Study population	10
4.3.3 Inclusion and Exclusion criteria.....	10
4.3.4 Sample size and sampling technique.....	11
4.4 Study variables.....	12
4.4.1 Dependent variables.....	12
4.4.2 Independent variables	12
4.5 Data collection process and measurement	12
4.6 Data collectors	12

4.7 Data analysis, processing, and interpretation.....	13
4.8 Data quality assurance	13
4.9 Ethical consideration.....	13
4.10 Dissemination plan.....	14
4.11 Operational definitions.....	14
CHAPTER FIVE: RESULTS	15
5.1. Individual factors and knowledge of MDI among study participants.....	17
5.2 MDI inhaler techniques demonstrations steps	18
5.3. Level of competency among health care providers in NEMMCSH	19
5.4 Overall score of the respondents on MDI inhaler techniques demonstrations.....	20
5.5. Factors associated with the level of competency on MDI inhaler techniques among health care providers in NEMMCSH	21
CHAPTER SIX: DISCUSSIONS	22
STRENGTH AND LIMITATION OF THE STUDY	23
CHAPTER SEVEN: CONCLUSION AND RECOMMENDATIONS	24
7.1 CONCLUSION.....	24
7.2 RECOMMENDATIONS	24
ANNEX I: REFERENCES	25
ANNEX II: CONSENT FORM	31
ANNEX III: QUESTIONNAIRES	32
ANNEX IV: ASSURANCE OF PRINCIPAL INVESTIGATOR.....	34

LIST OF TABLES AND FIGURES

Table 1: Socio- Demographic Characteristics of health care provider in NEMMCSH from November 10, 2021, to January 10, 2022 (n=300)	16
Table 2: Individual characteristics of health care providers in NEMMCSH from November 10, 2021, to January 10, 2022 (n=300)	17
Table 3: Frequency of evaluation of respondents to demonstrate each step of metered dose inhaler technique among health care providers in NEMMCSH from November 10, 2021, to January 10, 2022 (n=300).....	18
Table 4: Factors associated with the level of competency on MDI inhaler techniques among HCP in NEMMCSH from November 10, 2021, to January 10, 2022 (n=300)	21

ACRONYMS/ ABBREVIATIONS

ACCP ----- American college of chest physicians

ATS----- American thoracic society

BOLD ----- Burden of obstructive lung disease

COPD ----- chronic obstructive lung disease

GINA----- Global Initiative for Asthma

GOLD----- Global initiative for chronic Obstructive Lung Disease

GP ----- General Practitioner

HCP ----- Healthcare Professional

JUMC ----- Jimma University Medical Center

KAT ----- Knowledge of aerosol tool

MDI ----- Metered dose inhaler

NAEPP----- National Asthma education and prevention program

NCD ----- Non communicable disease

NEMMCSH----- Nigist Elleni Mohammed memorial Comprehensive specialized hospital

NICE ----- National Institute for Clinical Excellence

NRAD----- National review of asthma death

RN ----- Registered nurses

RT----- Respiratory therapist

SNNPR----- South nations, nationalities and peoples region

SPSS----- Stastical package of social science

CHAPTER ONE: INTRODUCTION

1.1 Background

Asthma is a chronic inflammatory airway disease that affects approximately 358 million people worldwide (1). Based on the burden of obstructive lung disease (BOLD) and other large scale epidemiological studies, it is estimated that the number of chronic obstructive pulmonary disease (COPD) cases were 384 5million in 2010, with a global prevalence of 11.7%(2). Globally, there are around three million deaths annually(3). The prevalence of COPD is expected to rise over the next 40 years and by 2060 there may be over 5.4 million deaths annually from COPD and related conditions (4).

In Africa in 1990, the estimated prevalence of asthma was 74.4 million in the total population which increased to 94.8 and 119.3 million in 2000 and 2010 respectively whereas the 2010 approximated prevalence for COPD contributed for 196.4 million people when applied to the relevant age group (5,6).

According to a study conducted in Ethiopia's Abeshege district and Debra Berhan referral hospital, COPD and bronchial asthma affected 17.8% and 29.6% of adult patients, respectively (5,6).

The inhaled route of administration is the optimal method of drug delivery for the management of patients with obstructive airway diseases(7). The most important advantage of inhaled therapy is that drugs are delivered directly onto the sites of action producing higher local concentrations for better efficacy and with significantly less systemic exposure hence a reduced risk of side effects(8–10). The therapeutic drugs used in the management of asthma and COPD, mostly bronchodilators and corticosteroid anti-inflammatory agents, therefore have been formulated as inhaled aerosols. Consequently, a wide array of inhalation devices have been introduced to the market and have become the prime methods for drug administration in the treatment of patients with obstructive pulmonary diseases(11). There are two main groups of inhaler devices: metered dose inhalers (MDI) and dry powder inhalers (DPI). The pressurized metered dose inhaler (pMDI) is presently the most commonly used(12). Despite the pressurized metered dose inhaler (pMDI) being widely prescribed, many patients do not achieve the full therapeutic benefit because their inhalation technique is poor(13,14).

In conclusion by addressing adherence, refining inhaler technique, and encouraging patients to self-manage their asthma, health practitioners have a significant effect on a patient's asthma and asthma-related quality of life (15). Patients' competence in using metered dose inhalers related to their health care providers' proficiency in the technique .so that, respiratory care practitioners are better in the outpatient setting since they were the most proficient among all the health care providers in the proper use of metered-dose inhalers(16).

1.2 Statement of the problem

Despite the availability of effective treatments, asthma control is often inadequate (17)and one of the most important causes of inadequate disease control is the misuse of inhaler devices(18,19) According to some estimates, about half of all patients do not get enough benefit from their inhalers due to inadequate inhaler techniques (7) A correct inhaler technique by the patient is crucial for the success of the therapy(20,21) It has been acknowledged that the most commonly encountered pMDI technique problems by patients are; poor coordination of inhalation with inhaler actuation, stopping to inhale shortly after activating the pMDI and inspiration through the nose(22) The use of a metered dose inhaler (MDI) system is common, and proper inhaler technique and adherence are essential. For proper use of this device, explicit steps and excellent harmonization are needed in terms of technique. According to studies, about 90% of asthma and COPD patients fail to use their inhalers (21,23). The National Review of Asthma Deaths (NRAD) reported in 2014 that a lack of awareness and inappropriate use of inhalers were thought to be reasons for a large number of the 195 asthma deaths (24). Incorrect asthma inhaler device use is related to inadequate asthma control and multiple visits to the emergency room, and it's linked to a number of risk factors, including poor patient education and instruction. (18).

As a result, patients taking MDI should be properly informed about inhaler techniques by professionals, as this will improve adherence and management of the disease. So health care workers' competence is determinant to train their patient about the technique of inhaler. However, in most studies conducted around the globe, pharmacists, nurses, and general practitioners have suboptimal knowledge and skill on MDI technique indicating that inhaler technique training programs for healthcare providers must include not only the specialist but

also general practitioners, accident and emergency physicians, nurses, pharmacists and health educator(24–28).

In Ethiopia, there is limited data about health care professionals' competence in metered dose inhaler techniques. According to data from a study done on community pharmacy professionals of Gondar and Mekelle towns they have very poor competence ranging from 0.9% -4.8%(29,30)None of the socio-demographic characteristics was significantly associated with knowledge (27). According to available studies only training significantly affects health care providers competence in metered dose inhaler technique whereas individuals qualification roughly associated with the technique(31–34). Therefore, the purpose of this study was to assess competency (skill) in metered dose inhaler technique and its associated factors among health care professionals of Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital, South Ethiopia.

