**Arab American University**

**Faculty of Graduate Studies**

**Department of Health Sciences**

**Master Program in Intensive Care Nursing**

# The Knowledge, Perception, and Attitude of Healthcare Workers Toward Nebulized Furosemide Therapy in The West Bank, Palestine. A Cross-Sectional Study

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## Thesis Approval

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This thesis was defended successfully on 13/2/2025 and approved by:

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Palestine, Feb/2025

## Declaration

I declare that, except where explicit reference is made to the contribution of others, this thesis is substantially my own work and has not been submitted for any other degree at the Arab American University or any other institution.

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## Dedication

This piece is dedicated to my father, a hard-working staff nurse whose kindness and constant support have driven me along this journey. His dedication to serving others has instilled a sense of resilience and compassion. However, this dedication letter would be useless without mentioning my mother, the flower of my house, with her consistent love, support, and caring.

The inspiration for the topic of this thesis was my time in the ICU, a part of healthcare that brings great importance to people's lives.

I would like to extend my humblest thanks to my advisor, Dr. Mohammed Jallad for his irreplaceable support and motivation throughout the completion of this work. His knowledge and insights have greatly influenced my research as well as my academic progress.

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Fuad Ali Hasan Abu Alfayyah

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Finally, I owe everything to my family for their constant love and encouragement. Their faith in me was what motivated me the most. This thesis has been made possible because of all of you.

**The Knowledge, Perception, and Attitude of Healthcare Workers Toward Nebulized Furosemide Therapy in The West Bank, Palestine. A Cross-Sectional Study**

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**Supervision Committee: Dr. Mohammed Jallad**

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## Abstract

Introduction: This study investigates the knowledge, perception, and attitude of Healthcare Workers (HCWs) about nebulized furosemide therapy in the West Bank, Palestine, as a new option for the treatment of Chronic Lung Disease (CLD). When nebulized, a diuretic, furosemide has been suggested as a therapeutic agent in CLD patients. It can reduce pulmonary congestion, enhance mucociliary clearance, and reduce airway edema.

Methodology: A descriptive cross-sectional design was used, and a non-probability convenience sampling method was adopted to recruit 357 HCWs, including physicians, nurses, pharmacists, and professionals from other clinical sectors from different locations across the West Bank. Data collection was done using a self-reported questionnaire. The questionnaire comprised 14 quiz-type questions assessing knowledge and 13 items/statements to assess attitudes and perceptions on a 5-point Likert scale.

Results: The results showed that among the majority of HCWs (73.7%) who had heard of nebulized furosemide, only 36.4% had critically assessed and displayed therapeutic knowledge about it. The mean knowledge score was 11.63 (out of 18) and 63.6% of the subjects were categorized as non-knowledgeable. HCWs expressed positive views attitudinally but mostly reported neutral responses suggesting that more education is warranted. Younger professionals and those in specialized roles showed better understanding than older professionals and those involved in multiple roles.

Conclusion: This study reflects the key role of awareness levels among the HCWs in the West Bank and may highlight the need for the implementation of educational intervention programs to help them better understand the importance of nebulized administration of furosemide in the management of patients with respiratory distress, focusing on its clinical practice integration that could lead to better patient prognostic perspectives.

Keywords: Knowledge, Perception, Attitude, Nebulized Furosemide, Therapy

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## List of Definitions of Abbreviations

| Abbreviation | Title |
|---|---|
| CLD | Chronic Lung Disease |
| COPD | Chronic Obstructive Lung Disease |
| HCW | Healthcare Worker |
| CCU | Coronary Care Unit |
| ICU | Intensive Care Unit |
| IV | Intravenous |
| SPSS | Social Package for the Social Sciences |
| IRB | Institutional Review Board |
| CI | Confidence Interval |
| E | Margin of Error |
| P | Population Proportion |
| N | Population Size |

# Chapter One: Introduction

## 1.1 Introduction

This chapter's primary aim is to present the background, significance, and rationale behind the study exploring HCWs' knowledge, attitudes, and perceptions regarding nebulized furosemide as a potential therapeutic option for Chronic Lung Disease (CLD), such as asthma and Chronic Obstructive Pulmonary Disease (COPD).

Nebulized furosemide, traditionally used as a diuretic, has recently shown promise in respiratory therapy due to its potential to improve pulmonary function by decreasing airway edema and enhancing mucociliary clearance. The study is grounded in the recognition of the knowledge gap and the need for further investigation into the broader application of nebulized furosemide within clinical practices, particularly in the West Bank region of Palestine.

This study aims to illuminate the challenges and opportunities in incorporating nebulized furosemide into current clinical practices for managing CLDs by assessing healthcare workers' (HCWs) understanding and perception of this novel therapeutic strategy. The chapter will outline the research objectives, study significance, and hypotheses, which together seek to provide valuable insights into improving treatment strategies and enhancing patient outcomes.

## 1.2 Background

Nebulized furosemide, an alternative approach in pulmonary medicine drawbacks of the conventional route of drug therapy CLD such as asthma and COPD have warranted clinical research to validate the efficacy of furosemide in terms of timely onset, favorable patient compliance, swift therapeutic response without the concern of drug-induced adrenal suppression (Ghaysouri et al., 2020).

This new therapeutic window for furosemide, a diuretic already used to treat edema and hypertension, could be relevant for managing patients with respiratory diseases (Khan et al.., 2022). Asthma is described by reversible airway narrowing (WHO, 2023a), compared to COPD, which presents progressive airflow limitation (WHO, 2023b).

However, furosemide is a loop diuretic used for patients with fluid overload causing edema, while edema depends on the disease pathogenesis and where fluid accumulates in the human body. It is also used in managing hypertension (Khan et al., 2022). Although furosemide has been popular for its role as a loop diuretic in the management of fluid overload and hypertension, it is still in the early stage of exploration when used as respiratory therapy.

Furosemide's main mechanism of action is to decrease sodium reabsorption in the renal tubules, which also affects pulmonary function. This diuretic effect ultimately causes a decrease in pulmonary congestion, which is highly beneficial in patients presenting with exacerbations of edematous lung diseases. A better understanding of furosemide is needed to understand its mechanism in modulating airway resistance and pulmonary function, which is important in determining its therapeutic effectiveness and safety in CLD.

However, nebulized furosemide may enhance treatment plans for CLD by influencing airway smooth muscle tone and fluid balance in the respiratory tract (Vahedi et al.,2013). Furosemide may also ameliorate airflow and respiratory function in asthmatic and COPD subjects through enhanced mucociliary clearance and decreased airway edema (Vahedi et al.,2013).

The World Health Organization (WHO) 2022, defines health workers as all people engaged in work actions whose primary intent is to improve health, including doctors, nurses, midwives, public health professionals, laboratory technicians, health technicians, medical and non-medical technicians, personal care workers, community health workers, healers and traditional medicine practitioners (WHO, 2022). However, these research participants were HCWs from the medical field in the West Bank region of Palestine.

The study took place in the West Bank region of Palestine. Moreover, this study represents a large step towards understanding the potential clinical indications for nebulized furosemide and adds to the newly expanding literature in the field. This is the first study to assess the knowledge, attitude, and perception of HCWs regarding this novel therapy, yet the first one in the Palestinian context.

Additionally, an understanding of HCWs' perspectives can help to inform targeted educational interventions to improve the inclusion of this therapy in standard care protocols. (Santos et al., 2022)

The ultimate goal of this study is to reduce the knowledge and clinical gaps between novel therapeutic strategies and clinical practice in managing patients with CLD, aiming for better outcomes. While the findings may help to advance nebulized furosemide globally, they might also provide a basis for further studies to refine therapeutic administration in CLD.

## 1.3 Problem Statement

Patients diagnosed with CLD such as asthma or COPD suffer from the symptoms of cough and dyspnea (Diab et al., 2022; Hodara & Becker, 2023; O'Donnell et al., 2019), which affect their quality of life (Kubo et al., 2021; Laviolette & Laveneziana, 2014); Approximately 82% of patients diagnosed with COPD have dyspnea of any grade (Hanania & O'Donnell, 2019); also, 41% of patients with asthma complain of having dyspnea (Lavietes, 2015).

An inadequate understanding of these biological interactions is a major difficulty in treating asthma and COPD (Maselli & Hanania, 2019). This could be a more significant hindrance to the successful clinicopathological management of both diseases, with critical implications for patient outcomes and healthcare costs.

Moreover, clinically, the symptoms of respiratory diseases such as cough and dyspnea, could be relieved by a nebulized dose of furosemide. Also, based on the observations taken from the researcher's work as an intensive care nurse, the researcher noticed a disparity in knowledge and acceptance of furosemide nebulization as one of the therapeutic solutions for patients with asthma and COPD.

Based on these practical observations, the researcher headed to prepare this study to clarify the cognitive extent of knowledge, perception, and attitudes toward this new therapeutic method, to open new horizons for future studies of another type that allow for the practical application of this type of treatment and its adoption in the treatment plans for these patients.

Hence, according to the current knowledge and scope of practice, there is a definitive gap related to using nebulized furosemide in treating CLD. This gap has to be addressed to improve the management of patients with CLD in the region.

## 1.4 Significance of the Study

The importance of the study for health is to assess the distensibility in knowledge, perception, and attitudes of HCWs toward this novel therapy of nebulized furosemide and to address new meaning for this medication and its effects from another route of administration. Also, patients need to help improve their quality of life by relieving stressful symptoms such as chronic cough and dyspnea. (Choate et al., 2020)

This study is important because it has multiple implications for clinical practice in CLD in the West Bank and health care protocols. This investigation was carried out to enhance comprehension of nebulized furosemide therapy.

The findings can serve as a reference for future research on integrating nebulized furosemide into respiratory care guidelines. Also, by identifying knowledge gaps among HCWs, this study can lead to targeted training programs, ensuring patients receive evidence-based and effective respiratory care. However, the study highlights the importance of nebulized furosemide as a potential adjunct therapy for CLDs.

Many HCWs are unaware of the therapeutic benefits of nebulized furosemide, and this study provides the foundation for incorporating it into clinical settings where appropriate. The results can inform policymakers, hospital administrators, and medical educators about the need for structured training programs on nebulized furosemide. Nevertheless, hospitals and healthcare institutions can allocate resources toward educating HCWs and possibly incorporating nebulized furosemide into their formularies and standard treatment guidelines.

## 1.5 Objectives of the Study

1. Assess knowledge of HCWs toward nebulized furosemide therapy.
2. Assess the attitude and perception of HCWs toward nebulized furosemide therapy.
3. Assess the relationship between sociodemographic variables and the level of knowledge regarding nebulized furosemide therapy.

## 1.6 Questions of the Study

1. What is the healthcare workers' knowledge of nebulized furosemide therapy?
2. What are the healthcare workers' attitudes and perceptions toward nebulized furosemide therapy?
3. What is the relationship between sociodemographic variables and the level of knowledge regarding nebulized furosemide therapy?

## 1.7 Study Hypotheses

1. HCWs aged 35 years and above have higher knowledge scores regarding nebulized furosemide therapy, with scores of 13 or more considered knowledgeable.
2. HCWs with master's or doctorate degrees have higher knowledge scores regarding nebulized furosemide therapy, with scores of 13 or more considered knowledgeable.
3. HCWs working in CCU/ICU have higher knowledge scores regarding nebulized furosemide therapy, with scores of 13 or more considered knowledgeable compared to other working departments.
4. Specialists have higher knowledge scores regarding nebulized furosemide therapy than all professionals, scoring 13 or more considered knowledgeable.
5. HCWs with experience of less than 1 year have lower knowledge scores regarding nebulized furosemide therapy, with scores of 12 or less considered non-knowledgeable.

## 1.8 Conceptual and Operational Definitions

- *Knowledge:*
    - Conceptual definition: Understanding the underlying principles and theories governing various phenomena. (Goff, 2024)
    - Operational definition: An online-based questionnaire assessing participants' knowledge regarding nebulized furosemide therapy through 13 questions to determine whether or not participants are knowledgeable.

- *Perception:*
    - Conceptual definition: The process of taking raw data from the environment and making sense of it. (The Content Authority, 2023)
    - Operational definition: An online-based questionnaire assessing participants' perception toward nebulized furosemide therapy by 14 items.

- *Attitude:*
    - Conceptual definition: An individual's characteristic way of responding consistently favorably or unfavorably to objects, people, or events in his environment. (Nilesh, 2020)
    - Operational definition: An online-based questionnaire assessing participants' attitudes toward nebulized furosemide therapy by 14 items.

- *Healthcare workers:*
    - Conceptual definition: Health workers are all people engaged in work actions whose primary intent is to improve health, including doctors, nurses, midwives, public health professionals, laboratory technicians, health technicians, medical and non-medical technicians, personal care workers, community health workers, healers and traditional medicine practitioners (WHO, 2022).
    - Operational definition: This research participants were HCWs from the medical field in the West Bank region of Palestine

- *Nebulization:*
    - Conceptual definition: deliver a drug's therapeutic dosage by inhalation of the drug-aerosol, which is generated with a drug solution or suspension by

a nebulizer, through the mouth, nose, or artificial airway (including endotracheal and tracheotomy tubes) into airways and lungs. (Anns Transl Med, 2019)

- Operational definition: This research aims to assess participants regarding a nebulized drug called furosemide via an online-based questionnaire, evaluating participants' knowledge, perception, and attitudes.

- *Furosemide:*
  - Conceptual definition: Furosemide is a type of medicine called a diuretic. It's used to treat hypertension, heart failure, and edema (NHS, 2022).
  - Operational definition: This research aims to assess participants regarding nebulized furosemide via an online-based questionnaire, evaluating participants' knowledge, perception, and attitudes.

- *Therapy:*
  - Conceptual definition: Therapeutic medical treatment of impairment, injury, disease, or disorder (Merriam-Webster Dictionary, 2024).
  - Operational definition: An online-based questionnaire assessing participants' knowledge regarding nebulized furosemide therapy through 13 questions to determine whether or not participants are knowledgeable.

- *West bank:*
  - Conceptual definition: The West Bank is a region in the Middle East, located west of the Jordan River. It is one of the two Palestinian territories, the other being the Gaza Strip (The Editors of Encyclopaedia Britannica, 2024).

- Operational definition: The research took place in the West Bank region of Palestine.

- *Cross-sectional study:*
  - Conceptual definition: A type of research design in which data is collected from many different individuals at a single point in time (Thomas, 2023).
  - Operational definition: This research took the approval of IRB in Jun 2024, pilot study in Jun 2024, sample recruitment from Jun to Aug 2024, data analysis in September 2024, and finalizing thesis in Oct 2024

## 1.9 Summary

This chapter provides an in-depth overview of the study's background, outlining the emerging role of nebulized furosemide in treating CLD such as asthma and COPD. It introduces the physiological mechanisms of furosemide and its potential benefits in managing respiratory function by addressing airway edema and enhancing mucociliary clearance.

The study, conducted in the West Bank region, aims to bridge the gap between novel therapeutic approaches and clinical practice by assessing HCWs' knowledge, attitudes, and perceptions of nebulized furosemide.

