Factors Influencing Intensive Care Nurses' Adherence To 'Prevention of Ventilator-Associated Pneumonia' Clinical Practice Guidelines in Saudi Arabia: A Mixed-Methods Study

Submitted by

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A thesis presented in fulfillment of the requirements

for the degree of Doctor of Philosophy

Adelaide Nursing School

Faculty of Health and Medical Sciences

The University of Adelaide

2023

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Abstract

Background: Patients who are critically ill and require mechanical ventilation in hospital intensive care units face a substantial health risk attributed to ventilator-associated pneumonia (VAP). Previous studies have shown that a significant portion of intensive care nurses in Saudi Arabia fail to comply with the VAP prevention guidelines. Within those guidelines, there are a number of strategies that fall within the specific remit of nurses, including oral hygiene, elevation of head of bed, and hand hygiene. There is a scarcity of research studies in the Saudi Arabian context that explore the factors influencing nurses' adherence to VAP prevention guidelines.

Aim: The study aimed to gain a deeper understanding of the factors that influence intensive care nurses' adherence to VAP prevention guidelines in the Saudi Arabian context.

Methods: A sequential explanatory mixed methods design was used to assess the problem in a comprehensive manner. The data collection occurred in two phases: initially, a quantitative phase was undertaken, which was subsequently followed by a qualitative phase. The quantitative data collection procedure involved an audit of current practice, using a combination of direct observation and medical record review using a non-participant approach, and a self-administered questionnaire. The data collected in the quantitative phase was analysed using SPSS statistical software (version 24) and the p-value <0.05 was regarded as statistically significant. The findings from the quantitative phase informed the subsequent qualitative phase to delve deeper into and comprehend the factors influencing ICU nurses' adherence to the VAP prevention guidelines. Qualitative data was collected through Zoom interviews and analysed through inductive content analysis approach. Integration of the data from both quantitative and qualitative phases was performed using following a thread and join display techniques to provide a deeper insight into the issue. Finally, the Integrated Promoting Action on Research

Implementation in Health Services (i-PARIHS) framework was used for assessing and discussing the integrated data, with an aim to form practical recommendations/solutions to the issue.

Results: A total of 62 visits were carried out across 8 intensive care units in two hospitals to audit three recommendations from the VAP prevention guidelines. The highest observed adherence score was for hand hygiene (76.1%), followed by oral hygiene (74.1%) and elevation of head of bed (55.9%). Survey data from 316 nurses were collected in the quantitative phase. Only 56.3% of the participants had an education level of a degree or above. Over 80% of the participants reported that they complied with the VAP prevention guidelines. However, there was a significant deviation from the nurses' self-reported adherence and observed adherence to the VAP prevention guidelines (Chi–square p values 0.005, < 0.001 and < 0.001 respectively, for the oral hygiene, elevation of head of bed and hand hygiene guidelines). Further, on sub-dimension scale regression analysis, it was identified that only 53.8% (n=170) had a positive attitude towards the VAP prevention guidelines. Over 70% of the respondents stated that shortage of time, availability of supplies, and/or patient condition hindered their adherence to the hand hygiene, oral hygiene and elevation of head of bed recommendations. The results of the regression analysis revealed that nursing experience significantly influenced self-reported adherence to VAP prevention guidelines. The associations varied: a negative correlation was observed for oral hygiene (OR =0.921, 95% CI: 0.883–0.961, p < 0.001) and head of bed elevation (OR = 0.899, 95% CI: 0.829–0.974, p = 0.011), while a positive correlation was found for hand hygiene (OR = 1.657, 95% CI: 1.357–2.023, p < 0.001). Analysis of the qualitative data supported the findings of the quantitative phase and revealed that both internal and external factors influence the intensive care nurses' adherence to the VAP prevention guidelines. Integration of the quantitative and qualitative results affirmed the role of influential

factors like nurses' knowledge scores, workload, availability of supplies, nurses experience and patient's condition.

Conclusion: The intensive care nurses' knowledge levels, excess workload, lack of supplies, lack of adequate experience in the intensive care settings were the main factors influencing the nurses' adherence to the VAP prevention guidelines. Subsequently, this study provides recommendations informed by the i-PARIHS framework to facilitate the implementation of VAP prevention guidelines in the Saudi Arabian healthcare system.