1.3 Significance of the study

A rise in asthma morbidity can be attributed to a lack of education and inadequate use of MDI (MDI technique). The latter does not only affect the quality of life of asthmatic patients but also places a huge economic burden on the health care systems of countries, especially developing countries. So to give an adequate demonstration for patients the skill and knowledge of health care professionals are so important.

Thus, this study was expected to determine the level of competency and identify factors influencing the competency of health care professionals of Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital.

The finding of this research might initiate responsible bodies to establish an asthma training center, planning to evaluate health care professionals' inhalation technique competence continuously and give immediate appropriate intervention. It may also show a need for regular training of health professionals about how to use inhaler medications. It will be used as baseline information for future research to assess health care providers' knowledge and skill on MDI utilization.

2. LITERATURE REVIEW

Even though there are different studies about health care workers' competence in MDI techniques globally, data is scarce in our country. The following review illustrates the magnitude of MDI technique incompetency among HCPs, factors affecting the technique, and recommendations to overcome this problem.

2.1 Magnitude of inappropriate use of inhaler techniques among health workers

Just 11 (7 percent) of the 150 HCPs evaluated in a study in the United Kingdom could demonstrate all of the recognized steps in administration, including the assessment of inspiratory flow using the in-check device. Only 113 (75%) of the HCPs said they were interested in inhaler technique teaching, and only 113 (11%) could show all of the recognized Steps (24). A total of 96 community pharmacies in five cities in Saudi Arabia's Al Qassim province were contacted, and it was discovered that the majority (93.7 percent) of community pharmacists failed to demonstrate proper pMDI inhalation technique. (35). A study was conducted to assess the effectiveness of the metered-dose inhaler (MDI) technique in a group of doctors and nurses working in Hamadan University hospitals. 35 (20.2%) doctors and 138 (79.8%) nurses were among the 173 participants. Only 12 people (6.93%) got all of the steps right. Physicians outperformed nurses by a wide margin (85.7 percent vs. 63.8 percent, $P < 0.05$) (36). The ability of nurses to use a metered dose inhaler was investigated at Chitwan Medical College in Nepal. A majority (94%) of the 50 respondents were between the ages of 19 and 22. None of them were proficient in the use of MDI. 3.72 was the average technical score. Only 6% of nurses completed the most difficult and essential step of actuation, which is to breathe deeply and steadily (37).

Cross sectional study in Nigeria showed of Fifty five Pediatric senior registrars the knowledge score on inhaler use was good in 14.5% of them and poor in 85.5% (27). The mean checklist scores on the MDI and Diskus were 5.3 3.0 and 2.3 3.3 (maximum 11), respectively, according to a report on the competence of pharmacists on the use of the metered dose inhaler (MDI), Diskus, Turbuhaler, and the MDI with a spacer in Nigeria (26).

According to a cross-sectional study conducted in Mekelle among registered pharmacists and druggists from public and private pharmacies and drug stores, Only two (1.9 percent)

and one (0.9 percent) of the 106 providers who took part in this study had adequate competency in metered dose inhaler for essential steps for the optimum therapeutic value of MDI(38). According to a survey of 70 community pharmacy workers conducted in Gondar, only three (4.8 percent) were competent in demonstrating the critical steps of MDI correctly and only 13 participants received a score of seven or higher in total, but the majority of them had skipped critical steps such as steps 1, 2, 5, 6, 7, or 8 (30).

2.2 Factors associated with MDI technique among health care workers

2.2.1 Socio-demographic factors

As shown in a study conducted at Chitwan Medical College on fifty-five nurses, the majority (94%) of respondents were of age group 19-22 years old, 4 % were 23-26 years and 2 % were between 27-30 years old. None of them performed all the steps of MDI(37). Another hospital based cross sectional study was done in three general hospitals in Mexico among 244 HCWS and no difference between gender, labor category, schedule, service, age, seniority, and education degree between the three hospitals was observed(39).

According to a cross-sectional study conducted in Nigeria on 55 senior pediatric residents, none of the socio-demographic factors significantly affects the knowledge score of metered dose inhaler technique, whereas the same is true for the latest time for prescription of inhaler material(27). According to a study was carried out in two major cities in Anambra State, Nigeria, using 41 registered community pharmacists using simulated patient approach showed that gender, age, and years of practice did not significantly influence the demonstrations ability of the community pharmacists in the study(40).

In a study conducted on community pharmacies of Mekelle town, only three participants achieved adequate scores on metered dose inhaler technique irrespective of the variation in age, sex, educational status, and experience of study participants(38).

2.2.2 Knowledge of inhaler techniques

The survey conducted in Canada among medical personnel to assess their knowledge of and ability to use three widely used inhaler devices; MDI, MDI with a spacing chamber the RT's percent mean knowledge score (67 +/- 5 percent) was significantly higher than those achieved by either the RNs (39 +/- 7 percent) or the MDs (48 +/- 7 percent) (for all p <

0.0001)(32) this knowledge score significantly correlated with their ability to demonstrate inhaler technique correctly. In Michigan USA, one hundred eighty-five health care providers, comprising emergency medicine house staff (n = 60), attending emergency physicians (n = 50), and ED nurses (n = 75) were recruited to assess their knowledge of estimating the amount of medicine left in the canister. Only 15% of health care providers can estimate the amount of drug left in the canister correctly(41). Overall, there is a poor correlation between perceived ability and investigator-measured performance of inhaler technique(42).

As shown by a study conducted in Nigeria acknowledgment of familiarity with basic steps in MDI technique was also not significantly associated with knowledge score ($X = 2.613$, $p = 0.106$)(27).

2.2.3 Individual health professional's factors (service year, qualification, type of Profession, training on the use of the device)

According to research conducted in Oman, physicians performed substantially better than non-physicians (20% vs. 2%, $p < 0.05$)(25). Among the physicians, internists (26%) outperformed general practitioners (5%) and accident and emergency doctors (9%). According to a study conducted in five Midwestern community teaching hospitals of health care providers, there were no significant differences in performance scores among the emergency medicine house staff (42%), attending emergency physicians (34%), and ED nurses (45%)(41). Hamedan, Iran 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%, $P < 0.05$)(43). According to, an interventional 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(31).

Following the intervention, a doctor, four medical interns, and eight nurses all correctly illustrated the steps. Physicians' MDI inhalation success scores for shaking the canister, absolute expiration before using the MDI, breath-holding afterward, and mouthpiece positioning were all associated with their knowledge level($p \leq 0.02$) (33). According to a study conducted in Canada, the RT's percent mean knowledge score ($67 \pm 5\%$) was significantly higher than that of either the RNs ($39 \pm 7\%$) or the MDs ($48 \pm 7\%$) (all p

0.0001), and similarly, percent mean demonstration scores for each device were significantly higher for RTs than either the RN or MD groups;(32). As shown in a survey conducted in Philadelphia, pediatric residents correctly performed an average of 3.8 steps regardless of work experience, familiarity with MDI, participation in asthma management, or patient counseling, and there was no substantial difference in theoretical awareness of the metered-dose inhaler among 1st, 2nd, and 3rd-year residents (44).