The significance of this research lies in its potential to inform healthcare policies, improve clinical protocols, and promote targeted educational interventions that could integrate nebulized furosemide into routine respiratory care. This study is pivotal for addressing the knowledge gaps in HCWs, fostering better patient care, and advancing the clinical applications of nebulized furosemide in the management of CLDs.

# Chapter Two: Literature Review

## 2.1 Introduction

The literature review's search strategy involved a comprehensive search across multiple databases, including PubMed, CINAHL, and Google Scholar, to ensure a broad scope of relevant literature. These databases were chosen for their extensive coverage of peer-reviewed health and medical science articles. The search was limited to articles published within the past 12 years, with exceptions made for seminal works or studies deemed foundational to the research topic, regardless of their publication date.

Specific keywords and medical terms were utilized to identify relevant studies, refined through iterative searches. The selection criteria focused on the quality and relevance of the articles, ensuring they met the inclusion standards of the review. Studies not directly related to the research question, or those with methodological limitations, were excluded from the review. This search strategy was designed to capture both current findings and historically significant contributions to the field, providing a balanced and comprehensive understanding of the research topic.

In pharmacological science, furosemide is a loop diuretic for treating fluid overload-mediated conditions. Since it prevents sodium and chloride reabsorption in the ascending loop of Henle found in every nephron of renal system anatomy. (Khan et al., 2022) Note should be made that the route of the medication is mostly intravenous (IV); however, in some cases, it can also be administrated sublingual or orally. (Khan et al., 2022)

In pathophysiology science, asthma is a disease of the airway and bronchi, in ordinary terms, it is a permanent inflammation of the bronchi. Moreover, any individual can acquire asthma, regardless of age. (WHO, 2023a) COPD is another chronic disease; however, it is more extensive and involves limits on airflow, which may be emphysema or chronic bronchitis. (WHO, 2023b)

Cough and dyspnea should be noted as the symptoms of the two diseases (Diab et al., 2022; Hodara & Becker, 2023; O'Donnell et al., 2019), but also both are the reason why the patients feel tired with low quality of life (Kubo et al., 2021; Laviolette & Laveneziana, 2014). Nonetheless, studies indicate that patients given a nebulizer containing furosemide have had a significant impact on many respiration parameters, focusing on furosemide nebulizer and its effect on COPD and asthmatic patients from multiple perspectives.

However, this literature review contains four sections: the first is the history of nebulized furosemide therapy; the second is the effect of a furosemide nebulizer on COPD and dyspnea; the third is the effect of a furosemide nebulizer on asthma and cough; and lastly, section four involves the mechanism of action of nebulized furosemide.

## 2.2 Literature review

### 2.2.1 History of nebulized furosemide therapy

Furosemide, a loop diuretic that was initially identified in the late 1950s, is quite common and useful for managing fluid overload secondary to conditions like heart failure or hypertension. It represented a major pharmacotherapeutic advance since it allowed clinicians to treat edema and lower blood pressure. So, as knowledge of its pharmacological properties increased, research

continued from standard indications into extra-traditional uses of furosemide such as in the world of pulmonary medicine.

The concept of nebulized furosemide therapy gained momentum during the closing decades of the 20th century in response to increasing demand for better management of symptoms experienced by patients with CLD such as asthma and COPD (Inokuchi et al, 2014). Some early investigations indicated potential benefits in using nebulized furosemide as a bronchodilator with another mode of action for symptomatic relief like dyspnea and cough (Vahedi et al. 2013).

A promising new mode of delivery emerged with furosemide nebulization, which allowed furosemide to be delivered directly to the lungs and bypass systemic adverse effects seen with either IV or oral form.

Research activity in nebulized furosemide began emerging and gained momentum early during the 2000s. The results of a key study underscored the capacity of nebulized furosemide to potentiate mucociliary clearance, thereby ameliorating airway obstruction and optimizing pulmonary function (Waskiw-Ford et al., 2018).

Further research was called for as the evidence base developed, researchers recognizing that what was required were high-quality Randomized Controlled Trials (RCT) in asthma and COPD to create a more standardized approach to treatment.

Over the same period by the 2010s, doses of clinical trials and retrospective analyses established proof that nebulizer furosemide worked. Studies even showed good results about dyspnea and lung function improvement in patients with COPD (Ragab et al., 2024; Saba et al., 2020). Nonetheless, uncertainties over dosing and safety profiles persisted which necessitated further investigations into this domain (Abdul-Hasan & Hisham, 2021).

Although some trials reported positive results, other studies cast a shadow on the efficacy and inconsistency of furosemide therapy. Some researchers have recognized the complexity of

patient response and further need for elucidating its mechanism in the respiratory system (Inokuchi et al, 2014).

Some studies showed some beneficial effects on dyspnea and cough, other ones did not show massive impacts in certain conditions which highlights the difficulty of using furosemide features in the pulmonary context (Morélot-Panzini et al., 2018).

Nebulized furosemide continues to be an active area of research, concerning its mechanisms as a bronchodilator, mucolytic, and anti-inflammatory (Mahshidfar et al 2018). New evidence is being released and the hope is to standardize protocols that include nebulized furosemide for the treatment of CLD, leading to better patient outcomes and quality of life.

### 2.2.2 Furosemide nebulizer and COPD with dyspnea

COPD is characterized by progressive limiting airflow, and other respiratory signs, primarily dyspnea. (WHO, 2023b) However, as mentioned earlier, furosemide acts as a diuretic with multiple administration forms like oral and IV (Khan et al., 2022); this medication is under discussion as potentially nebulized for COPD patients. This section reviews the effectiveness and implications of furosemide nebulizer on COPD, and dyspnea as a symptom.

An RCT by Ragab et al. (2024) studied the effect on dyspnea and pulmonary performance response to the furosemide nebulizer. The authorized reduction in the dyspnea and measured lung function components mention that the furosemide nebulizer has a compensating result in reducing dyspnea.

Similarly, a retrospective analysis by Brennecke et al. (2020) extrapolates the effect of the long-term furosemide nebulizer on COPD and dyspnea. The endpoint found that following the furosemide nebulizer, the exacerbation rate decreases.

Meanwhile, an article demands to examine furosemide nebulizer on COPD and its mechanism of action. However, they found that this therapy has a high bronchodilator pro-inflammatory property, with huge recommendations to search into optimal dosing of furosemide nebulizer and the criteria for existing patients limited it. (Abdul-Hasan & Hisham, 2021)

Furthermore, the correlation between the furosemide nebulizer and the safety profile was evident, in the study by Saba et al. (2020), in COPD patients who displayed high tolerability of it with relatively few adverse drug reactions. Therefore, this study suggests that there may be a safe integration of furosemide nebulizer into the existing COPD treatment standard protocols.

Moreover, based on Inokuchi and colleagues' respected article, the furosemide nebulizer evidenced non-inferiority when compared with the maximal and best standard practice matched harmonization part in terms of the changes related to dyspnea and lung function subscales. (Inokuchi et al., 2014)

Finally, Morélot-Panzini et al. (2018) published an article on the activity of furosemide nebulizer on dyspnea patients. However, they found that furosemide nebulizer did not have a significant role in decreasing dyspnea with a strictly controlled delivery method, but instead, they found interesting data where furosemide nebulizer could inhibit fibroblast activity, and the possibility requires further research confirmation.

### 2.2.3 Furosemide nebulizer and asthma with cough

Since asthma is a disease of airway inflammation and hyperresponsiveness (WHO, 2023a), cough is considered a common symptom across all asthmatic patients. Moreover, since innovative therapy has become available to manage the disease, the furosemide nebulizer has been studied less to identify an allowable amount of information. Therefore, there is enough information about the new modality regarding the dosages and reduction of active cough episodes.

This section provides a recount or review of the existing published article on the utilization of furosemide nebulizer as an experiment to reduce cough episodes among asthmatics.

For example, Atwi (2022) published a review article on the effect of furosemide nebulizer on the severity of cough and airway inflammation. The article had an adequate amount of published information regarding the administration of furosemide, hence recording a significant reduction of cough episodes while on the escalated doses.

Similarly, Inokuchi et al. (2014) published an article and systematic review regarding the furosemide nebulizer offers a better treatment than standard therapy. Hence, as indicated from published information, there is enough information suggesting the possibility of approved furosemide nebulizer to be an approach mainly in the management of cough episodes among refractory chronic asthmatics.

Furthermore, the data below contains a piece of interesting published information on the furosemide bronchodilatory and mucolytic activities. An article published in 2018 provides a review of the chronic use of furosemide nebulizer. It had a statistically significant result in the control of patients' symptoms and their quality-of-life improvement. (Banzett et al., 2018)

Finally, back in 1990, Ventresca and colleagues published an article that described the furosemide antitussive activity and was proven by multiple-center clinical trials for pediatric patients with chronic reactive asthma. (Ventresca et al., 1990)

### 2.2.4 Mechanism of action of furosemide nebulizer

Understanding the mechanistic basis of furosemide nebulizer is critical for improving its therapeutic effect and identifying its unique potential in every respiratory pathology. Precisely, this section is concerned with the pharmacological side of furosemide nebulizer action.

In Newton et al. (2012) and Vahedi et al. (2013) articles, it was evident that furosemide increased smooth muscle relaxation by blocking calcium into the smooth muscle cells and activating potassium out of these cells to reduce bronchoconstriction for airflow to increase.

Moreover, Waskiw-Ford et al. (2018) study found that furosemide reduced mucus viscosity and enhanced mucous expectoration in chronic bronchitis and cystic fibrosis patients. Therefore, where quickly pass defend the mucus lining can be removed. Also, the same study found that a 40 mg nebulized dose of furosemide does not differ from higher doses, reaching 120 mg.

In addition, Mahshidfar et al. (2018) concluded from their study on the anti-inflammatory effect that furosemide suppresses pro-inflammatory cytokines and decreases the number of leukocytes in the in vitro and vivo airway walls.

Furthermore, Bianco et al. (1993) study established an understanding of furosemide pharmacokinetics, where they found that furosemide absorption and distribution occur in the respiratory space for a local effect stops reaching a systemic effect.

Within the same concept, Stone et al. (1993) article studied the effect of a furosemide nebulizer on vascular tone, and they found that furosemide has an effect on decreasing vascular tone and leads to vasodilation, but also improves oxygenation.

Other authors studied the molecular signal of cells and found that in the nucleus, the medication thus suppresses the transcription factors and kinase enzyme inhibition. (Morélot-Panzini et al., 2018) Therefore, furosemide pharmacological intervention will result in bronchodilation, decreased difficulty breathing, and reduction of airway inflammation.

## 2.3 Summary

In conclusion, furosemide nebulizer is a prospective and effective medication to work on the treatment of the majority of patients with respiratory pathologies who present with signs of dyspnea, cough, and inflammatory process of the airways.

However, due to its three mechanisms of action, that is bronchodilatory, mucolytic, and anti-inflammatory reactions, the agent could decrease the severely reported symptoms and modify the course of the disease in cases of COPD, asthma, and other respiratory pathologies. Although the actual dosing of medication should be studied more carefully due to the lack of information, it is also important to study the long-term effect of this therapy in terms of efficacy and safety.

# Chapter Three: Methodology

## 3.1 Introduction

The methodology of this study was to approach the knowledge, perception, and attitudes of HCWs about nebulized furosemide therapy in the West Bank of Palestine.

In this view, the study used a descriptive cross-sectional study design to serve the need to be able to capture their views of them at some point in time as the healthcare system is dynamic. The design was selected to reflect the current standard of practice concerning knowledge, perceptions, and attitudes among HCWs towards nebulized furosemide therapy and its current practice at the time of conducting this study.

The process diagram explicitly illustrates the essential elements of the methodology; as well as sample selection and eligibility criteria, tool development and items generated covering all objectives and variables, pilot study with validity and reliability, data collection, and analytical procedures for enhanced transparency and reproducibility.

## 3.2 Study Design

Quantitative research using a cross-sectional study design was utilized in this study that aimed to assess the HCWs' knowledge, perception, and attitudes toward the application of nebulized furosemide treatment on CLD in the West Bank of Palestine.

However, the cross-sectional study is a type of observational research design that discovers data on a specific population at one point. Researchers report the prevalence of the given conditions or outcomes in this study.

This study design is beneficial, particularly for detecting relationships between variables; it provides a picture of relations within the population without touching any manipulative variable (Levin, 2006).

Although they provide important information and may inform public health policies, one of the main weaknesses in cross-sectional studies is that their design does not allow for establishing causal relationships because exposure and outcome are measured at the same time (Creswell, 2014).

Therefore, although they can indicate possible associations, it may be necessary for future longitudinal studies to investigate causality further. It is deemed reasonable to use quantitative methods to obtain numbers that may be statistically tested to gain an objective understanding of the knowledge and standpoint of HCWs. A cross-sectional study with data from a convenience sample from HCWs.

Nevertheless, according to the study, this permitted the assessment of variable-variable relationships and provided a static overview of what is known and believed regarding nebulized furosemide therapy by HCWs in the target population.

### 3.3 Site and Setting

This was a non-probability sample of HCWs in the West Bank of Palestine. Moreover, the intervention of furosemide nebulization was shown to have a greater impact in specific environments situated in hospitals and clinical settings, inclusive of specialized respiratory units.

HCWs from any healthcare sector in the West Bank were requested to participate, and an online-based questionnaire was used. The questionnaire was generated by the researcher with expert opinions and helped to enable HCW to participate in a unique type of study.

This study therefore involved only HCWs in the West Bank and thus presented a valuable chance to understand frontline professionals of relevance to the clinical context and therefore an assumption that findings and results gleaned would be of relevance and applicable to the particular patient population.

### 3.4 Population, Sample, and Sampling

**Population**: HCWs working in the West Bank of Palestine. Preferably these HCWs work in-hospital and in-clinic specialized respiratory units. However, according to the latest health annual report by the Palestinian Ministry of Health in 2022, the total number of HCWs was 6296 from all kinds of professionals related to the healthcare sector.

Thus, using Cochran's sample size formula which contains the Confidence Interval (CI), Margin of Error (E), Population Proportion (p), and Population Size (N). Moreover, CI=95% or Z-score=1.96, E=5 units, p=50%, and N= 6296, according to the previous values, here is the formula with its application in consequence:

$$n_0 = \frac{Z^2 \cdot p \cdot (1-p)}{E^2}$$

$$n_0 = \frac{1.96^2 \cdot 0.5 \cdot (1-0.5)}{0.05^2} = \frac{3.8416 \cdot 0.25}{0.0025} = \frac{0.9604}{0.0025} = 384.16$$

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

$$n = \frac{384}{1 + \frac{384-1}{6296}} = \frac{384}{1 + 0.061} = \frac{384}{1.061} \approx 362$$

Nevertheless, the number of participants in the study that was convenient to the researcher was 357 HCWs.

**Sample**: A non-probability sampling method was used to recruit a convenience sample of HCWs such as physicians, nurses, anesthesia, specialists, residents, pharmacists, and others working in the healthcare sectors.