Keywords: Ventilator-associated pneumonia, VAP prevention guidelines, clinical practice guidelines, adherence or compliance or non-adherence or non-compliance, critical care or intensive care, and nurses or nursing staff.

Thesis declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint award of this degree.

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Nader Eqaab D Alotaibi

15 December 2022

Dedication

With sincere appreciation, this thesis is dedicated to the individuals who have played an indispensable role in shaping both my academic voyage and personal growth. As I embark on this new chapter, I extend my heartfelt gratitude to those who have provided unwavering guidance and support.

To my father, Eqaab, and my mother, Awatif, your unfaltering confidence in my abilities has been a driving force. Your dedication has left an indelible mark on my academic pursuits.

To my brother, Omar, and my sisters, Hadeel, Almaha, and Taraf, your continuous encouragement and shared wisdom have been instrumental in navigating the complex terrain of research and self-discovery.

To my partner, Sahar, your steadfast patience and belief in my aspirations have been a constant source of strength. Your presence has been a guiding light, leading me through the intricacies of academia. And to my beloved children, Najd and Fahad, while your understanding of this endeavour might be limited, it is for your future that I strive to achieve excellence.

While their names may not be inscribed on these pages, their impact is woven into the fabric of my journey. This dedication stands as a testament to their influence and support.

Acknowledgements

In the name of the Almighty Allah, the Most Gracious, the Most Merciful, I begin by expressing my deepest gratitude for the guidance, strength, and wisdom granted to me throughout this journey.

I extend my sincerest appreciation to my esteemed supervisory team at the University of Adelaide. Associate Professor Frank Donnelly, your mentorship and unwavering support have been invaluable in shaping my research. I am equally grateful to Associate Professor Philippa Rasmussen and Dr. David Foley for their guidance and insights. I would also like to acknowledge my previous committee members, Professor Gillian Harvey, Dr. Elizabeth Lynch, and Dr. Robert Laing, whose early contributions enriched the foundation of this thesis. I am grateful for the invaluable assistance provided by the professors who served as Higher Degree by Research coordinators throughout my PhD journey: Dr. Tim Schultz, Dr. Rick Wiechula, and Dr. Lynette Cusack. Their roles in supporting our study are greatly appreciated.

A heartfelt thank you goes to Ms. Suzanne Edwards, Data, Design and Statistics Services at The University of Adelaide, for her invaluable statistical guidance, and to Ms. Kate Leeson for her meticulous proofreading and editing, ensuring this thesis meets the highest standards. I want to express my profound gratitude to the friends and colleagues from Adelaide Nursing School and the University of Adelaide, whose consistent encouragement has been an indispensable pillar on my path. A special expression of gratitude is directed towards Omar AlQaladi, whose steadfast friendship and unwavering encouragement have been truly exceptional.

I extend my heartfelt gratitude to King Saud University for the remarkable scholarship that made this academic pursuit possible. Furthermore, I want to express my sincere appreciation to the College of Nursing, including its esteemed dean and dedicated staff, for

List of abbreviations

Acronyms	Explanation
CDC	Centers for Disease Control and Prevention
CLABSI	Central line–associated blood stream infection
CPG	Clinical practice guidelines
CPSI	Canadian Patient Safety Institute
EBP	Evidence-based practice
GCS	Glasgow Coma Scale
HH	Hand hygiene
HHA	Hand Hygiene Australia
HOB	Head of bed
ICA	Inductive content analysis
ICU	Intensive care unit
IHI	Institute for Healthcare Improvement
i-PARIHS	Integrated Promoting Action on Research Implementation in Health Services
KSA	Kingdom of Saudi Arabia
MOH	Ministry of Health
OH	Oral hygiene
PIS	Participant Information Sheet
PPE	Personal protective equipment
RT	Respiratory therapist
SARI	Strategy for the Control of Antimicrobial Resistance in Ireland
SHEA/IDSA	Society for Healthcare Epidemiology of America/Infectious Diseases Society of America
VAP	Ventilator-associated pneumonia
WHO	World Health Organisation