In a Louisiana State University study comparing metered dose inhaler (MDI) performance among physicians, nurses, and respiratory therapists, respiratory therapists outperformed house staff physicians, nurses, and non-pulmonary faculty(45). Physicians conducted the right inhaler technique substantially better than nurses, according to a nationwide multicentric study in Spain, whereas general practitioners and pediatricians had lower scores than chest doctors and allergists(46). Male pharmacists, pharmacists with a family history of respiratory disease, and pharmacists with a master's degree all had higher KAT scores in an observational cross-sectional analysis in Iraq(47). According to a study conducted among 142 internal medicine residents from six Korean university hospitals for their techniques with three different inhaler devices: a metered dose inhaler (MDI), Diskus, and Turbuhaler to estimate the impact of a single teaching session, reassessment was performed two months after education and overall skills for all three inhalers improved significantly($p = 0.001$)(48). Right response rates were 47 percent for prescribers (internal medicine residents, family medicine residents, and pulmonary fellows) and 47 percent for Non-prescribers (respiratory therapists, nursing workers, and pharmacists), respectively ($p = 0.6919$). Respiratory therapists, on the other hand, had the highest overall right answer rate of 85 percent (34). According to an intervention study conducted in India, nurses' proficiency with pMDI increased from 21.8 percent to 36.8percent, and their proficiency with pMDI with spacer increased from 2.3 percent to 21 percent, and for nebulizer from 33.3 percent to 53.21 percent(49).

This literature review illustrates that the health care professionals' 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 are

conflicting about the relationship between theoretical knowledge and skill.it also pointed out training has a significant impact on competence.

Considering this review health care workers' competence in MDI technique should be evaluated regularly, but significant data is lacking in our country.

2.3 Conceptual framework

This conceptual framework was developed after reviewing different kinds of literature which are related to my topic assuming that these factors have a negative or positive impact on HCP's Competence in the use of MDI technique.

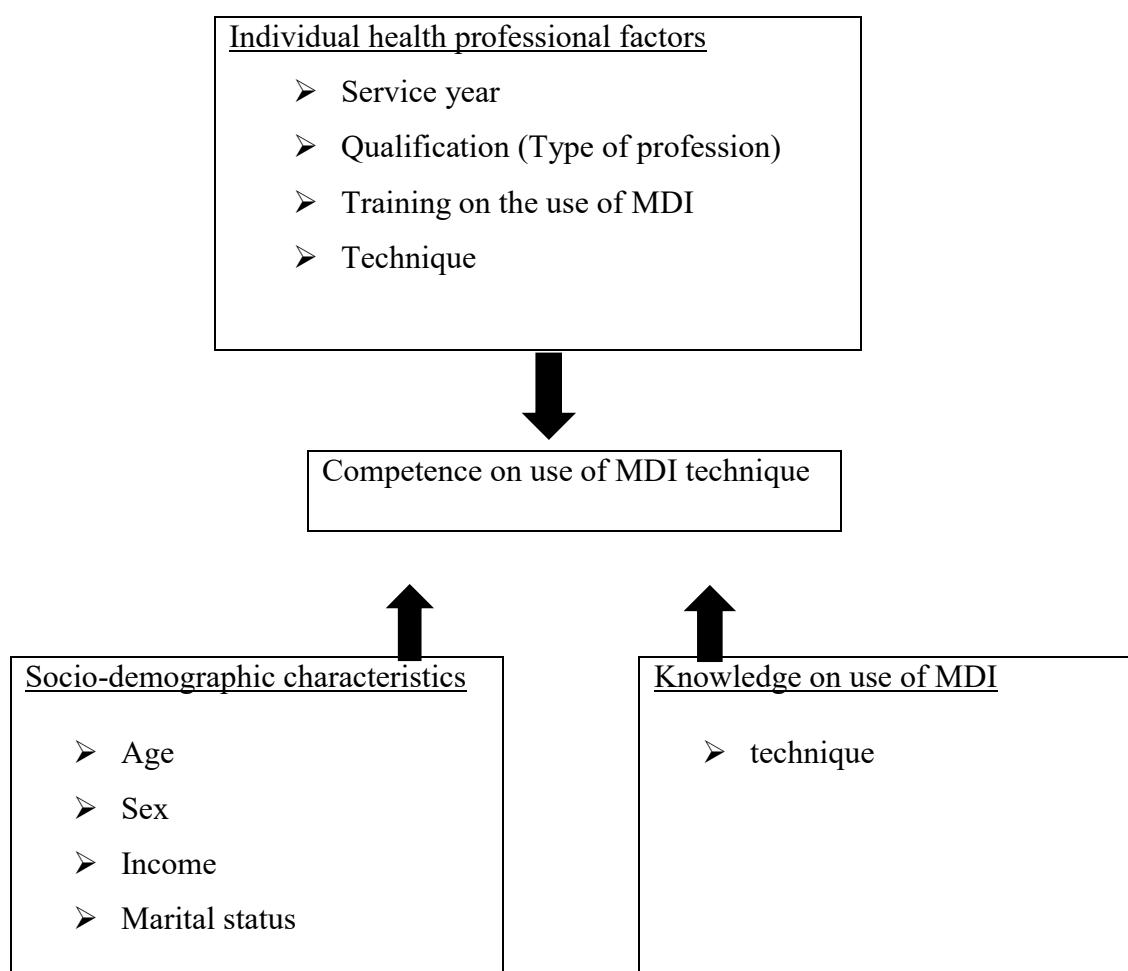


Figure 1: Conceptual framework the study

CHAPTER THREE: OBJECTIVES

3.1. General objective

This study was aimed to assess competency on use of metered dose inhaler technique and its associated factors among health care professionals, Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital, south Ethiopia, 2021/2022.

3.2. Specific objectives

- To determine the level of health professionals' competency on the use of metered dose inhaler (MDI) technique in Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital.

- To identify factors associated with the level of health professionals' competency on the use of metered dose inhaler (MDI) technique in Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital.

CHAPTER FOUR: METHODS

4.1. Study area

The study was conducted in Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital, Hosanna town Hadiya Zone. Hosanna town, Capital of Hadiya Zone of SNNP region of Ethiopia, with a total population of 69,995 with a male population 35,523 and female 34,472 is located 232 km away from Addis Ababa. The hospital had 22 specialists, 65 general practitioners, 230 nurses, 33 laboratory professionals, 32 pharmacy professionals, 21 anaesthetists, 56 other health professionals, and 382 supportive staff.

4.2. Study period and study design

A cross-sectional study was employed on health professionals working in Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital Hosanna town south Ethiopia from November 10, 2021, to January 10, 2022.

4.3 Population

4.3.1 Source population

All health care workers in Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital.

4.3.2 Study population

Health professionals including nurses, pharmacists, druggists, and general practitioners working in Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital.

4.3.3 Inclusion and Exclusion criteria

4.3.3.1 Inclusion criteria

Pharmacists, druggist nurses, and general practitioners

4.3.3.2 Exclusion criteria

Those who refused to participate

Seniors, Medical interns

Those who were involved in data collection

4.3.4 Sample size and sampling technique

4.3.4.1 Sample size

The sample was calculated using Epi-Info Stastical software population survey formula assuming usage of correct MDI technique to be 50%, margin of error 5%, and 95% confidence interval. Accordingly, the calculated sample size was 177. But since the total 300 eligible study population (207 nurses, 64 practitioners, and 29 pharmacy professionals) were manageable, all were included in the study.

4.3.4.2 Sampling technique

All of the nurses (207), pharmacy professionals 29), and General practitioners (64), who were available during the data collection period, were included in the study using non-probability sampling.