**Sampling**: First, an online-based pilot study via Google form was filled out with 35 HCWs, as its results are shown in the section pilot study. However, the same questionnaire was re-opened for data recruitment, including pilot participants, which took place from early Jul to late Aug, recruiting a total of 357 participants.

### 3.5 Inclusion and Exclusion Criteria

Inclusion Criteria:

1. HCW working in the West Bank of Palestine.

Exclusion Criteria:

1. HCW not working in the West Bank of Palestine.
2. HCWs have no readiness to participate in the study.
3. HCWs did not complete the questionnaire.

### 3.6 Study Variables

Dependent Variable:

- Knowledge of nebulized furosemide therapy: Participants' knowledge of using nebulized furosemide therapy, consists of 14 items in a quiz-like structure.

- Perception and attitude towards nebulized furosemide therapy: Participants' perception and attitudes toward using nebulized furosemide therapy, consist of 13 Likert scale items.

Independent Variables:

- Demographic variables: Age, gender, level of education, and years of experience.
- Professional variables: professional type, and department (work unit).
- Awareness of nebulized furosemide therapy: Previous knowledge about nebulized furosemide therapy and source of information.

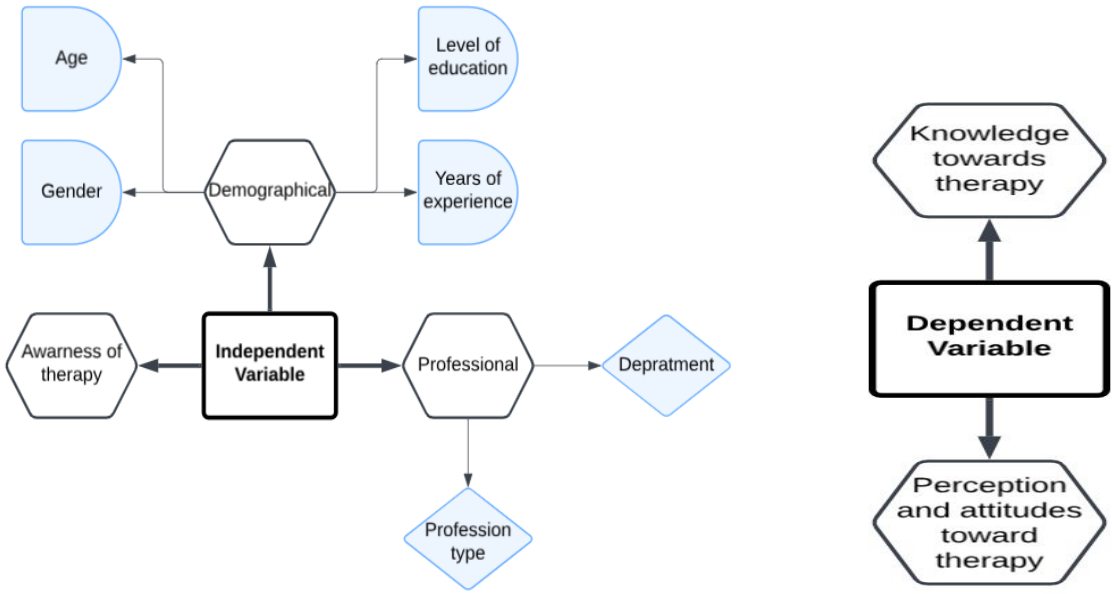


Figure 3.1: Study variables map.

### 3.7 Data Collection Tool and Process of Educational Sessions

An online-based Google form questionnaire served as the primary data collection tool for this study. The questionnaire was generated by the researcher and experts in the field, and it consisted of structured items designed to assess HCWs' knowledge, perception, and attitudes toward nebulized furosemide therapy. The questionnaire is divided into several sections:

- Demographic information: gathering information on participants' age, gender, level of education, years of experience, profession type, and department (work unit).
- Awareness of nebulized furosemide therapy: Previous knowledge about nebulized furosemide therapy and source of information.

- Knowledge of nebulized furosemide therapy: Participants' knowledge of using nebulized furosemide therapy consists of 14 items in a quiz-like structure.
- Perception and attitude towards nebulized furosemide therapy: Participants' perception and attitudes toward using nebulized furosemide therapy, consist of 13 Likert scale items.

The items within each section were formulated based on a comprehensive review of relevant literature and input from experts in respiratory medicine and survey design.

Questionnaire generation was made in early Jun 2024 and then established an online-based pilot study via Google form with 35 HCWs who filled out the survey. Accordingly, both validity and reliability took place in late Jun.

However, the same online questionnaire re-opened for data recruitment from early Jul to late Aug. Moreover, data analysis was done in Sep. Finally, the thesis chapter completion was in Oct 2024.

### 3.8 Study Procedure:

Participants were recruited through an online questionnaire distributed to HCWs across various hospitals and clinics in the West Bank. The researcher initially shared the questionnaire link with hospital and clinic directors, who subsequently forwarded it to HCWs within their institutions, whether via e-mails or WhatsApp. To ensure the credibility of responses, access to the questionnaire was restricted, allowing participation only for individuals approved by the researcher.

Additionally, to verify participants' professional affiliations, the email used to complete the questionnaire had to originate from the respective hospital or clinic domain, with the institution's domain abbreviation included in the email address. For some healthcare workers, particularly specialists, individual invitations containing the study link were sent directly via email or WhatsApp to facilitate their participation, accepting those email addresses with their respective names within. Moreover, the first 35 HCWs who participated in the study followed the same procedure, as well as the rest of the study participants.

### 3.9 Pilot Study:

Speaking about the pilot study, the findings of the pilot study were designed to provide clarity and comprehensibility as to what the items presented to participants asked of them, and also showed descriptive data regarding the responses. This was a preliminary study, which merely constituted an initial search for ambiguities and difficulties encountered by the participants to improve the validity of further full-scale study.

The descriptive analysis also shed light on varying response patterns which helped in gaining an understanding of the perception and attitude of participants.

As mentioned earlier, a total of 35 participants were enrolled in the pilot study, which added to further defining the demographics and awareness status among HCWs regarding this study.

**Demographic profile:**

The 25–34 years age group was the most represented, with 62.9% (n = 22) of participants falling into this range. The next smallest major group was the 35–44-year-olds, who made up 20% (7 people). Fewer participants were below the age of 25 (14.3%, n = 5) and those aged between 45–54 (2.9%, n =1).

In terms of gender distribution, the vast majority were male, who represented 62.9% (22 subjects), while the females consisted of 37.1% (13 cases).

Regarding professional roles, the profile of 22 participants (62.9%) was nurses. General practitioners (5.7%, 2 participants), residents (22.9%, 8 participants), and a few representing other categories including pharmacists, anesthetists, and unspecified roles were represented in fewer numbers.

Participants had an uneven distribution of educational backgrounds, though most either had a bachelor's degree (77.1%, 27), Fewer participants reported a master's degree (17.1%, n = 6), with even fewer holding just a diploma or doctorate/PhD (2.9% n = 1 each).

That experience also gave the participants years of context. More than half of the participants (51.4%, n = 18) reported work experience from 1 to 5 years. Moreover, 20% (7)

participants had experienced between 6–10 years, 17.1% (6) between 11-20, and only one person with more than 20 years of experience.

About working units, ICU/CCU is the most with 65.7% (n = 23), followed by medical-surgical units (22.9%; n = 8) and a few at emergency rooms, pharmacies, or clinics.

**Knowledge assessment:**

Assessment of knowledge levels yielded a mean of 11.43, median of 11.00, and mode of 9.00. There was some variability in the knowledge among participants, which is made clear by a standard deviation of 2.52 Among the 35 consulted participants, 45.7% (16) were considered knowledgeable as they answered 13 points or more, and 54.2% (19) were non-knowledgeable as they collected 12 points or less.

**Perception and attitude:**

The participants exhibited a range of perceptions and attitudes towards nebulized furosemide therapy, with some common trends emerging across the responses. Overall, there was a positive yet cautious outlook. For instance, 45.7% of participants agreed that the therapy was beneficial, though a significant portion (37.1%) remained neutral, suggesting that while many HCWs recognized the potential benefits of the therapy, they also expressed some level of wariness.

This cautious optimism was further reflected in Statement 3, where 45.7% agreed that the therapy had minimal side effects, but 34.3% remained neutral, indicating uncertainty or lack of definitive knowledge on its safety profile.

A notable point of divergence was seen in responses to Statement 2, where opinions were more divided, with 41% remaining neutral and 34.3% in agreement. This suggests a level of skepticism or uncertainty regarding the therapy's broader applicability or effectiveness in practice.

Similarly, 31.8% of participants agreed that nebulized furosemide should be administered in clinical settings, while 28.6% disagreed, indicating mixed feelings about its practical use. However, there was strong support for making the therapy more widely available, with 60% of participants agreeing with Statement 5. This suggests that while HCWs acknowledge some uncertainty, they still see the value in having nebulized furosemide therapy as a treatment option.

Additionally, a significant portion of participants (57.1%) emphasized the importance of training for HCWs regarding nebulized furosemide therapy, reflecting the consensus that further education would enhance comfort and confidence in using the therapy. On matters of safety and long-term use, most participants (51.4%) agreed that the therapy was safe, and 57.1% believed its benefits outweighed the risks, further supporting the positive general attitude toward its implementation.

However, some gaps in knowledge were evident, as shown by divided responses to Statement 10, where 51.4% disagreed about the availability of sufficient research to back evidence-based practice for the therapy, indicating the need for more robust evidence to support its clinical application.

### 3.10 Validity and Reliability

- **Validity:**

Several strong strategies were used to validate the questionnaire. The development of the survey items was grounded in a two-step systematic process. The choice of survey questions was built upon a comprehensive literature review, and as such, it had a sturdy basis from which to start.

The workgroup was followed up by a couple of experts in the Arab American University in Palestine from different fields (ahmad.juma@aaup.edu, basma.salameh@aaup.edu imad.fashafshi@aaup.edu, Sajed.Ghawadra@aaup.edu, imad.abukhader@aaup.edu). Together, their expertise ensures that these questions are not only scientifically grounded but also relevant to healthcare in the region.

The second stage involved a detailed content validity conducted on the item level by an expert of both an internal medicine specialist (alifayyad.85@gmail.com) and a Doctor of Pharmacy (sana.alaqqad@nu-vte.edu.ps) judging each item for what it is supposed to be, which is a domain-related construct. Their feedback was instrumental to these revisions and helped to guide the language, focus, and relevance of the questions that are crucial for a questionnaire designed for an audience so specific as ours.

This comprehensive approach to questionnaire development ensures the instrument is valid and that the data generated by it can be relied upon as providing information that pragmatists would otherwise accept concerning the phenomenon.

- **Reliability:**

When assessing the reliability of this newly generated questionnaire, critical in-depth expert checking on survey items was performed by a statistician (faisal.awartani@aaup.edu). The implication from the statistician is an insight into the minefield that is reliability testing of knowledge assessments in Multiple Choice Questions format.

Items in this style are carefully constructed so they have right or wrong answers and help measure accuracy rather than consistency because of the single correct response per item.

Reliability (typically measured with metrics like Cronbach's alpha, split half, or test-retest), considers internal consistency, which is how well items intended to measure a given construct do so with some consistency. The central concern of any knowledge assessment is accuracy; however, in factual knowledge assessments such as this context, validity appears to be a more relevant concern. (Kinnear et al., 2024)

This is directly related to the similarity of each question to the underlying knowledge being assessed or not following the traditional reliability metrics. Nevertheless, the decision was made not to continue reliability testing related to knowledge questions.

For the part of perception and attitudes items, the statistician suggested performing a Cronbach's alpha analysis for this part. Reliability testing, especially for items measuring perceptions and attitudes centered on a 5-point Likert scale, is important in making sure that the items are generating consistent responses that may reflect their reliability.

For the scale that was measured in this analysis, Cronbach's alpha was 0.785, indicating an acceptable level of internal consistency. This implies that the items within this section were reliable enough to use in concluding attitudes or perceptions of HCWs. However, the table below contains reliability testing results for this section of the assessment:

Table 3.1: Cronbach's alpha result table for the perception and attitudes items.

| | **Scale Mean if item deleted** | **Scale variance if item deleted** | **Corrected item-Total correlation** | **Cronbach's alpha if the item deleted** |
|---|---|---|---|---|
| **Item-1** | 40.5 | 32.9 | .569 | .756 |
| **Item-2** | 40.9 | 36.0 | .264 | .784 |
| **Item-3** | 40.6 | 36.4 | .272 | .783 |
| **Item-4** | 41.0 | 30.4 | .622 | .747 |
| **Item-5** | 40.4 | 32.9 | .686 | .749 |
| **Item-6** | 40.8 | 36.1 | .252 | .786 |
| **Item-7** | 39.8 | 33.7 | .512 | .762 |
| **Item-8** | 40.4 | 35.8 | .394 | .774 |
| **Item-9** | 40.5 | 34.0 | .480 | .765 |
| **Item-10** | 41.2 | 35.5 | .285 | .783 |
| **Item-11** | 40.0 | 37.3 | .174 | .790 |
| **Item-12** | 40.7 | 34.7 | .262 | .790 |
| **Item-13** | 40.2 | 31.4 | .668 | .745 |

### 3.11 Data Analysis

Data from the results section was manually transcribed into IBM Statistical Package for the Social Sciences (SPSS) version 20.0 for analysis. However, analytical steps applied:

- Univariate Analysis:
    - Descriptive Statistics: Frequencies and percentages were computed for categorical variables; measures of central tendency (Mean, Median, Mode), minimum, and maximum were used to summarize continuous variables.
    - Graphical Representation: Graphical methods such as pie charts, clustered bar charts for categorical variables, and histograms for continuous variables were used.
    - Derived variable: A new variable was computed to represent the level of knowledge since it classified respondents into knowledgeable and non-knowledgeable.
- Bivariate Analysis:
    - Group Differences: Means were compared using means comparison to examine whether groups differed on these descriptive statistics.
    - Graphical representation: Box plot was used as a graphical presentation for continuous variables between categories.

- Hypothesis Testing: One-way ANOVA was used to test all hypotheses and determine if there were significant differences in knowledge regarding nebulized furosemide therapy among the different demographical aspects of HCWs. However, the reason behind choosing the one-way ANOVA test is the fact that the dependent variable was a scaler one, which is the knowledge level, and the independent variables were categorical variables with more than 2 categories, which gains an advantage of using the one-way ANOVA instead of the independent samples T-test.

### 3.12 Ethical Considerations

In the beginning, the study title was determined and the direct supervisor was legally agreed upon from the Graduate Studies Department of the Arab American University and approval was given for the study topic. Then, the study was approved by the local Institutional Review Board (IRB) before starting tool design.

This study adhered to ethical principles and guidelines to ensure the rights, well-being, and confidentiality of participants. The following ethical considerations were addressed:

- Informed Consent: Before the research was initiated, participants were informed in detail about the purposes of the research, descriptions of the study, purpose, assessment tool, and rights as research participants. All participants obtained informed consent including the first page of the online questionnaire. However, participation was voluntary.