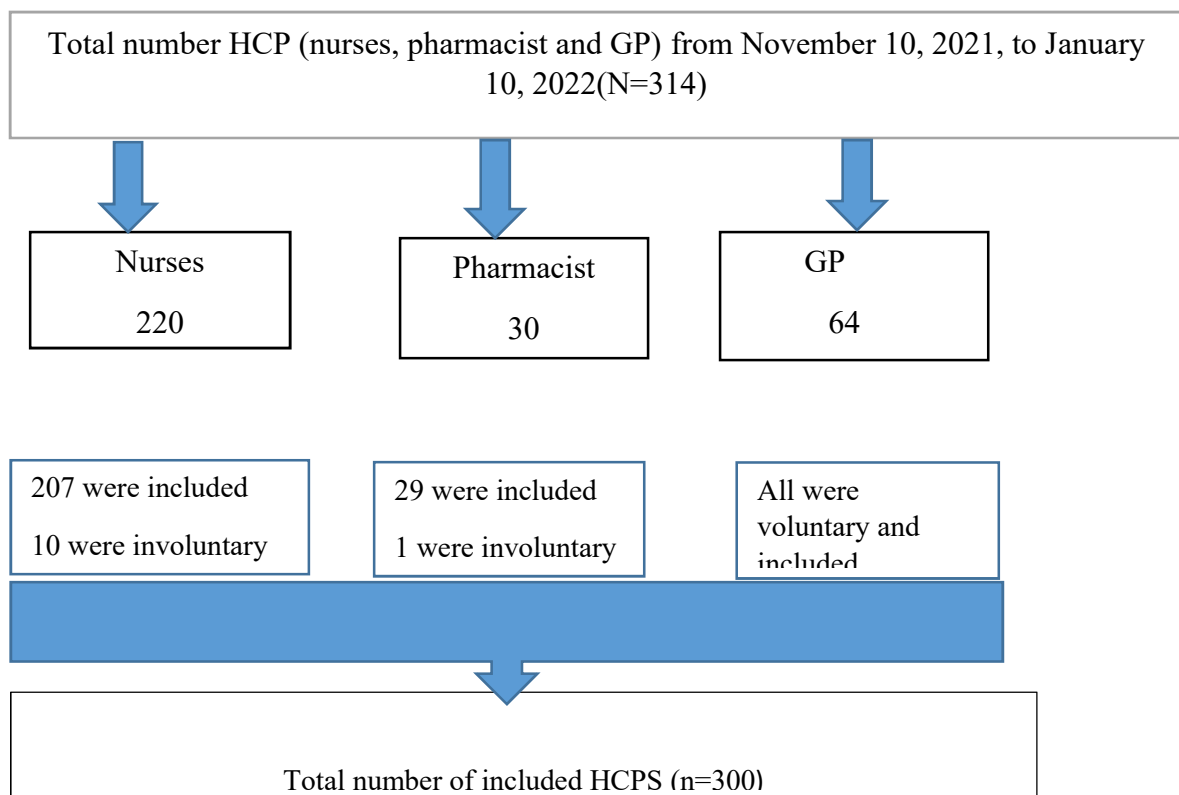


Figure 2: Schematic representation of sampling technique and procedures for the level of competency on use of MDI technique among HCP in NEMMCSH.

4.4 Study variables

4.4.1 Dependent variables

Level of competency on use of MDI technique (Adequate, Inadequate)

4.4.2 Independent variables

Age	Income
Sex	Knowledge of MDI
Marital status	Qualification
Previous training	Work experience

4.5 Data collection process and measurement

The tool for data collection had two parts. The first part involves participants' demographic factors, knowledge about MDI, and individual factors that affect HCP's skill of inhaler technique. This part was accomplished through questionnaires which were filled out by participants. The second part of the tool was the skill part in which the knowledge/skill of using a metered dose inhaler was scored using an evaluation method adapted from the National Asthma Education and Prevention Programs of America (NAEPP) step criteria for the demonstration of a metered dose inhaler(50). The participants were given metered dose inhaler device and asked to show steps for the standard metered dose inhaler technique and each step was given a score of one if correct, zero if not. Salbutamol puff was used as an inhaler device due to its accessibility and relatively low cost. No intervention or critique was given to the participant while she /he was showing the steps.

4.6 Data collectors

Data collection was undertaken by a total of four persons and two supervisors. One pharmacist, two nurses, one general practitioner, and two senior internists for supervision were recruited and trained about the study matter for 2 days. They were also given training on the objective of the study, variables on the questionnaire, and its implication. After training all data collectors were evaluated to assess whether they understand or not and any ambiguity was clarified ahead of data collection.

Then, they were assigned to fill the data collection format. The tool for data collection had two parts. The first part which consisted of questions about socio demographic factors and participants' knowledge about MDI were filled by the participants. In the second part the participants were given salbutamol puff and asked to perform steps for standard MDI technique without any criticism and intervention. Each step was given one if correctly performed and zero if incorrectly performed or skipped.

4.7 Data analysis, processing, and interpretation

After data collection was completed it was checked for consistency and completeness and entered into Epi data version 3.1 then exported to IBM SPSS 25 and data cleaning was made. Then after, the data was analyzed using descriptive statistics by running frequencies and proportions. Additionally, the data was analyzed by logistic regression. It was performed in two stages: in the first stage, a bivariate logistic regression was conducted to identify candidate variables for multivariate analysis at a p-value less than or equal to 0.25. IN the second stage, independent predictors of outcome and strength of association between dependent and independent variables was identified by using multivariate logistic regression analysis of the candidate variables entered by enter method. The presence and strength of association was declared by considering the AOR and 95% CI of the AOR, and p value < 0.05 as significant. Also, presence of multicollinearity between independent factors and model fitness were checked. Finally, the data was summarized and presented using tables and figures.

4.8 Data quality assurance

Adequate training was provided for data collectors, and the compilation format was prepared in simple English to maintain clarity and easier understanding by these data collectors. The collected data was checked for completeness and consistency on the day of collection by the principal investigator and any inconsistency, inaccuracy, or missing data implied was returned for correction on the same day. Technical support and supervision were provided by a senior internist of the hospital on the collected data.

4.9 Ethical consideration

Ethical clearance to conduct the study was obtained from the Ethical Review Board of Jimma University, before the official commencement of the data collection process. Written

informed consent was obtained from all participants before data collection. Participants' confidentiality was ensured during the study period as individuals' scores won't be disclosed to participants or other staff members. This study didn't involve any potentially harmful intervention to participants.

All possible COVID-19 protection measurements were taken during data collection as per WHO recommendation. Both data collector and participant wore a face mask, hand hygiene protocol was kept before and after using the MDI simulator device using alcohol-based hand rub. Furthermore, the MDI simulator was cleaned with standard alcohol before being used by the next participant.

4.10 Dissemination of results

After research completion and finalizing the report, the findings of the study were disseminated to all relevant stakeholders through a presentation, and Copies of the research were given to JUMC, the Department of Internal Medicine, and NEMMCSH. Furthermore, copies of this paper will be given to the ministry of health, and Ethiopian Non-communicable diseases (NCDs) association, other concerned institutions, and stakeholders for possible intervention based on the findings.

4.11 Operational definitions

Metered dose inhaler (MDI) _ a small device that delivers a measured amount of medication to your lungs(51).

Inhalational techniques – steps performed to use the inhaler devices correctly(52).

Inhaler error/Incorrect handling of inhalers – missed or incorrectly used steps during use of inhaler devices which reduce or prevent deposition of medicine in the lungs(30).

Essential/critical steps – steps that have a significant effect on aerosol drug delivery(38). Steps 1, 2, 5, 6,7and 8 were considered essential as per NAEPP.

Critical errors – missed or incorrect performance of essential/critical steps that can lead to either little or no drug delivery to the target point(30).

Adequate competence –if essential steps are performed correctly and a total score of seven and above(29).

Inadequate competence- if any of the essential steps are missed and a total score of below seven(29).