- Confidentiality: the participants were kept anonymous during the study. This may be considered to be rich data but ensures all data remains fully anonymized and handled as confidential.
- Data Security: to safeguard the information that was being gathered, questionnaires were protected in a safe space, with access only to the researcher. However, all data will be discarded within guidance after finalizing the thesis.
- Voluntary Participation: no incentivization took place and subjects were free to discontinue the survey at any stage with no repercussions Finally, it is important to note these informants were not solicited or approached specifically for their views.

### 3.13 Summary

This cross-sectional study was conducted to assess HCWs' knowledge, perceptions, and attitudes regarding nebulized furosemide therapy in the West Bank, Palestine. A descriptive cross-sectional design was selected since having an equally up-to-date picture of the opinion that HCWs hold, considering dynamic changes in the healthcare system.

The study included 357 HCWs recruited using a convenience sampling approach. The structured questionnaire, which was designed with the input of experts, encompassed areas such as demographics, information about nebulized furosemide therapy perceptions, and attitudes toward its use. The questionnaire was reviewed by experts and piloted on a small group of participants to check clarity and relevant questions.

Key ethical points included ensuring that participants consented and protecting the confidentiality of the covered data. The data were analyzed using SPSS and descriptive statistics, as well as inferential statistics relationships among variables.

Nevertheless, this study presents a set of robust frameworks that aim to provide insight into HCWs' perspectives on nebulized furosemide therapy and to guide decision-making associated with clinical practice and patient care.

# Chapter Four: Results

## 4.1 Introduction

In this chapter, we present the results of a survey study that aims to assess the knowledge, perception, and attitudes about nebulized furosemide therapy among HCWs in the West Bank - Palestine. The study sought to evaluate the three mentioned perspectives of HCWs on this therapy and elucidate the factors likely to affect them.

The cross-sectional research included a community-based sample of 357 HCWs with diverse ages, genders, work positions, educational levels, and years of experience. These sections provide the results regarding the demographic characteristics, knowledge level, and perception/attitude of HCWs toward nebulized furosemide therapy.

The questionnaires were designed to assess knowledge so a quantitative assessment scale was used with 14 questions about nebulized furosemide therapy. Based on their scores, participants were divided into the knowledgeable group and non-knowledgeable group.

Descriptive statistics were used for an overview of the knowledge categories, and hypotheses regarding differences among demographic variables (age, educational level, professional role, and years of practice) were analyzed through one-way ANOVA.

In addition, a set of statements rated on a Likert scale (from strongly disagree to strongly agree) was used to judge the perceptions and attitudes. This article provides a more nuanced perspective of HCWs' perceptions and attitudes regarding using nebulized furosemide in clinical

practice, which enables the application of the searchable summary resulting from this qualitative approach.

This is an important area of investigation through which, as the study results show, HCWs at all levels lack knowledge regarding nebulized furosemide therapy and possess essential perceptions/attitudinal considerations that can help develop educational interventions to improve care in this therapeutic domain. The results are further elaborated, including key patterns and implications to be considered for future application.

**Part 1: Demographic data**

This section describes the demographic features of a study sample of 357 HCWs in the West Bank. For this reason, it is important to know the demographic profile when interpreting results of knowledge, perception, and attitudes toward nebulized furosemide therapy.

**Age:**

The distribution of ages among the participants was characterized by a majority of young professionals with 61.3% of responses aged 25-34 years. The sample had 16.5% of participants aged <25 years and 16.2% aged 35-44 years, but only 5.9% were aged between 45 to 54 years.

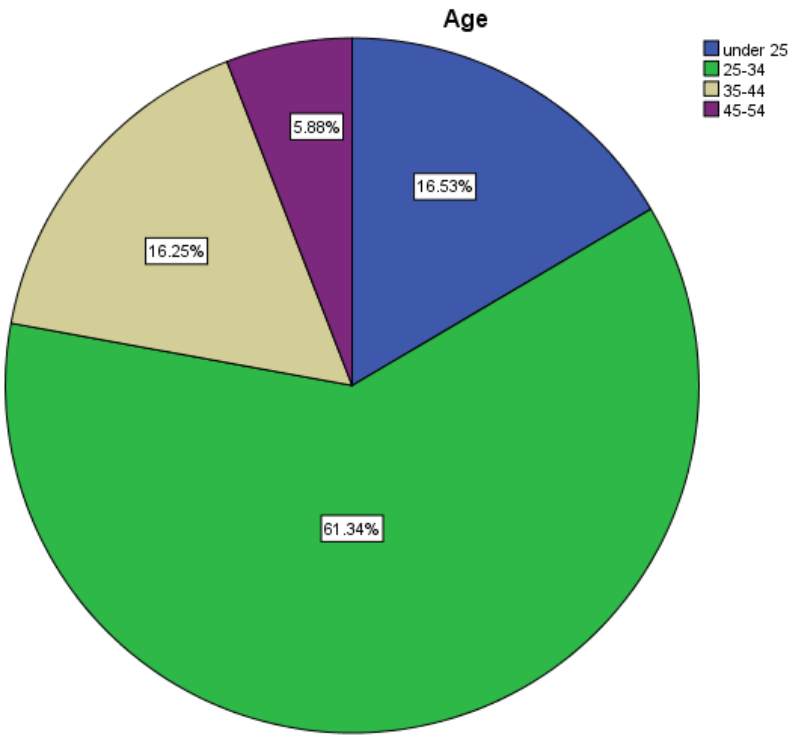


Figure 4.1: Pie chart for age category.

**Gender:**

A slightly higher proportion of male HCWs were included in the sample regarding gender, with 202 males (56.6%) and 155 females (43.4%).

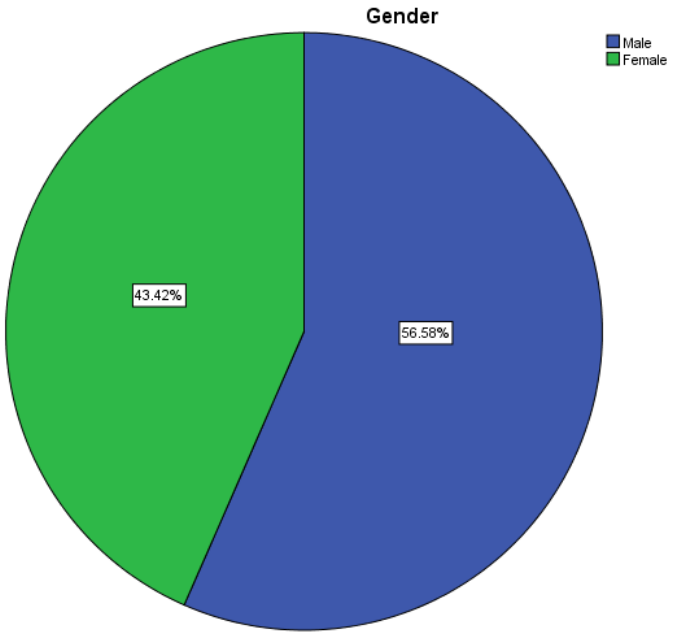


Figure 4.2: Pie chart for gender category.

**Professional role:**

The participants had a wide variation in their professional roles. The largest group was the nurses at 60.5% (216 participants), followed by GPs at 4.8% (17 participants), pharmacists at 6.4% (23 participants), anesthesiologists at 7.6% (27 participants), specialists at 5.0% (18 participants), residents in training programs at 14.0%, and others for the remaining percentage of responses.

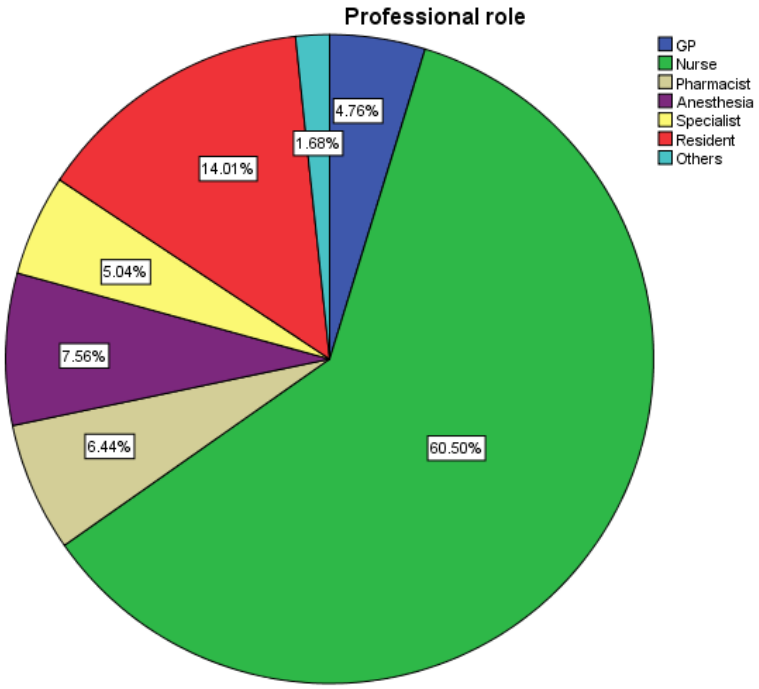


Figure 4.3: Pie chart for professional role category.

**Level of education:**

The participants were relatively highly educated, as suggested by their educational qualifications. Most of them had a Bachelor's degree (74.2 %), 21.8% were Master's Degree holders, 3.6% were Doctorate/PhDs, and a very low percentage were Diploma Holders by Education Background.

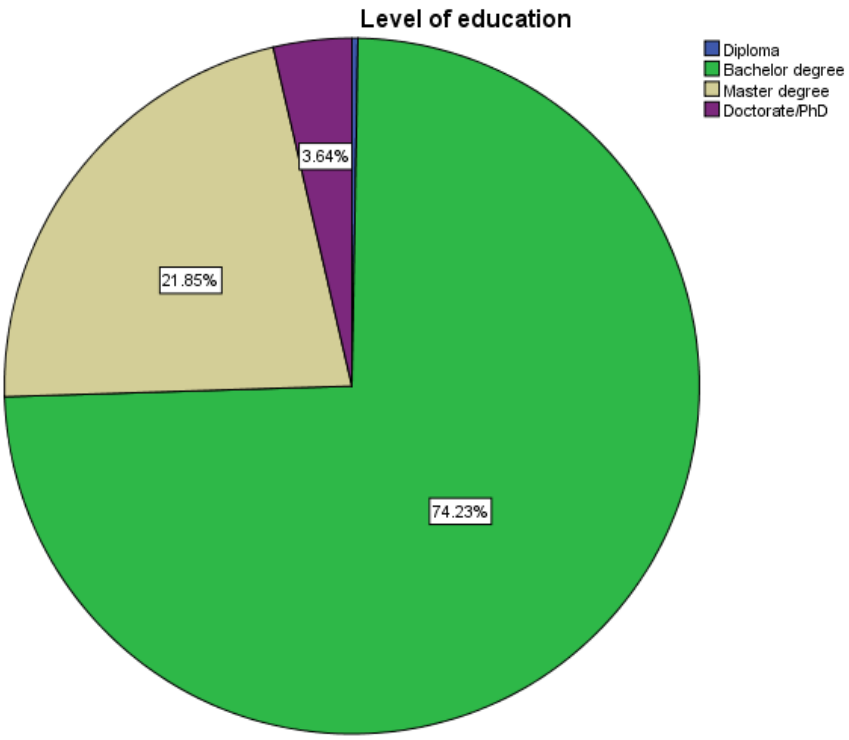


Figure 4.4: Pie chart for level of education category.

**Years of experience:**

There were different levels of experience among participants; 53.2% had from 1 to 5 years of experience in their professional areas. 7.3% of the total had <1 year of experience, 21.6% had 6–10 years, 14.3% had 11–20 years and only the rest (3.6%) had more than 20 years of experience.

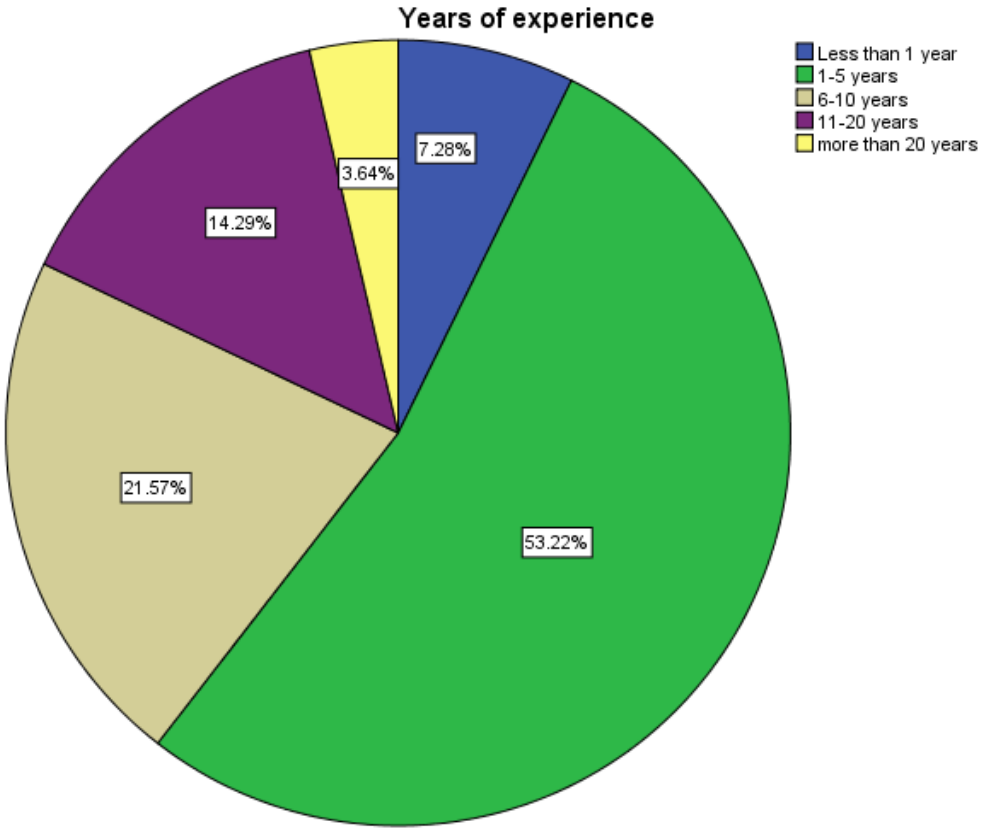


Figure 4.5: Pie chart for years of experience category.

**Department (Work Unit):**

Concerning the employment department, 49.6% of the participants worked were from the ICU or CCU. Additionally, 22.7% were from a medical-surgical unit, 8.1% from an emergency room, 0.8% from a pharmacy, 5.9% from a clinic, and 12.9% were from other departments.

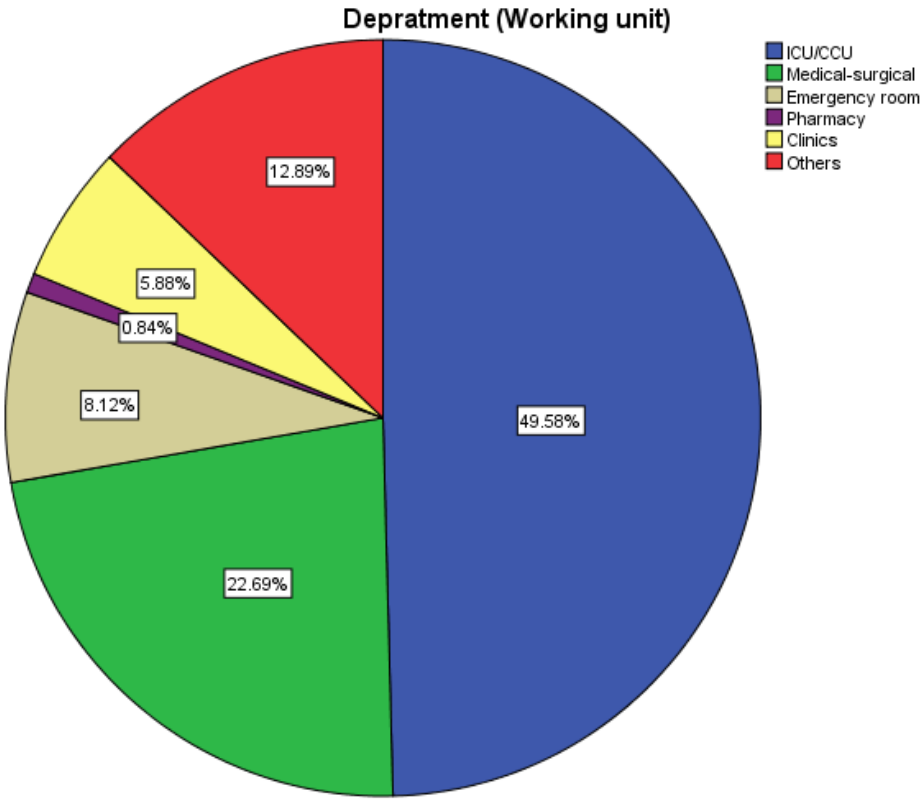


Figure 4.6: Pie chart for department (work unit) category.

## 4.2 Analysis by Research Questions

- **Awareness of nebulized furosemide therapy:**

Most participants (n = 263, 73.7%) reported hearing about nebulized furosemide therapy while only 94 (26.3%) did not know the treatment. Participants were surveyed on their awareness

of nebulized furosemide therapy and, if applicable, the resources from which they learned about this potential intervention.

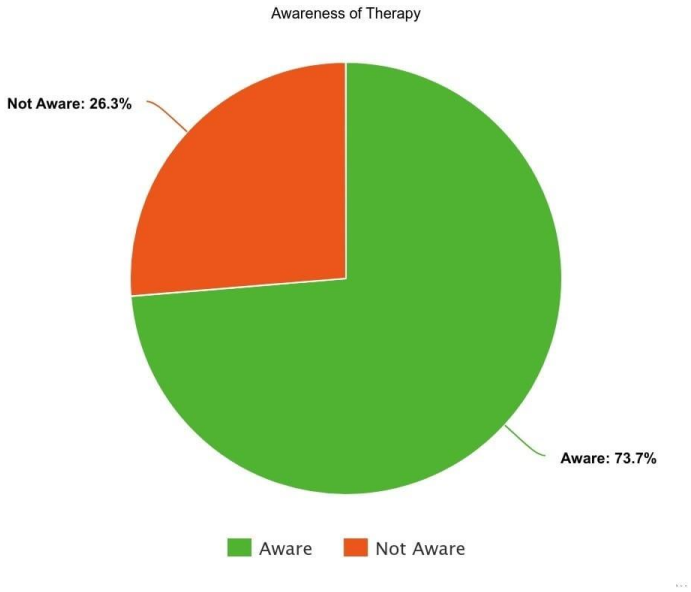


Figure 4.7: Pie chart for awareness of therapy.

Participants who were aware of the therapy were asked to select as many response options as possible so that every HCW could respond accurately. The most frequent source was healthcare providers, reported by 209 participants (49.6%). 79 respondents (18.7%) indicated that they got informed by the Internet and 77 (18.2%) through medical lectures. For 34 participants (8%), friends or family helped raise awareness, and 22 (5.2%) answered with others not specified.

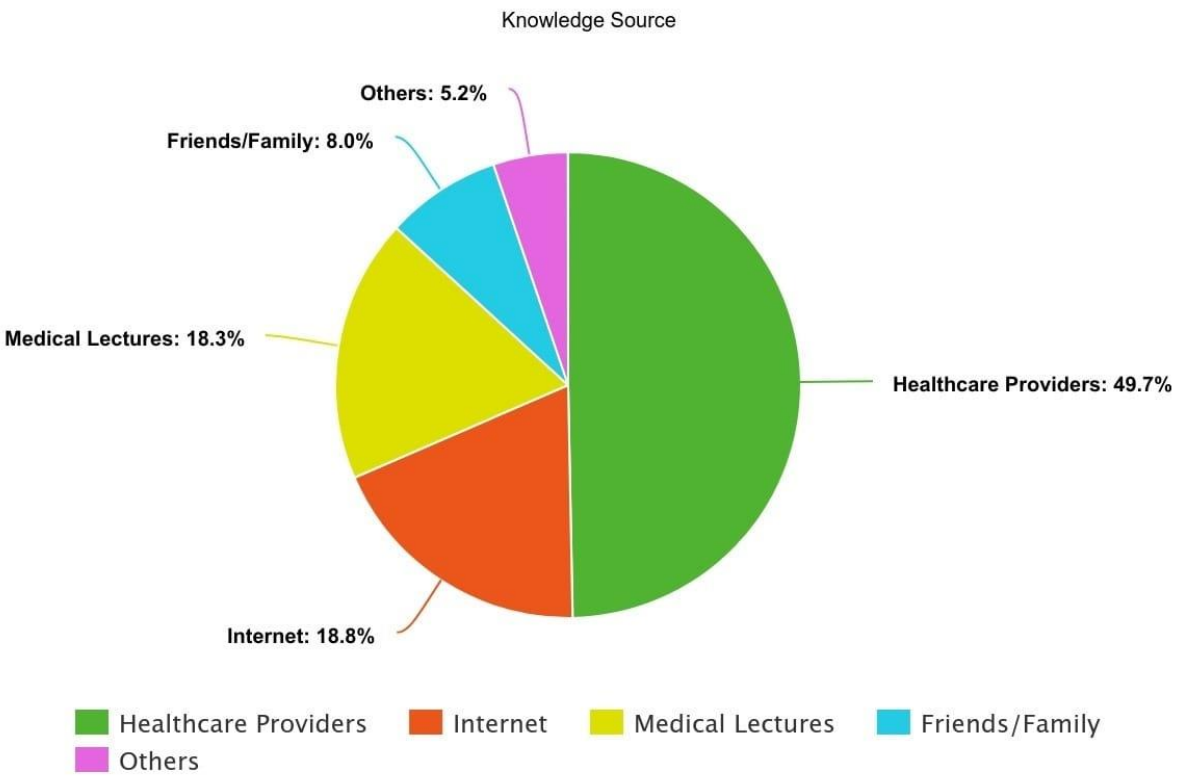


Figure 4.8: Pie chart for knowledge source.

- **Knowledge level and category:**

The knowledge of nebulized furosemide therapy was evaluated using a 14-item with questions that were initially assessed on a quantitative basis, with a maximum score of 18. The mean overall knowledge score was 11.63 (SE = 2.56), with media and mode of 11.00, showing clustering of knowledge scores around the central value A minimum score for the first sum of 7, and a maximum of 18.

Table 4.1: The table consists of knowledge score central tendency values.

| **Knowledge score** | | |
|---|---|---|
| Mean | | 11.63 |
| Median | | 11 |
| Mode | | 11 |
| Std. Deviation | | 2.55 |
| Minimum | | 7 |
| Maximum | | 18 |
| Percentiles | 5 | 7 |
| | 10 | 8 |
| | 90 | 15 |
| | 95 | 15.1 |

Table 4.2: The table consists of knowledge score frequency and percentage.

| **Knowledge Scores** | | **Frequency** | **Percent** |
|---|---|---|---|
| Score | 7 | 20 | 5.6 |
| | 8 | 26 | 7.3 |
| | 9 | 34 | 9.5 |
| | 10 | 33 | 9.2 |
| | 11 | 69 | 19.3 |
| | 12 | 45 | 12.6 |
| | 13 | 41 | 11.5 |
| | 14 | 29 | 8.1 |
| | 15 | 43 | 12.0 |
| | 16 | 10 | 2.8 |
| | 18 | 7 | 2.0 |
| | **Total** | 357 | 100 |

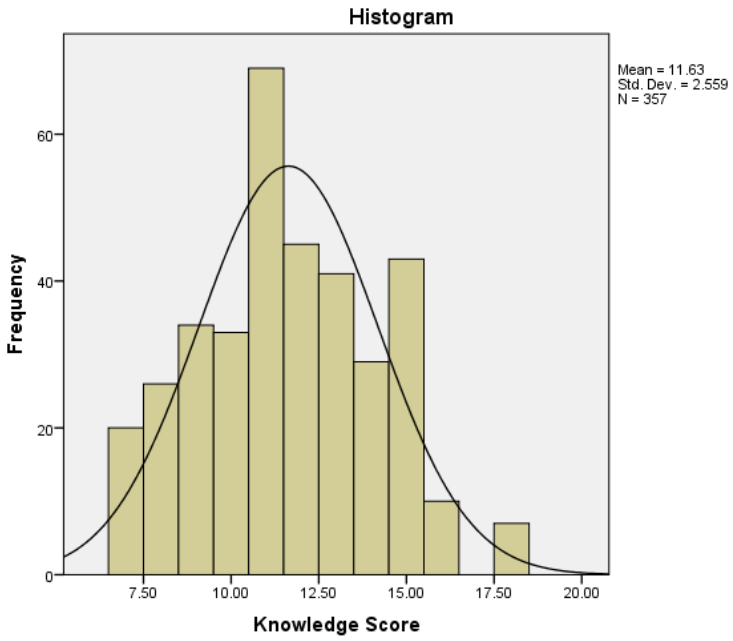


Figure 4.9: Histogram with the bell-shaped curve for knowledge score.

Moreover, participants were then divided according to the status of their knowledge into two groups, non-knowledgeable (those who scored 12 points or less) and knowledgeable (those who scored 13 points or more). Participants who were classified as non-knowledgeable were 227 participants (63.6%) Compared to Knowledgeable HCWs which had a total number was 130 patients (36.4%.) respectively.

The histogram of scores demonstrated that the knowledge levels of participants followed a normal distribution, demonstrating how local areas with nebulized furosemide therapy varied widely in familiarity.

Table 4.3: The table consists of knowledge category frequency and percentage.

| Knowledge Category | Frequency | Percent |
|---|---|---|
| Non-Knowledgeable | 227 | 63.6 |
| Knowledgeable | 130 | 36.4 |
| **Total** | 357 | 100.0 |

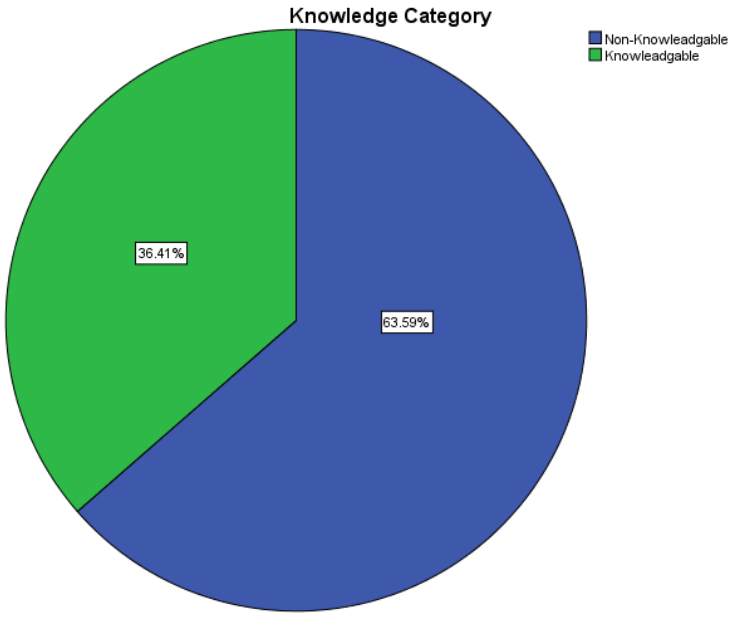


Figure 4.10: Pie chart for knowledge category.

- **Perception and attitudes:**

Participants answered a series of 13 statements on a five-point Likert scale to gauge the perception and attitudes of HCWs toward nebulized furosemide therapy. The grading system provided by the grads ranged from strongly disagree to strongly agree.

The bulk of the median responses for all statements fell into the neutral range while the modes were somewhat leaning toward agreement, one that collectively reflects an overall positive perception of nebulized furosemide therapy. Here we recap the trends and patterns seen regarding each statement.

- Statement 1 had a result of 42.0% of participants who agreed with this statement, and 37.5% were neutral, this suggests that respondents have a positive but wary outlook.
- Opposite to Statement 1, the responses to Statement 2 were more varied with 41.2% neutral and only 36.4% in agreement, suggesting some skepticism or uncertainty around this possibility.
- Statement 3: 33.9% agreed, while a total of 40.1% were neutral, showing that there are plenty who see this therapy can having minimal side effects, and plenty of others still on the fence.
- Statement 4: 28.0% agreed, while 33.9% selected neutral, indicating there was a good distribution of opinions regarding the administration of nebulized furosemide therapy.
- Statement 5: This was accepted by a high percentage of 53.5% meaning well that people believe the therapy should be widely available.
- Statement 6: Participants were divided, with 40.1% agreeing and 36.1% remaining neutral, pointing to a need for further education or clarification of the long-term use of nebulized furosemide.
- Statement 7: Most agreed (54.1%), showing the importance of training regarding the therapy, and some strongly disagreed (8.1%).
- Statement 8: Results were largely favorable, with 47.9% agreeing and only 5.9% strongly disagreeing, supporting the safety of this therapy.

- Statement 9: A large margin saw the therapy as possibly beneficial, with a plurality of 50.1% agreeing and only 35.6% neutral, indicating that the therapy's benefits outweigh its risks.
- Statement 10: This statement prompted a more divided response; only 25.5% agreed and 39.5% disagreed, suggesting some debates regarding research about nebulized furosemide therapy as supportive data for better evidence-based practice.
- Statement 11 was supported by 57.1% and had the highest level of strong agreement, with only 9.0% strongly disagreeing.
- Statement 12: The response would seem that this statement was moderately balanced with 31.9% neutral and a total of 43.4% agreeing implying that sometimes the answer was found to different levels of conviction or confidence in response, according to the available information regarding this therapy.
- Statement 13: This statement had the strongest positive attitude toward nebulized furosemide its level of agreement was (56.9%).