CHAPTER FIVE: RESULTS

Out of 314 eligible health care professionals for the study, only 300 participated in the study which makes the response rate 95.5%. The 14 health care professionals (13 nurses and one pharmacist) did not participate in the study due to a lack of interest.

The mean age of the study participants was 28.69 (SD±4.024) and majority of the study participants 204(68%) were below 29 years age group. About 198(66%) and 155(51.7%) of the study participants were males and Protestants respectively. More than half of the study participants 181(60.3%) had an income range between EB 5000 to 10,000 (Table 1).

Table 1: Socio Demographic Characteristics of health care providers in NEMMCSH from November 10, 2021, to January 10, 2022.

Characteristics	Category	Frequency(n=300)	Percent
Age	≤ 29	204	68%
	30-39	91	30.3%
	≥ 40	5	1.7%
Gender	Male	198	66%
	Female	102	34%
Marital status	Single	196	65.3%
	Married	104	34.7%
Religion	Orthodox	126	42%
	Muslim	14	4.7%
	Protestant	155	51.7%
	Others*	5	1.7%
qualification	Nurse	207	69%
	Pharmacist	29	9.7%
	GP	64	21.3%
Income	< 5000 ETB	42	14%
	5000-10000 ETB	181	60.3%
	>10000 ETB	77	25.7%

Others* : Catholic religion followers

5.1. Individual factors and knowledge of MDI among study participants

The majority (77.3%) of the study participants had work experience of below five years whereas most of the study participants (95.7%) had no previous training on MDI techniques. Only 12% of the study participants knew how to check for the amount of medicine left in the canister. In addition, more than half of the study participants 179(59.7%) were not involved in MDI prescription. From four questions used to assess theoretical knowledge of participants about MDI, all except necessity mouth rinsing after beclomethasone puff were answered by less than 50% of participants correctly (Table 2).

Table 2 Individual factors and knowledge of MDI among health care providers of NEMMCSH from November 10, 2021, to January 10, 2022.

Characteristics	Category	Frequency(n=300)	Percent
Work experience	< 5 years	232	77.3%
	5-10 years	48	16%
	>10 years	20	6.7%
Previous MDI training	Yes	13	4.3%
	No	287	95.7%
Involvement in MDI prescription	Yes	121	40.3%
	No	179	59.7%
False about MDI	Correctly answered	124	41.3%
	Incorrectly answered	176	58.7%
Check the amount of medicine left in the canister	Yes	36	12%
	No	264	88%
Need for mouth rinsing	Correctly answered	205	68.3%
	Incorrectly answered	95	31.7%
The proportion of each salbutamol puff reaches the respiratory system	Correctly answered	75	25%
	Incorrectly answered	225	75%

5.2 MDI inhaler techniques demonstrations steps

In this study, removing the cap (62%), shaking the content of the canister (53.7%), and holding the inhaler upright position (48.7%) were the three most frequently demonstrated steps by the study participants while waiting for one minute before repeating the steps (31.3%), inhaling deeply for five seconds (32.7%) and Placing inhaler 2-4 cm away from the mouth or in the mouth (33.7%) were the least demonstrated steps (Table 3).

Table 3: Frequency of evaluation of respondents to demonstrate each step of metered dose inhaler technique among health care providers in NEMMCSH from November 10, 2021, to January 10, 2022 (n=300)

Variables	Correct	Incorrect
Shaking 4-5 times the content *	161(53.7%)	139(46.3%)
Remove the cap*	186(62%)	114(38%)
Hold the inhaler upright	146((48.7%)	154(51.3%)
Breath out completely	79(26.3%)	221(73.7%)
Place inhaler 2-4 cm away/in the mouth*	101(33.7%)	199(66.3%)
Inhale slowly and activate the inhaler*	123(41%)	177(59%)
Inhale deeply until the lungs are full*	98(32.7%)	202(67.3%)
Take the inhaler out of the mouth and close lips*	161(53.7%)	139(46.3%)
Hold breath for 10 seconds	117(39%)	183(61%)
Breath out slowly	128(42.7%)	172(57.3%)
Wait at least 1 minute before repeating other steps	94(31.3%)	206(68.7%)

Essential steps according to NAEPP*

5.3. Level of competency among health care providers in NEMMCSH

In this study, only 22(7.3%) of the study participants had an adequate level of competence in MDI inhaler techniques. The competency of MDI inhaler techniques is 7(3.4%) for nurses, 7(24.1%) pharmacists, and 8(12.5%) GP (Figure 3).

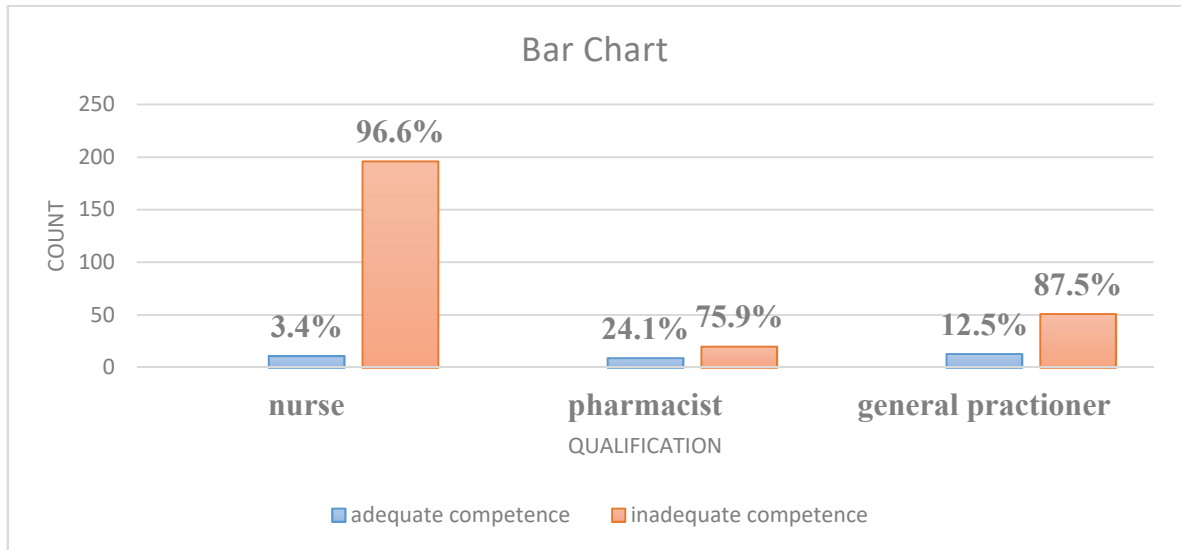


Figure 3: level of competency on MDI inhaler techniques among health care providers in NEMMCSH from November 10, 2021, to January 10, 2022 (n=300).

5.4 Overall score of the respondents on MDI inhaler techniques demonstrations

In this study majority of study participants, 75(25%) demonstrated only four steps of MDI techniques correctly, while only one study participant performed all the eleven steps accurately. Overall only 38(12.7%) participants performed seven or more steps but most of them missed one or more essential steps (Figure 4).

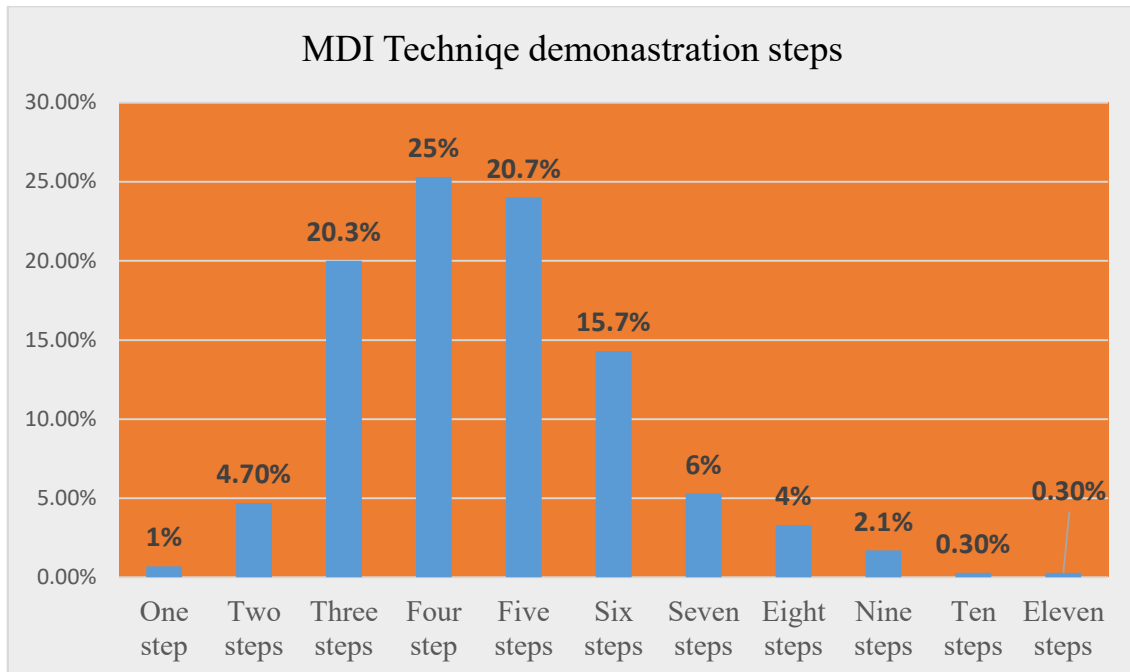


Figure 4: Overall score of the respondents on MDI inhaler techniques demonstrations steps among health care providers in NEMMCSH from November 10, 2021, to January 10, 2022 (n=300)

5.5. Factors associated with the level of competency on MDI inhaler techniques among health care providers in NEMMCSH

In bivariate analysis marital status of HCP, qualification of HCP, knowledge about proportion of the drug that reaches respiratory system after each puff of salbutamol and need of mouth rinsing after administration of beclomethasone puff were potential predictor at p-value of <0.25 and transferred to multivariate analysis and in multivariate analysis only qualification of HCP was significant predictor of the level of competence in MDI inhaler techniques.

In this study, the odds of having an adequate level of competence in MDI inhaler technique was 8.82 times more likely [(AOR=8.82, 95% CI: 2.59 – 30.07)] among pharmacists compared to the nurses. In another way, the odds of having an adequate level of competence in MDI inhaler techniques was 3.89 times more likely [(AOR=3.89, 95% CI: 1.26 - 11.87)] among general practitioners compared to nurses (Table 4).

Table 2: Factors associated with the level of competence in MDI inhaler techniques among HCP in NEMMCSH from November 10, 2021, to January 10, 2022 (n=300)

Variables		Competence (%)		Bivariate analysis		Multi variate analysis	
		Adequate	Inadequate	COR(CI)	P value	AOR(CI)	P value
Marital status	single	17(8.7)	179(91.3)	1.88(.673, 5.251)	.228	1.24(.420,3.670)	.697
	married	5(4.8)	99(95.2)	1			
Qualification	GP	8(12.5)	56(87.5)	4.08(1.419,11.743)	.009	3.89(1.261,11.864)	.018
	Pharmacist	7(24.1)	22(75.9)	9.09(2.918,28.323)	.001	8.82(2.585,30.067)	.001
	Nurse	7(3.4)	200(96.6)	1			
Mouth rinsing	Correct	18(8.8)	187(91.2)	2.19(.720, 6.658)	.167	1.50 (.443 , 5.057)	.517
	Incorrect	4(4.2)	91(95.8)	1			
Proportion of drug reaches lung	Correct	8(10.7)	67(89.3)	1.80(.724, 4.476)	.206	2.46(.917,6.615)	.074
	Incorrect	14(6.2)	211(93.8)	1			

CHAPTER SIX: DISCUSSIONS

The inhaled route of administration is the optimal method of drug delivery for the management of patients with obstructive airway diseases(7). The most important advantage of inhaled therapy is that drugs are delivered directly onto the sites of action producing higher local concentrations for better efficacy and with significantly less systemic exposure hence a reduced risk of side effects(8–10). The pressurized metered dose inhaler (pMDI) is presently the most commonly used(12). Despite the pressurized metered dose inhaler (pMDI) being widely prescribed, many patients do not achieve the full therapeutic benefit because their inhalation technique is poor(13,14).

In this study, the magnitude of an adequate level of competency for metered dose inhalers (pMDI) among the studied health care workers was 7.3%. This result is comparable to the result of the study done in Hamadan University hospitals (6.9%), Saudi Arabia's Al Qassim province (6.3%) (27, 35,37). This result is higher than that of a study done in Mekelle (1.9%) and Gondar (4.8%) which involved only community pharmacists and druggists (29, 30).

But the magnitude of an appropriate level of competency on metered dose inhaler (pMDI) in this study is lower than a study done in Nigeria (14.5%) and the United Kingdom(11%) (24,27). The discrepancy for this result may be due to the difference in the study participants in which this study included nurses, pharmacists, and general practitioners but the comparison study include only community pharmacies.

In this study majority (25%) of the study, participants perform only four steps on MDI techniques and only one study participant performed all of the eleven steps on MDI inhaler techniques. 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 Oman, in five Midwestern community teaching hospitals and Manipal Teaching Hospital in Nepal (25, 31, 41). However waiting at least for one minute before repeating other steps, breathing out slowly, and holding the breath for ten seconds were the least performed steps on MDI inhaler techniques by all study participants.

In this study, the odds of having an adequate level of competency on MDI inhaler techniques was 8.82 times more likely [(AOR=8.82, 95% CI: 2.59 – 30.07)] among pharmacists compared

to the nurses. In another way, the odds of having an adequate level of competency on MDI inhaler techniques was 3.89 times more likely [(AOR=3.89, 95% CI: 1.26 - 11.87)] among general practitioners compared to nurses. This result is similar to a study done in Hamadan and Iran in which general practitioners had an adequate level of competency ($P<0.005$) on MDI inhaler techniques (31).

A study showed that age, sex, religion, income level, work experience, and theoretical knowledge about MDI had no significant impact on competency in MDI administration techniques (37, 39, 40). Our study also showed that none of these factors affected competence in MDI techniques significantly. According to our study training had no significant effect on competence. However, according to a study conducted in India competence was improved after training significantly (49).

STRENGTH AND LIMITATION OF THE STUDY

This survey highlights an area of health care providers' practice where literature is scarce in Ethiopia. However, the survey has some limitations that should be noted while interpreting the results. As far the study was a cross-sectional survey conducted in NEMMCSH, caution should be exercised when generalizing to other hospitals in the country. Moreover, our direct visit of health care professionals at their workplace could affect the responses as it may be subjected to respondent bias, which could have been reduced. Despite the above limitations, this survey has significant implications for improving the active engagement of health care professionals in health promotion and disease state management for patients with asthma and COPD by using the result of this study as input to recommend the NEMMCSH management team to arrange a regular capacity building session to health care providers to improve their knowledge and skills towards MDI use techniques.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSION

Health care providers' (nurses, pharmacy, and general practitioner) competency in MDI inhaler techniques was poor. In this study, none of the socio-demographic factors are associated with the level of competency on MDI inhaler techniques. However significant differences ($P=0.001$ and $P=0.009$) were noted in the level of competency on MDI inhaler techniques among respondents who were pharmacists and general practitioners compared with nurses respectively.