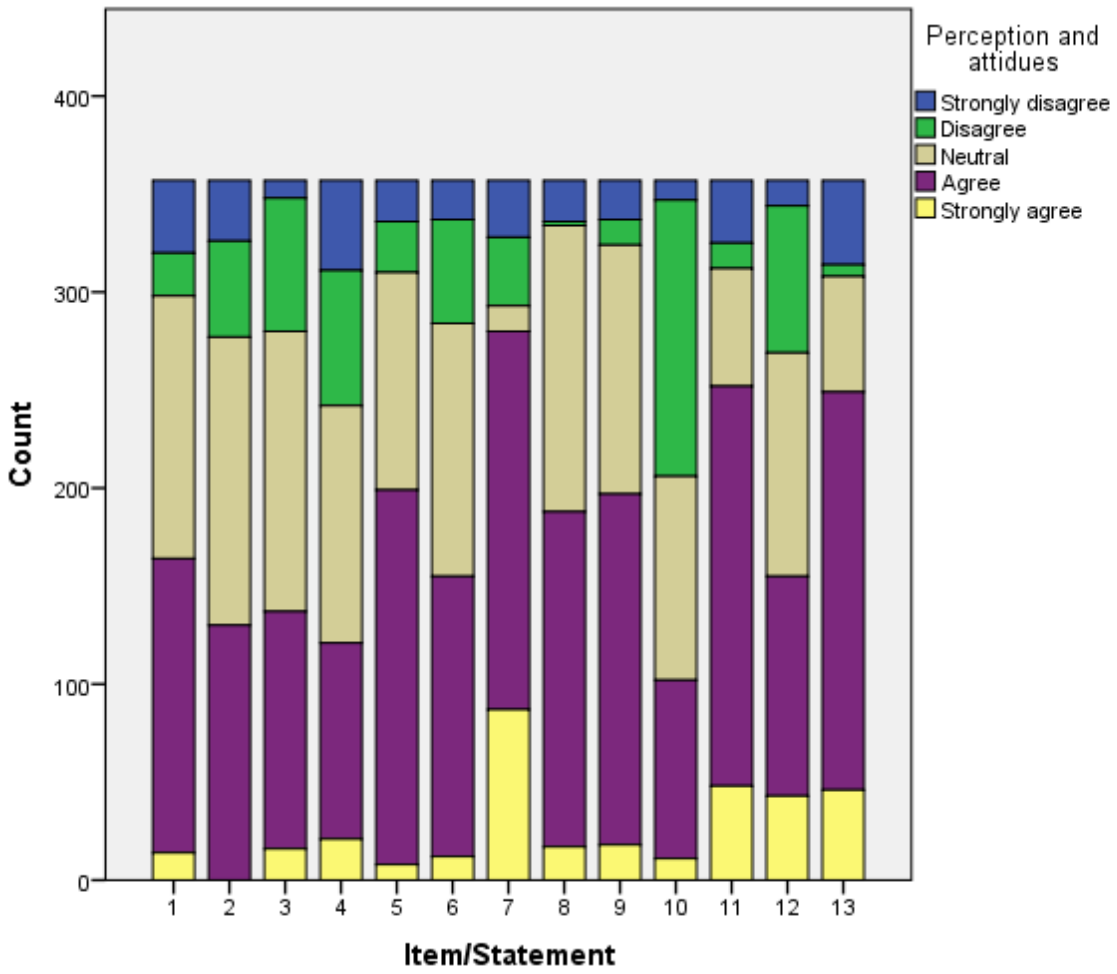


Figure 4.11: Stacked bar chart for perception and attitude responses.

Within the context of this generally favorable impression of HCWs regarding nebulized furosemide therapy, as suggested by their agreement with most items evaluated here, neutral responses were noted.

### 4.3 Hypothesis testing:

One-way ANOVA was used as a statistical test to examine different hypotheses of the knowledge of HCWs about nebulized furosemide therapy in this study. This test was suitable as there were more than two categories in the independent variables and the dependent variable was knowledge level as a quantitative ratio variable.

– *Hypothesis-1*

Alternative Hypothesis (Ha): HCWs aged 35 years old and above have higher knowledge scores regarding nebulized furosemide therapy, with scores of 13 or more considered knowledgeable.

Null Hypothesis (H0): There is no significant difference in knowledge score regarding nebulized furosemide therapy between HCWs aged 35 or above and younger ones.

Table 4.4: The table consists of comparing means between knowledge score and age.

| Age | Mean | N | Std. Deviation |
|---|---|---|---|
| **under 25** | 12.6271 | 59 | 2.42756 |
| **25-34** | 11.6164 | 219 | 2.73592 |
| **35-44** | 10.7931 | 58 | 2.10061 |
| **45-54** | 11.3333 | 21 | .48305 |
| **Total** | 11.6331 | 357 | 2.55882 |

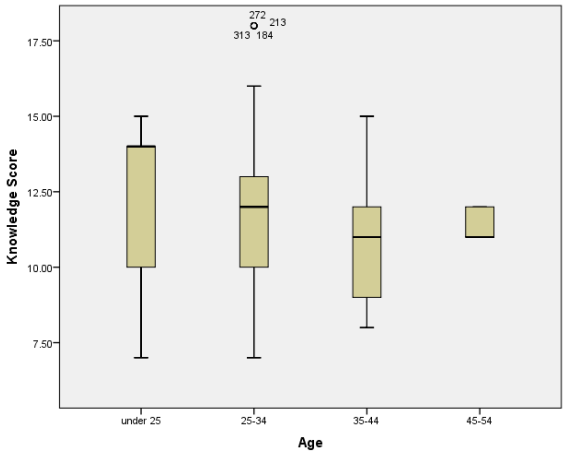


Figure 4.12: Boxplot for the relationship between knowledge score and age category.

Table 4.5: The table consists of a one-way ANOVA test for knowledge score relationship with age.

| One-Way ANOVA | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| **Between Groups** | 101.169 | 3 | 33.723 | 5.339 | .001 |
| **Within Groups** | 2229.761 | 353 | 6.317 | | |
| **Total** | 2330.930 | 356 | | | |

The results indicate a significant difference ($p < .001$) in knowledge levels among HCWs of different age groups, rejecting the null hypothesis. However, this adds a challenge to the healthcare sector in which younger HCWs should gain access to continuous education through courses, lectures, and other learning tools, which can help improve the overall knowledge of younger HCWs while practicing their careers.

– *Hypothesis-2*

Ha: HCWs with master's or doctorate degrees have higher knowledge scores regarding nebulized furosemide therapy, with scores of 13 or more considered knowledgeable.

H0: There is no significant difference in knowledge level regarding nebulized furosemide therapy between HCWs with master's or doctorate degrees and those with lower degrees.

Table 4.6: The table consists of comparing means between knowledge score and level of education.

| Level of education | Mean | N | Std. Deviation |
|---|---|---|---|
| **Diploma** | 9.0000 | 1 | |
| **Bachelor degree** | 11.6566 | 265 | 2.68395 |
| **Master degree** | 11.9487 | 78 | 2.03794 |
| **Doctorate/PhD** | 9.4615 | 13 | 1.66410 |
| **Total** | 11.6331 | 357 | 2.55882 |

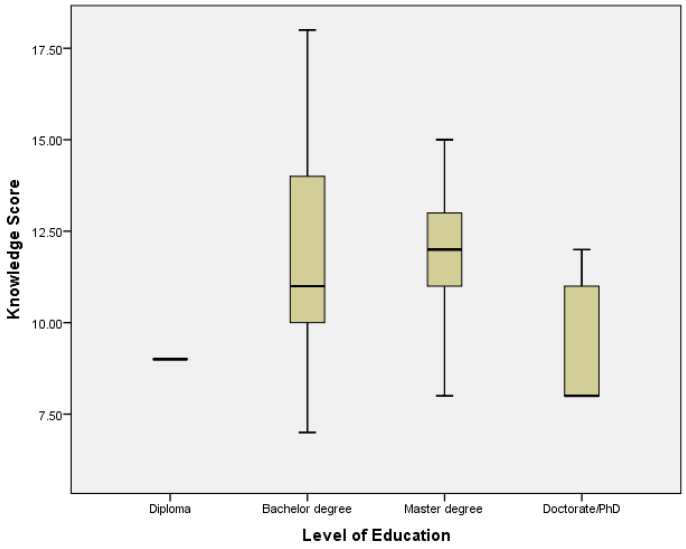


Figure 4.13: Boxplot for the relationship between knowledge score and level of education category.

Table 4.7: The table consists of a one-way ANOVA test for knowledge score relationship with level of education.

| **One-Way ANOVA** | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 76.153 | 3 | 25.384 | 3.974 | .008 |
| Within Groups | 2254.777 | 353 | 6.387 | | |
| Total | 2330.930 | 356 | | | |

The results indicate a significant difference (p = .008) in knowledge levels based on educational qualifications, rejecting the null hypothesis. Moreover, this indicates that those of HCWs with higher educational degrees are knowledgeable when compared others, this highlights the need to encourage HCWs to continue with their education for higher degrees, which benefit them knowledgeably, but also in their practice within the field.

– *Hypothesis-3*

Ha: HCWs working in CCU/ICU have higher knowledge scores regarding nebulized furosemide therapy, with scores of 13 or more considered knowledgeable in comparison with other working departments.

H0: There is no significant difference in knowledge level regarding nebulized furosemide therapy between HCWs working in CCU/ICU and other departments.

Table 4.8: The table consists of comparing means between knowledge score and department (work unit).

| Department (Work unit) | Mean | N | Std. Deviation |
|---|---|---|---|
| **ICU/CCU** | 11.9435 | 177 | 2.49253 |
| **Medical-surgical** | 11.3580 | 81 | 2.99294 |
| **Emergency room** | 10.6207 | 29 | 2.47002 |
| **Pharmacy** | 12.0000 | 3 | .00000 |
| **Clinics** | 12.3333 | 21 | .48305 |
| **Others** | 11.2174 | 46 | 2.46678 |
| **Total** | 11.6331 | 357 | 2.55882 |

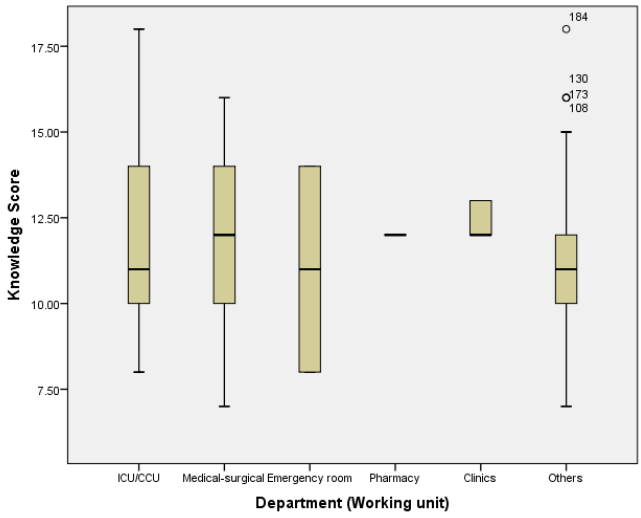


Figure 4.14: Boxplot for the relationship between knowledge score and department (work unit) category.

Table 4.9: The table consists of a one-way ANOVA test for knowledge score relationship with department (work unit).

| One-Way ANOVA | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| **Between Groups** | 71.557 | 5 | 14.311 | 2.223 | .052 |
| **Within Groups** | 2259.373 | 351 | 6.437 | | |
| **Total** | 2330.930 | 356 | | | |

The results indicate no significant difference (p = .052) in knowledge levels among different departments, failing to reject the null hypothesis. However, this was a surprising set of data, where those HCWs working in closed units are usually higher in knowledge. Moreover, this could highlight the need to introduce HCWs regardless to the department to continuous educational courses and lectures regarding the therapy, which can improve clinical practice and decision-making.

– *Hypothesis-4*

Ha: Specialists have higher knowledge scores regarding nebulized furosemide therapy than all professionals, with scores of 13 or more considered knowledgeable.

H0: There is no significant difference in knowledge level regarding nebulized furosemide therapy between specialists and HCWs with other professional roles.

Table 4.10: The table consists of comparing means between knowledge score and professional role.

| Professional role | Mean | N | Std. Deviation |
|---|---|---|---|
| **GP** | 12.5882 | 17 | 2.09341 |
| **Nurse** | 11.8796 | 216 | 2.66141 |
| **Pharmacist** | 11.4348 | 23 | 1.59049 |
| **Anesthesia** | 11.7037 | 27 | 2.79855 |
| **Specialist** | 11.3889 | 18 | .50163 |
| **Resident** | 10.9000 | 50 | 2.48465 |
| **Others** | 7.3333 | 6 | .81650 |
| **Total** | 11.6331 | 357 | 2.55882 |

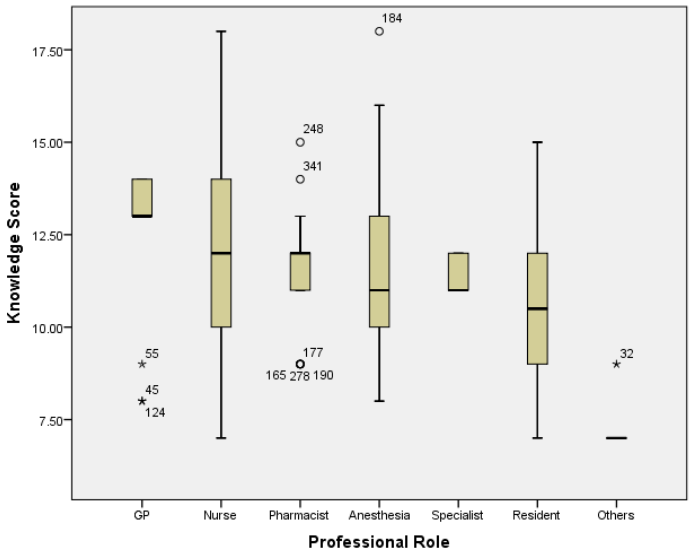


Figure 4.15: Boxplot for the relationship between knowledge score and professional role category.

Table 4.11: The table consists of a one-way ANOVA test for knowledge score relationship with professional role.

| One-Way ANOVA | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| **Between Groups** | 168.549 | 6 | 28.092 | 4.547 | .000 |
| **Within Groups** | 2162.381 | 350 | 6.178 | | |
| **Total** | 2330.930 | 356 | | | |

The results indicate a significant difference ($p < .001$) in knowledge levels among different professional roles, rejecting the null hypothesis. This indicates that specialists are considered knowledgeable when compared to other professional roles. As mentioned in previous hypothesis results, specialists can be considered as lecturers and instructors when establishing continuous educational courses and lectures and can help understand the therapy more clearly throughout their experiences.

– *Hypothesis-5*

Ha: HCWs with experience of less than 1 year have lower knowledge scores regarding nebulized furosemide therapy, with scores of 12 or less considered non-knowledgeable.