7.2 RECOMMENDATIONS

By using the result of this study as input I recommend, NEMMCSHN and Hosanna town health office to arrange a regular capacity building session for the health care providers to improve their knowledge and skills towards MDI inhaler techniques. To strongly integrate HCP into future asthma and COPD care and to optimize the contribution of all health care providers for the patient interventions, establishing and providing capacity building education and training has to be made by all stakeholders.

Since there is limited literature in our country further powerful study should be conducted to identify factors affecting MDI inhaler technique.

ANNEX I: REFERENCES

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. *Lancet*. 2018;392(10159):1789–858.
2. Adeloye D, Chua S, Lee C, Basquill C, Papana A, Theodoratou E, et al. Global and regional estimates of COPD prevalence: Systematic review and meta-analysis. *J Glob Health*. 2015;5(2).
3. Abubakar II, Tillmann T, Banerjee A. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2015;385(9963):117–71.
4. Global Initiative for Chronic Obstructive Lung Disease. GOLD Report 2020. *Glob Initiat Chronic Obstr Lung Dis* [Internet]. 2020;141. Available from: https://goldcopd.org/wp-content/uploads/2019/12/GOLD-2020-FINAL-ver1.2-03Dec19_WMV.pdf
5. Adeloye D, Chan KY, Rudan I, Campbell H. An estimate of asthma prevalence in Africa: A systematic analysis. *Croat Med J*. 2013;54(6):519–31.
6. Adeloye D, Basquill C, Papana A, Chan KY, Rudan I, Campbell H. An estimate of the prevalence of COPD in Africa: a systematic analysis. *COPD J Chronic Obstr Pulm Dis*. 2015;12(1):71–81.
7. Virchow JC, Crompton GK, Dal Negro R, Pedersen S, Magnan A, Seidenberg J, et al. Importance of inhaler devices in the management of airway disease. *Respir Med*. 2008;102(1):10–9.
8. Ernst P. Inhaled drug delivery: A practical guide to prescribing inhaler devices. *Can Respir J*. 1998;5(3):180–3.
9. Lipworth BJ. Systemic adverse effects of inhaled corticosteroid therapy: A systematic

- review and meta-analysis. *Arch Intern Med.* 1999;159(9):941–55.
10. Ovchinnikova L. “Knowing how” is not enough : A Mixed Methods Exploration of Inhaler Technique Maintenance in Patients with Asthma. *J Can Soc Allergy Clin Immunol.* 2019;91(1):458–67.
 11. Rootmensen GN, Keimpema ARJ Van, Jansen HM, Haan RJ De. Predictors of Incorrect Inhalation Technique in Patients with Asthma or COPD : A Study Using a Validated. 2010;23(5):323–8.
 12. Oprehek J, Gayard P, Grimaud CH, Charpin J. Patient error in use of bronchodilator metered aerosols. *Br Med J.* 1976;1(6001):76.
 13. Orehek J, Gayard P, Grimaud C, Charpin J. Patient error in use of bronchodilator. *Br Med J.* 1976;January(6001):76.
 14. Micallef LA. A review of the metered dose inhaler technique in asthmatic and COPD patients. *Malta Med J.* 2015;27(1).
 15. Dhruve H. Management of asthma: Adherence, inhaler technique and self-management. *Pract Nurs.* 2018;29(10):465–8.
 16. Interiano B, Guntupalli KK. Metered-Dose Inhalers: Do Health Care Providers Know What to Teach? Vol. 153, *Archives of Internal Medicine.* 1993. p. 81–5.
 17. Mahon J, Fitzgerald A, Glanville J, Dekhuijzen R, Glatte J, Glanemann S, et al. Misuse and/or treatment delivery failure of inhalers among patients with asthma or COPD: A review and recommendations for the conduct of future research. *Respir Med.* 2017;129:98–116.
 18. 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 Clin Immunol.* 2013 Mar;9(1):8.
 19. Addad RM, Al-Momani JA, Al Suleihat AS. Poor Inhaler Technique in Patients with Bronchial Asthma Treated in King Hussein Medical Center (KHMC) : Rates and Effects. *Middle East J Intern Med.* 2020;12(1):3–6.

20. Jolly GP, Mohan A, Guleria R, Poulouse R, George J. Evaluation of Metered Dose Inhaler Use Technique and Response to Educational Training. *Indian J Chest Dis Allied Sci.* 2015;57(1):17–20.
21. Crompton GK, Barnes PJ, 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. *Respir Med.* 2006;100(9):1479–94.
22. Lee SM, Chang YS, Kim CW, Kim TB, Kim SH, Kwon YE, et al. Skills in handling Turbuhaler, Diskus, and pressurized metered-dose inhaler in Korean asthmatic patients. *Allergy, Asthma Immunol Res.* 2010;3(1):46–52.
23. Hardwell A, Barber V, Hargadon T, McKnight E, Holmes J, Levy ML. Technique training does not improve the ability of most patients to use pressurised metered-dose inhalers (pMDIs). *Prim Care Respir J.* 2011;20(1):92–6.
24. 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):A117–8.
25. Baddar SA, Al-Rawas OA, Al-Riyami KA, Worthing EA, Hanssens YI, Taqi AM, et al. Metered-dose inhaler technique among healthcare providers practising in Oman. *SQU J Sci Res Sci.* 2001;3(1):39.
26. Ozoh O, Omogie H, Obaseki D, Dosu A. The competence of community pharmacists in Lagos, Nigeria, on correct inhaler techniques. *J Clin Sci.* 2018;15(4).
27. 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. *Niger J Paediatr.* 2017;44(3):168.
28. Sawsan A. Baddar, Omar A. Al-Rawas, [...] and BMSA-R. Metered-dose inhaler technique among healthcare providers practising in Oman. *SQU J Sci Res.* 2001;1:39–48.
29. Ali HD, Worku GS, Alemayehu AA, Gebrehiwot WH. Competence in metered dose inhaler technique among dispensers in Mekelle. *Allergy, Asthma Clin Immunol.*

- 2014;10(1):1–5.
30. Belachew SA, Tilahun F, Ketsela T, Ayele AA, Netere AK, Mersha AG, et al. Competence in metered dose inhaler technique among community pharmacy professionals in Gondar town, Northwest Ethiopia: Knowledge and skill gap analysis. *PLoS One*. 2017;12(11):1–10.
 31. KISHORE P.V., PALAIAN S, ALAM K, SHANKAR PR, BAJRACHARYA B DEJVA. Correct Use Of A Metered Dose Inhaler : A Prospective. *J Clin Diagnostic Res*. 2008;2(2):720–6.
 32. Hanania NA, Wittman R, Kesten S, Chapman KR. Medical personnel's knowledge of and ability to use inhaling devices: metered-dose inhalers, spacing chambers, and breath-actuated dry powder inhalers. *Chest*. 1994;105(1):111–6.
 33. Tsang KWT, Lam W, Ip M, Kou M, Yam L, Lam B, et al. Inability of physicians to use metered-dose inhalers. *J Asthma*. 1997;34(6):493–8.
 34. Karle E, Patel TP, Zweig J, Krvavac A. Understanding the Knowledge Gap and Assessing Comfort Level among Healthcare Professionals Who Provide Inhaler Education. *COPD J Chronic Obstr Pulm Dis [Internet]*. 2020;17(2):197–204. Available from: <https://doi.org/10.1080/15412555.2020.1746251>
 35. Adnan M, Karim S, Khan S, Al-Wabel NA. Comparative evaluation of metered-dose inhaler technique demonstration among community pharmacists in Al Qassim and Al-Ahsa region, Saudi-Arabia. *Saudi Pharm J [Internet]*. 2015;23(2):138–42. Available from: <http://dx.doi.org/10.1016/j.jsps.2014.06.007>
 36. Nadi E, Zeraati F. Evaluation of the metered-dose inhaler technique among healthcare providers evaluation of the metered-dose inhaler technique among healthcare providers. 2014;(January 2005).
 37. Rajbanshi L, S KC2. ONURSES' COMPETENCY ON USE OF METERED DOSE INHALER L Rajbanshi L* , S KC2 1. 2016;6(34):33 37.
 38. Ali HD, Worku GS, Alemayehu AA, Gebrehiwot WH. Competence in metered dose inhaler technique among dispensers in Mekelle. *Allergy, Asthma Clin Immunol*.