H0: There is no significant difference in knowledge level regarding nebulized furosemide therapy between HCWs with less than 1 year of experience and those with more experience.

Table 4.12: The table consists of comparing means between knowledge score and years of experience.

| Years of experience | Mean | N | Std. Deviation |
|---|---|---|---|
| **Less than 1 year** | 11.8846 | 26 | 3.53640 |
| **1-5 years** | 11.5421 | 190 | 2.43993 |
| **6-10 years** | 12.8571 | 77 | 2.71310 |
| **11-20 years** | 10.0588 | 51 | 1.30249 |
| **more than 20 years** | 11.3846 | 13 | .50637 |
| **Total** | 11.6331 | 357 | 2.55882 |

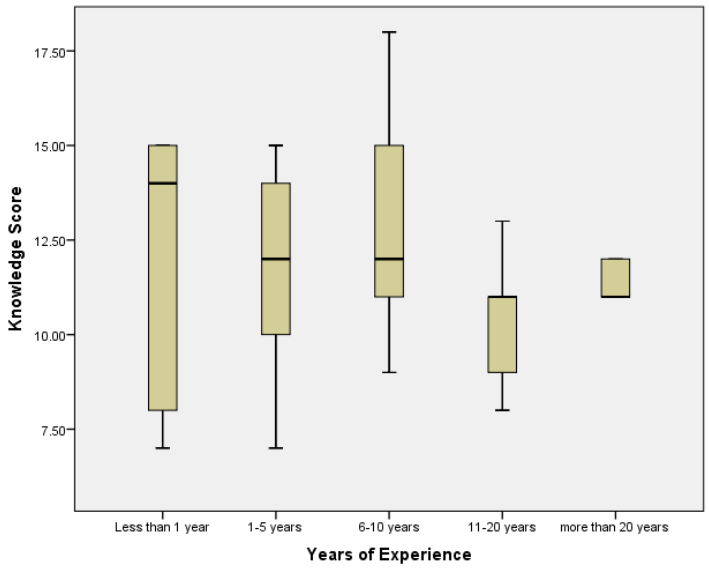


Figure 4.16: Boxplot for the relationship between knowledge score and years of experience category.

Table 4.13: The table consists of a one-way ANOVA test for knowledge score relationship with years of experience.

| One-Way ANOVA | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| **Between Groups** | 245.784 | 4 | 61.446 | 10.373 | .000 |
| **Within Groups** | 2085.146 | 352 | 5.924 | | |
| **Total** | 2330.930 | 356 | | | |

The results indicate a significant difference ($p < .001$) in knowledge levels based on years of experience, rejecting the null hypothesis. However, this adds a challenge to the healthcare sector in which younger HCWs should gain access to continuous education through courses, lectures, and other learning tools, which can help improve the overall knowledge of younger HCWs while practicing their careers.

## 4.4 Summary

Finally, according to the results of the one-way ANOVA for nebulized furosemide therapy about age, educational level, professional role, and years of professional experience, the knowledge levels differed significantly. However, there was no difference between HCWs in CCU/ICU and other departments. The identification of professional groups that may benefit from focused educational interventions is of particular relevance and interest to these study results.

# Chapter Five: Discussion

## 5.1 Introduction

This chapter explores the findings obtained through surveying HCWs' knowledge, perceptions, and attitudes toward nebulized furosemide therapy among HCWs and relation to previous literature. The conclusion of those data could be enormous because they provide invaluable info on what practitioners can be taught to change their application in ways that would benefit patient care.

### 5.1.1 Overview of Findings:

There were 357 HCWs mainly young professionals, with more than 61% of them between the ages of 25 and 34 years. This demographic change has been synchronously reflected worldwide as a younger healthcare workforce trend (Kubo et al., 2021).

Although 73.7% of HCWs reported prior exposure to the topic of nebulized furosemide, only 63.6% were able to answer 57.1% of questions correctly in a structured knowledge assessment. An average knowledge score of 11.63 illustrates a clear gap that must be addressed urgently.

This gap represents a risk for the global standards of training. The use of self-reported knowledge is a known limitation in practice paradigms, leading clinical workers for example to over-represent their understanding of management pathways. This can lull clinicians into a false

sense of security, as they no longer feel the need to obtain additional education or training, which may place patient safety and quality care at risk.

There has been evidence to demonstrate poor knowledge of pharmacological treatments and their impact on patient outcomes (Laviolette & Laveneziana, 2014). Consequently, closing this knowledge gap with broad educational efforts is vital, as it directly relates to the effectiveness of patient care.

### 5.1.2 Knowledge Disparities Among HCWs:

A comparison of this analysis showed that younger age, lower-degree education, and non-respiratory HCW group members seemed to have less knowledge of nebulized furosemide. HCWs aged over 35 had significantly better knowledge scores (p <. 001). These data suggest that increased time spent in clinical practice and the variability of types of patients encountered help in developing quality critical thinking skills.

The positive association between age and knowledge is consistent with the conclusions of Abdul-Hassan & Hashim (2021) who highlighted the significance of experiential learning in practical training. In addition, HCWs with Master's or Doctorate degrees had more knowledge than those with a Bachelor's degree only (p =. 008). These findings emphasize the need for postgraduate education in building clinical competency.

Nonetheless, an overdue alarm is raised by the overshone info that 74.2% of HCWs only have a Bachelor's and reveals the fact those other healthcare centers need to gear up their graduate programs. Advanced therapeutic methods blended with evidence-based approaches can be incorporated into the curricula in healthcare teaching institutes to make HCWs more futuristic to tackle contemporary clinical challenges.

Differences by professional role were observed, with specialists and proxies both achieving higher scores than non-specialists ($p < 0.001$), underlining the necessity for individualized interventions being predominantly educational. The low levels of confidence reported in the non-specialist roles might be explained by a lack of experience with more complex clinical scenarios where nebulized therapies are indicated.

Consequently, it is important for targeted training programs oriented to specific functions, particularly in high-care environments; so that all HCWs are capable of correct patient care (Waskiw-Ford et al., 2018). The variation in practice patterns highlighted by the authors of these two articles also touches on questions about continued education for HCWs.

This will require every college and university to evaluate its academic programs and strategically identify how they can equalize entry into robust career preparatory practice opportunities through degrees or certificates. Creating flexible training classes will allow HCWs to easily schedule when they can take the training, and cater to different learning styles.

### 5.1.3 Perceptions and Attitudes Toward Nebulized Furosemide Therapy:

The survey suggested that HCWs have generally positive perceptions and attitudes toward nebulized furosemide, with 53.5% in favor of its inclusion into clinical practice. Still, this optimism is somewhat guarded because only 25.5% felt that there has been enough research to show the drug is safe and effectively reduces other drug use.

The duality of this belies a key point about the intersection of knowledge and attitude that shapes clinical reasoning. A reluctance to more broadly adopt nebulized furosemide therapy is likely a function of limited knowledge regarding its pharmacologic profiles and clinical effectiveness. (Katiyar et al., 2022)

The fact that HCWs tend to endorse those treatments that are more empirically based and the skepticism observed here indicate the need for further research to develop solid recommendations in clinical practice. This supports the research published by Ventresca et al. (1990), which places a high profile on the need for strong evidence to inform clinical decision-making.

Moreover, the attitude towards nebulized furosemide may reflect cultural barriers within healthcare surroundings. Clinical care practice is generally rule-oriented and guided, threatening to act as a significant barrier against emerging treatments. However, HCWs require continued commitment to standard norms and practices; this can limit the acceptance of more advanced interventions. (Houghton et al., 2020)

Healthcare organizations need to foster an evidence-based culture that helps HCWs feel more comfortable using new treatment modalities. Leadership that champions innovation, encourages curiosity and values proactive engagement with new evidence will help drive this cultural change. Furthermore, HCWs' perceptions and attitudes are conditional to the past practices they were exposed to and in their general clinical environment.

Clinicians in busy practices be it high-pressure institutional settings or smaller private practices are likely to fall into a degree of default-traditional care-delivering mindset and develop skepticism towards obviously unconventional newer therapies if they have not seen them being effectively integrated in some clinically tested structured manner.

Therefore, organizations are needed to offer continued support and resources to build on beliefs that nebulized furosemide was safe and effective thanks to peer experiences or positive stories.

### 5.1.4 Barriers to Effective Implementation:

Although there is consensus regarding the usefulness of nebulized furosemide, as in all medical areas more improvements can be made to guarantee an appropriate implementation of this therapy. Variability in responses, specifically regarding safety and administration, points out the need for standardized protocols and clinical guidelines. This is critical for reducing uncertainty and ensuring that all HCWs follow guidelines (Waskiw-Ford et al., 2018).

Variability in knowledge results when there are no standard criteria, and it can also promote that the care has been given inconsistently across different healthcare groups. Youth and inexperience, it seems, provide HCWs with less of the metacognitive gusto required for determining when nebulized furosemide therapy is appropriate.

This reflects the call for structured mentorship programs to be developed where established clinicians in their profession can pass on knowledge and practice to junior staff (Abdul-Hassan & Hashim, 2021). These mentoring programs can help with the knowledge gap by focusing on a more collaborative culture of learning that promotes increased professional growth and clinical competencies.

Furthermore, institutional support is needed to enhance HCW compliance with evidence-based practices. Clinical decision-making of HCWs is tremendously influenced by healthcare institutions, which heavily govern their policies and research has shown that institutions with supportive policies have the most effect (Mahshidfar et al., 2018).

Institutions need to evolve a comprehensive system that helps in setting up evidence-based practices in day-to-day practice. Examples of this could be ongoing training, available updated research, and platforms for like-minded HCWs to discuss challenges and experiences with the rollout of these new therapies.

In addition, effective organizational leadership needs to establish a culture of continuous improvement and open trust. If HCWs are encouraged to express concerns and insights about the

barriers they experience, healthcare organizations will then be able to collect invaluable feedback that can inform continual training and policy development. By involving them in this process, HCWs also take ownership of their career development.

### 5.1.5 Educational Interventions:

The detected lack of knowledge in less experienced HCWs implies that targeted educational interventions are urgently required. There is a need to bridge these gaps which could be done through structured training programs that focus on pharmacodynamics and clinical applications of nebulized furosemide (Diab et al., 2022).

Using a mix, such as traditional classroom lectures, practical exercises, and e-learning modules, can help feed different learning styles and help people to retain knowledge better. Furthermore, including active learning methods, e.g. simulation-based teaching and case studies, are beneficial in increasing HCWs' involvement and application in clinical practice settings (Laviolette & Laveneziana 2014).

Routinely simulating nebulized furosemide administration can be used to allow HCWs the opportunity to practice providing patient care in this context, therefore reinforcing competence and confidence in clinical skills. These educational interventions should be validated in future research to assess whether knowledge, perception, and attitudes are retained or not by HCW in the long term.

In a similar vein, longitudinal studies are useful to learn how continuing education affects patient care and patient outcomes. Qualitative research to understand beliefs and perceptions of nebulized therapies by HCWs may provide further insights into these barriers, allowing for targeted training strategies.

In addition to this, evaluating the effect of mentorship programs on their learning gains and on how self-assured they have become may help us determine better ways in which we could establish support political machinery that works well. This line of inquiry is valuable because it can lead to new insights for effective mentorship, which in turn suggests what might be going on between the lines when learning and professional development are achieved.

## 5.2 Recommendations

The results of this study suggest several practical recommendations to improve the knowledge and practice of nebulized Furosemide therapy among HCWs at the West Bank. These suggested practices are from an educational, clinical process, and team collaboration approach to patient safety care. However, some step-by-step recommendations were requested by the author, as follows:

- Mandatory In-Service Training: All respiratory and critical care staff should receive annual in-service training on nebulized furosemide. Regularly scheduled training designed for flexible hours of work. It should include a mix of educational approaches (face-to-face workshops, online learning modules, and simulation-based experiences) so that all HCWs have the chance to participate.

- Comprehensive Educational Content: Training should not only include the pharmacological profile of nebulized furosemide but also treatment goals, recommended evidence-based dosing strategies, and possible side effects. This will instill further belief in these therapies within the HCW community, and facilitate better patient care outcomes by underlining the need for evidence-based practice.

- Monitoring Programs: This fosters a culture of lifelong learning and professional growth, and has many benefits to providing quality care for patients in Hospitals. Education programs should promote knowledge sharing and hands-on experience and guidance to develop proficiency in clinical practice.

- Standardized Clinical Protocols: The systematic use of nebulized furosemide should be guided by common clinical protocols in all healthcare institutions. Protocols must include specifications to ensure safe and effective use, including patient selection criteria, dosing guidelines, and monitoring parameters.

- Feedback Mechanisms: Institutions should establish feedback mechanisms to encourage HCWs to report their experiences and clinical outcomes with nebulized furosemide therapy. Such feedback could help to drive ongoing improvement in the practice of implementation and how challenges are resolved in real-world clinical settings. This is an important aspect of involving HCWs in the process so they can adjust therapy protocols based on their experiences of using these therapies in real-world settings, which may provide insights beyond those obtained through traditional randomized controlled trials.

- Collaboration with Pharmacy Departments: There is a need to educate on drug-drug interactions and adverse events. HCWs should have regular in-service training on possible side effects and interactions, incorporating pharmacists.

- Interdisciplinary Team Meetings: There should be periodic meetings of the interdisciplinary team with goals to facilitate knowledge sharing and collaboration in

patient care, especially in acute care units such as ICUs and CCUs where nebulized furosemide will be more frequently administered.

- Longitudinal Research: Lastly, this study suggests future longitudinal research to evaluate the sustained impact of these educational initiatives on HCW knowledge, attitudes, and clinical behaviors over time. Additional research on the link between higher knowledge and improved patient care metrics may therefore provide important information regarding whether and when nebulized therapies work in practice. This research can also inform future training programs and enable more effective patient outcomes.

## 5.3 Limitations

While many valuable insights can be derived from this study, several limitations should be considered.

- Cross-sectional Design: It is important to note that the cross-sectional design of this study hampers our ability to infer cause-and-effect relationships of demographic characteristics with knowledge levels. While this study found age and educational differentials in factual knowledge, the design does not allow testing how those relationships might change over time. This hinders our understanding of patterns of learning among HCWs.

- Response Bias: Such expectations are limited by the reliance on self-report data, which might predispose bias in responses. Participants may have been more

familiar with nebulized furosemide therapy than they thought or unknown their gaps. These biases may then introduce bias into the results, which can be extremely problematic in domains as critical as evidence-based healthcare delivery. Future research should explore how scores obtained from simple tests of knowledge correlate with self-reported measures.

- Sample Characteristics: Although the study intended to cover a broad demographic group by including HCWs from clinics, and governmental and private hospitals in West Bank, not having enough information regarding the respondent's institutional affiliation can potentially hide specific differences in knowledge and practice. The lack of detailed explanation of the represented institutions limits the ability to discern meaningful associations between organizational characteristics and HCWs' perception and awareness towards nebulized therapy.