- 2014;10(1).
39. Pérez-Malagón CD, Barrera-Rodriguez 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. *Adv Respir Med* [Internet]. 2021;89(1):8–14. Available from: https://journals.viamedica.pl/advances_in_respiratory_medicine/article/view/ARM.a.2021.0027
 40. Nduka SO, Anetoh MU, Amorha KC, Henry OO, Okonta MJ. Use of simulated patient approach to assess the community pharmacists' knowledge of appropriate use of metered dose inhaler. *J basic Clin Pharm*. 2016 Sep;7(4):116–9.
 41. Jones JS, Holstege CP, Riekse R, White L, Bergquist T. Metered-dose inhalers: do emergency health care providers know what to teach? *Ann Emerg Med*. 1995;26(3):308–11.
 42. De Tratto K, Gomez C, Ryan CJ, Bracken N, Steffen A, Corbridge SJ. Nurses' knowledge of inhaler technique in the inpatient hospital setting. *Clin Nurse Spec*. 2014;28(3):156–60.
 43. Nadi E, Zeraati F. Evaluation of the metered-dose inhaler technique among healthcare providers. *Acta Med Iran*. 2005;43(4):268–72.
 44. Amirav I. Clinical aspects of allergic disease What do pediatricians in training know about the correct use of inhalers and spacer devices? *J Allergy clin immunol*. 1994;94(4).
 45. Guidry GG, Brown WD, Stogner SW, George RB. Incorrect use of metered dose inhalers by medical personnel. *Chest*. 1992;101(1):31–3.
 46. Plaza V, Sanchis J, Antepará I, Basomba A, Cadahia A, Cobos N, et al. Medical personnel and patient skill in the use of metered dose inhalers: A multicentric study. Vol. 65, *Respiration*. 1998. p. 195–8.
 47. Abdulameer SA. Knowledge and pharmaceutical care practice regarding inhaled therapy among registered and unregistered pharmacists: An urgent need for a patient-

- oriented health care educational program in Iraq. Vol. 13, International Journal of COPD. 2018. p. 879–88.
48. Kim SH, Kwak HJ, Kim TB, Chang YS, Jeong JW, Kim CW, et al. Inappropriate techniques used by internal medicine residents with three kinds of inhalers (a metered dose inhaler, diskus, and turbuhaler): Changes after a single teaching session. Vol. 46, Journal of Asthma. 2009. p. 944–50.
 49. Ganjiwale J, Kshatriya RM, Joshi Y, Nimbalkar S, others. The effect of single educational intervention on improving nurses' proficiency in using different inhaler devices in a tertiary care setting. Indian J Allergy, Asthma Immunol. 2019;33(2):86.
 50. Education NA, Program P. Expert panel report 3 (EPR-3): guidelines for the diagnosis and management of asthma-summary report 2007. J Allergy Clin Immunol. 2007;120(5 Suppl):S94--S138.
 51. de Boer AH, Thalberg K. Metered dose inhalers (MDIs). In: Inhaled Medicines. Elsevier; 2021. p. 65–97.
 52. Giraud V, Allaert FA, Roche N. Inhaler technique and asthma: Feasibility and acceptability of training by pharmacists. Respir Med. 2011;105(12):1815–22.

ANNEX II: CONSENT FORM
INFORMATION TO THE PARTICIPANT

Interview code no _____ Greeting and self-introduction and consent

Greeting: - Good morning/afternoon.

My name is _____. I am a physician / Nurse working in Nigist Elleni Mohammed memorials comprehensive specialized hospital. We are conducting a scientific research on assessment of competence in metered dose inhaler technique among HCP of the hospital. 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 Internal Medicine at Jimma University. 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

Do you wish to participate in the study?

If the participant agrees to participate in the study, proceed with interview after the participant 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.

Name of Participant

Signature of Participant _____ Date _____

If the participant says "No" thank him (her) and stop.

Name of interviewer _____ Date ____ / ____ / ____

ANNEX III: QUESTIONNAIRES

Questionnaire No.: _____

Questionnaire designed to assess competence on inhaler techniques and knowledge gap among HCP of Nigist Elleni Mohammed memorial Comprehensive Specialized Hospital, Southern Ethiopia.

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

1. Age: _____years
2. Gender : **A. Male** **B. Female**
3. Marital status: **A. Single** **B. Married** **C. Divorced** **D. Widowed**
4. Religion: **A. Orthodox** **B. Muslim** **C. Protestant** **D. Other (specify)_____**
5. Income **A. <5000 ETB** **B 5000-10000** **C .>10000**

Part II: Factors affecting inhaler techniques and individual factors

6. Qualification **A.Nurse** **B. Pharmacist** **C. General practitioner**
7. Work experience **A <5 years** **B 5-10 years** **C >10years**
8. Previous training on MDI **A. yes** **B No**
9. Involvement in MDI prescription **A. yes** **B No**
10. Which of the following is false about MDI as compared to systemic therapy
 A.has few side effects **B.easy for administration** **C.has more side effects**
11. Do you know how to check for amount of medicine left in canister?
 A.Yes **B. No**
12. Which of the following needs mouth rinsing after administration
 A.salbutamol puff **B.beclamethasone puff**
13. What proportion of drug reaches respiratory system after each puff off salbutamol?
 A.10-20 **B.30-50** **C.50-80** **D 100**

Part III: pMDI/MDI Inhaler technique check list (Steps)

(Tick ‘√’ for every correct move And ‘X’ for every incorrect move)

1. Shake 4 or 5 times if suspension formulation _____
2. Take the cap off the inhaler mouthpiece _____
3. Hold the inhaler upright _____
4. Breathe out completely as far as comfortable (to empty the lungs) _____
5. 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 _____
6. Inhale slowly and activate the inhaler (MDI) _____
7. Continue to inhale deeply until the lungs are full. This should take an adult 4-5 seconds.

8. At the end of the inhalation, take the inhaler out of the mouth and close the lips. _____
9. Hold breath for 10 seconds or as long as possible _____
10. Breathe out slowly (normally) _____
11. Wait at least 1 minute before repeating steps 4 through 10 _____

ANNEX IV: DECLARATION

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been fully acknowledged.

Name: Dr.Chala Jiru

Signature: _____

Name of the institution: **Jimma University**

Date of submission: _____

This thesis has been submitted with my approval as university advisor

Name and Signature of the first advisor: Dr.Amare Hailu

Name and Signature of the second advisor: Mr.Chernet Hailu

Name and Signature of the examiner: _____