- Temporal Measurement: Some of the limitations include the survey capturing a single point-in-time snapshot of HCWs' knowledge, perceptions, and attitudes that may lead to an inability to track the changes throughout time. This restriction meant that the research could not review changes in the understanding of HCWs over time with the use of nebulized therapies nor as more authoritative data emerged. Longitudinal studies are required to explore these shifts and provide more insights into how educational interventions may affect knowledge retention and application in medical practice.

- Generalizability: The generalizability of results is restricted to other geographic regions or healthcare systems with different demographic, cultural, and educational background-based characteristics that were not represented in the HCWs practicing across the West Bank. It is also important to note that the unique issues identified by HCWs in the West Bank may not apply to other regions and this illustrates the

importance of regional research with tailored interventions based on each region's particular challenges.

- Lack of Clinical Outcome: In addition, this study is descriptive and the research question should lead clinicians to practical guidance or patient outcomes. Also, the author recommends that future research should assess the direct association of knowledge of nebulized furosemide among HCWs with the quality of services provided to patients. These studies can help establish best practices in the field and lead to better patient outcomes.

**5.4 Future Directions:**

- Comprehensive Educational Content: Training should not only include the pharmacological profile of nebulized furosemide but also treatment goals, recommended evidence-based dosing strategies, and possible side effects. This will instill further belief in these therapies within the HCW community, and facilitate better patient care outcomes by underlining the need for evidence-based practice.

- Monitoring Programs: This fosters a culture of lifelong learning and professional growth, and has many benefits to providing quality care for patients in Hospitals. Education programs should promote knowledge sharing and hands-on experience and guidance to develop proficiency in clinical practice.

- Interdisciplinary Team Meetings: There should be periodic meetings of the interdisciplinary team with goals to facilitate knowledge sharing and collaboration in patient care, especially in acute care units such as ICUs and CCUs where nebulized furosemide will be more frequently administered.

- Longitudinal Research: This study suggests future longitudinal research to evaluate the sustained impact of these educational initiatives on HCW knowledge, attitudes, and clinical behaviors over time. Additional research on the link between higher knowledge and improved patient care metrics may therefore provide important information regarding whether and when nebulized therapies work in practice. This research can also inform future training programs and improve patient outcomes.

## 5.5 Summary

To summarize, this study has shown that although HCWs have an overall positive attitude regarding the potential benefits of nebulized furosemide therapy, a large degree of knowledge deficits in its clinical application exist. The results highlight the dire necessity for specific educational intervention, formal incorporation of nebulized furosemide in clinical guidelines, and interdisciplinary teamwork.

Healthcare facilities can improve the readiness of their employees to adopt innovative therapies such as nebulized furosemide by promoting education, creating an environment that supports inquiry and evidence-based practice, and helping employees appreciate its relevance to respiratory care.

This will break down the highlighted barriers and knowledge gaps, which, in combination with structured training and continued support, can not only increase HCW confidence but also improve patient care in the West Bank and elsewhere. Without this strategy, nebulized furosemide therapy might not be effective for patients needing advanced respiratory therapies.

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# Appendices

Appendix A: IRB Approval Letter

Arab American University
Institutional Review Board - Ramallah

الجامعة العربية الأمريكية
مجلس اخلاقيات البحث العلمي – رام الله

**IRB Approval Letter**

**Study Title: "Knowledge and Perception of Healthcare Workers Toward Furosemide Nebulizer for Patients with Asthma and COPD in The West Bank, Palestine; A Cross-Sectional Study"**

**Submitted by: Fuad Ali Hasan Abu AlFayyah**

**Date received:** 12th May 2024

**Date reviewed:** 15th May 2024

**Date approved:** 15th May 2024

Your Study titled **"Knowledge and Perception of Healthcare Workers Toward Furosemide Nebulizer for Patients with Asthma and COPD in The West Bank, Palestine; A Cross-Sectional Study"** with the code number **"R-2024/A/73/N"** was reviewed by the Arab American University Institutional Review Board - Ramallah and it was approved on the 15th of May 2024.

**Sajed Ghawadra, PhD**
**IRB-R Chairman**
**Arab American University of Palestine**

الجامعة العربية الأمريكية - فلسطين
مجلس اخلاقيات البحث العلمي - رام الله
IRB-R
ARAB AMERICAN UNIVERSITY-PALESTINE
INSTITUTIONAL REVIEW BOARD - RAMALLAH

**General Conditions:**
1. Valid for 6 months from the date of approval.
2. It is important to inform the IRB-R with any modification of the approved study protocol.
3. The Bord appreciates a copy of the research when accomplished.

رام الله – فلسطين
**Tel:** 02-294-1999 **E-Email:** IRB-R@aaup.edu **Website:** www.aaup.edu

Appendix B: Informed Consent

# INFORMED CONSENT

**AAUP-IRB-R Code No.:** ……..

**AAUP-IRB-R Date:** …….

I, ……..... *(Name of Participant / optional)* hereby agree to take part in the clinical research (questionnaire study) specified below:

**Title of Study:** Knowledge, Perception, and Attitude of Healthcare Workers Toward Nebulized Furosemide Therapy in The West Bank, Palestine. A Cross-Sectional Study.

Fulfillment of master's degree, in intensive care nursing, in AAUP.

The nature and purpose of which has been explained to me by Fuad Ali Hasan Abu Alfayyah, and interpreted to the best of his/her ability in English.

I have been told about the nature of the research in terms of methodology, possible adverse effects, and complications (as per Participant Information Sheet).

After knowing and understanding all the possible advantages and disadvantages of this research, I voluntarily consent of my own free will to participate in the clinical research specified above.

I understand that I can withdraw from this research at any time without assigning any reason whatsoever.

**Date:** ……...……..….. **Signature:** ……..……

*(Participant)*

***IN THE PRESENCE OF:***

**Name:** ……..……

**Designation:** . ……..……..…… **Signature:** ……..……

(*Witness for Signature of Participant)*

I confirm that I have explained to the participant the nature and purpose of the above-mentioned research.

**Date:** ……. **Signature:** ……..……

*(Attending investigator)*

Appendix C: Study Questionnaire

## *Section 1: Demographic Information*

**Age:**

- ☐ Under 25
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 55 and above

**Gender:**

- ☐ Male
- ☐ Female

**Professional role:**

- ☐ Physician
- ☐ Nurse
- ☐ Pharmacist
- ☐ Anesthesia
- ☐ Specialist
- ☐ Resident
- ☐ Other

**Level of education:**

- ☐ Diploma
- ☐ Bachelor degree
- ☐ Master degree
- ☐ Doctorate/PhD

**Years of experience:**

- ☐ Less than 1 year
- ☐ 1-5 years
- ☐ 6-10 years
- ☐ 11-20 years
- ☐ More than 20 years

**Department (Working unit)**

- ☐ Coronary Care Unit or Intensive Care Unit (CCU/ICU)
- ☐ Step-down
- ☐ Medical-surgical
- ☐ Emergency room
- ☐ Other

## *Section 2: Awareness of Nebulized Furosemide Therapy*

**2.1** Have you ever heard of furosemide nebulizer therapy?

- ☐ Yes
- ☐ No

**2.2** If yes, where did you first learn about it?

- ☐ Healthcare provider
- ☐ Internet
- ☐ Friends/Family
- ☐ Medical literature
- ☐ Other (please specify): _____

## *Section 3: Knowledge of Nebulized Furosemide Therapy*

**3.1** What class of medication does furosemide belong to?

- ☐ Beta-blockers
- ☐ Diuretics
- ☐ Corticosteroids
- ☐ Antihistamines

**3.2** How is furosemide nebulizer therapy administered?

- ☐ Oral tablet
- ☐ Injection
- ☐ Inhalation via nebulizer
- ☐ Intravenous infusion

**3.3** What is the main action of furosemide when used in nebulizer therapy? (can choose more than one answer)

- ☐ Reduces inflammation
- ☐ It acts as a diuretic
- ☐ Relaxes airway muscles
- ☐ Reduce mucus production

**3.4** What is the mechanism of action of furosemide when used in a nebulizer for respiratory therapy?

- ☐ It inhibits sodium and chloride reabsorption in the kidneys
- ☐ It reduces pulmonary capillary pressure and fluid buildup in the lungs, alongside calcium influx to smooth muscle cells
- ☐ It blocks histamine receptors
- ☐ It stimulates beta-2 adrenergic receptors

**3.5** How does the onset of action of nebulized furosemide therapy compare to oral administration?

- ☐ Faster
- ☐ Slower
- ☐ The same
- ☐ Not sure

**3.6** Which patients might benefit the most from nebulized furosemide therapy? (can choose more than one answer)

- ☐ Patients with heart failure
- ☐ Patients with asthma
- ☐ Patients with COPD
- ☐ Patients with pulmonary edema

**3.7** How does nebulized furosemide therapy affect cough episodes in asthmatic patients?

- ☐ It increases cough episodes
- ☐ It has no significant impact on cough episodes
- ☐ It reduces cough episodes
- ☐ Its effects on cough episodes are inconclusive

**3.8** How does nebulized furosemide therapy affect dyspnea in COPD patients?

- ☐ It exacerbates dyspnea symptoms
- ☐ It has no significant impact on dyspnea
- ☐ It reduces dyspnea
- ☐ Its effects on dyspnea are inconclusive

**3.9** What is the typical dosage for nebulized furosemide therapy in respiratory conditions?

- ☐ 20 mg per dose
- ☐ 40 mg per dose
- ☐ 60 mg per dose
- ☐ 120 mg per dose
- ☐ Dosage varies based on the patient's weight and the severity of the condition

**3.10** What is the duration of action for nebulized furosemide?

- ☐ 30 minutes or less
- ☐ 1 hour
- ☐ 2 hours
- ☐ 3 hours
- ☐ duration of action varies based on the patient's characteristics and the severity of the condition

**3.11** What should be monitored during nebulized furosemide therapy?

- ☐ Blood pressure
- ☐ Blood glucose levels
- ☐ Electrolyte levels
- ☐ All of the above

**3.12** Which of the following is a contraindication for nebulized furosemide therapy? (can choose more than one answer)

- ☐ Diabetes Insipidus

- ☐ Acute kidney Injury (anuria)
- ☐ Hypertension
- ☐ Chronic sinusitis
- ☐ Not sure

**3.13** Is nebulized furosemide therapy suitable for pediatric patients?

- ☐ Yes, with proper dosage adjustment
- ☐ No, it is not recommended
- ☐ Only for children above 12 years
- ☐ Not sure

**3.14** What are the primary signs that nebulized furosemide therapy is working effectively?

- ☐ Reduced shortness of breath
- ☐ Increased urine output
- ☐ Improved blood pressure control
- ☐ All of the above

## *Section 4: Attitudes and Perceptions Toward Nebulized Furosemide Therapy*

Please indicate your level of agreement with the following statements regarding furosemide nebulizer therapy:

**4.1** I believe furosemide nebulizer therapy is an effective treatment for respiratory conditions.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.2** I am confident in my understanding of how nebulized furosemide works.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.3** I believe that furosemide nebulizer therapy has minimal side effects.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.4** I feel well-informed about the administration of nebulized furosemide.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.5** I think furosemide nebulizer therapy should be more widely available.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.6** I am concerned about the potential long-term effects of using furosemide nebulizer therapy.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.7** I believe that healthcare providers should receive more training on furosemide nebulizer therapy.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.8** I feel that furosemide nebulizer therapy is a safe treatment option.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral

- ☐ Agree
- ☐ Strongly agree

**4.9** The benefits of furosemide nebulizer therapy outweigh its risks.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.10** I feel that there is sufficient research supporting the efficacy of furosemide nebulizer therapy.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.11** I think that furosemide nebulizer therapy is easy to administer.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.12** I feel that the information available about furosemide nebulizer therapy is clear and easy to understand.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**4.13** I believe that healthcare providers should discuss furosemide nebulizer therapy as a treatment option with their patients.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

**معرفة, إدراك, و سلوك العاملين في مجال الرعاية الصحية تجاه العلاج بتبخيرة الفوروسيميد في الضفة الغربية, فلسطين. دراسة مقطعية**

**فؤاد علي حسن ابو الفيه**

**لجنة الإشراف: د. محمد جلاد**

**د. سمر جلاد**

**د. عماد ابو خضر**

## ملخص

مقدمة: تبحث هذه الدراسة في معرفة وإدراك وموقف العاملين في مجال الرعاية الصحية تجاه العلاج بالفوروسيميد المُبخّر في الضفة الغربية، فلسطين، كخيار جديد لعلاج أمراض الرئة المزمنة. وقد اقتُرح استخدام الفوروسيميد، المُدرّ للبول، كعامل علاجي لمرضى أمراض الرئة المزمنة، حيث يُقلّل من احتقان الرئة، ويُحسّن من تصفية المخاط الهدبي، ويُقلّل من وذمة مجرى الهواء لدى مرضى أمراض الرئة المزمنة. ورغم واعديته السريرية، إلا أن هذا العلاج قد يُعيق تطبيقه عمليًا من قِبل العاملين في مجال الرعاية الصحية.

المنهجية: استُخدم تصميم وصفي مقطعي، واعتمدت طريقة أخذ العينات الملائمة غير الاحتمالية لتجنيد 357 عاملًا في مجال الرعاية الصحية، بمن فيهم أطباء وممرضون وصيادلة ومهنيون من قطاعات سريرية أخرى من مواقع مختلفة في جميع أنحاء الضفة الغربية. وقد جُمعت البيانات باستخدام استبيان ذاتي الإبلاغ. تضمّن الاستبيان 14 سؤالاً من نوع الاختبارات لتقييم المعرفة، و13 فقرة/جملة لتقييم المواقف والانطباعات على مقياس ليكرت من خمس نقاط.

النتائج: أظهرت النتائج أنه من بين غالبية العاملين في مجال الرعاية الصحية (73.7%) الذين سمعوا عن الفوروسيميد المُبخّر، لم يُقيّمه ويُظهر معرفته العلاجية به تقييماً نقدياً إلا 36.4% منهم. بلغ متوسط درجة المعرفة 11.63 (من أصل 18)، وصُنّف 63.6% من المشاركين على أنهم غير ملمّين. عبّر

العاملون في مجال الرعاية الصحية عن آراء إيجابية من حيث المواقف، لكن معظمهم أفادوا بردود محايدة تُشير إلى ضرورة زيادة التعليم. أظهر المهنيون الأصغر سناً والعاملون في أدوار متخصصة فهماً أفضل من المهنيين الأكبر سناً والعاملين في أدوار متعددة.

الخلاصة: تعكس هذه الدراسة الدور الرئيسي لمستويات الوعي بين العاملين في مجال الرعاية الصحية في الضفة الغربية، وقد تُبرز الحاجة إلى تنفيذ برامج تدخل تثقيفية لمساعدتهم على فهم أهمية إعطاء الفوروسيميد عن طريق الرذاذ في إدارة مرضى الضائقة التنفسية بشكل أفضل، مع التركيز على تكامله مع الممارسة السريرية، مما قد يُحسّن من توقعات المرضى.

الكلمات المفتاحية: المعرفة، الإدراك، الموقف، الفوروسيميد المُبخّر، العلاج