Chapter 1: Introduction

1.1 Background

The focus of this study was to gain an in-depth understanding of the current practices of critical care nurses regarding ventilator-associated pneumonia (VAP) prevention guidelines in the Kingdom of Saudi Arabia (KSA). This study has been undertaken within the context of adult critical care provision to explore the factors influencing current and prospective intensive care unit (ICUs) nurses' adherence to VAP prevention guidelines. Utilizing a mixed-methods approach that comprised a quantitative study followed by a qualitative study, study data were collected from adult ICU nurses via an audit of current practice (including two observation checklists and medical record review), a self-administered questionnaire and Zoom interviews in two tertiary care hospitals in the city of Riyadh. Since the use of evidence-based VAP prevention guidelines is not yet examined in practice in Saudi Arabia, investigating the factors that influence the successful implementation of VAP prevention guidelines can provide valuable insights into the complex interplay of factors that affect the adoption of evidence-based practice (EBP) in Saudi ICUs. This chapter introduces the study as well as describing and justifying the research problem, objectives, and the contribution of this study. The chapter concludes with a summary of the thesis structure.

1.2 Introduction to the study

Ventilator-associated pneumonia (VAP) is a serious acquired infection of intubated critically ill patients who require mechanical ventilation (Humayun et al. 2021; Lambert et al. 2013). A ventilator is a device that helps to move air in and out of the patient's lungs through an artificial airway such as an endotracheal tube. A significant risk of being ventilated through an artificial

airway is aspiration, the movement of pathogens into the lungs which can lead to VAP. Among ventilated patients, VAP is the leading cause of death (Jorens 2016; Munaco, Dumas & Edlund 2014). It has been shown that between 5 and 40% of ventilated ICU patients develop VAP, which is associated with longer hospital stays, higher mortality rates and increased staff workload; hence initiatives to improve practice are necessary (Al-Mugheed et al. 2022; Papazian, Klompas & Luyt 2020). Ventilated patients suffering from VAP are estimated to have mortality rates ranging from 20 to 50%, with rates reaching alarming levels as high as 94% in low- and middle-income countries (Kalil et al. 2016). Given the serious complications associated with VAP, preventing VAP within ICUs is considered an essential patient safety measure and a quality benchmark (Toulabi et al. 2020). Therefore, there is a pressing need for a quality enhancement intervention that promotes adherence to safety protocols and effectively reduces the incidence of VAP.

Aside from mortality, VAP results in increased patient dependence on mechanical ventilation, which increases treatment costs (Papazian, Klompas & Luyt 2020). Ventilated patients with VAP require longer hospital stays, which places a tremendous economic burden on hospitals, as well as on public and insurance companies (Eagye, Nicolau & Kuti 2009). VAP-related costs are estimated to be between US$9000 and US$40,000 per affected ventilated patient (Gianakis et al. 2015); while the yearly cost of VAP care approaches $2 billion in the United States (Terjesen, Kovaleva & Ehlers 2017; Zand et al. 2017). In Saudi Arabia, VAP is thought to increase hospital stays by up to 10 days, making it a significant concern for healthcare providers and insurance companies (Al-Tawfiq & Abed 2010). Clearly, VAP is a significant issue for healthcare settings worldwide. Therefore, given the significant risk to patient outcomes, in intensive care units especially understanding the importance of guidelines to reduce VAP complications is essential. Despite the alarming prevalence and costs of VAP, studies have shown that approximately 50% of cases may be preventable through the

implementation of preventive guidelines (Branch-Elliman, Wright & Howell 2015). By adhering to these guidelines, healthcare providers can significantly reduce the risk of VAP in ventilated patients and improve patient outcomes.

There is evidence that VAP can be prevented by good infection control methods and early weaning from ventilation, and for this purpose, several different clinical practice guidelines (CPGs) have been developed (Institute for Healthcare Improvement 2012; Klompas et al. 2022; Klompas et al. 2014; Magill et al. 2013; SARI Working Group 2011; Tablan et al. 2004; Canadian Patient Safety Institute 2012). Within the various guidelines are recommendations that fall within the specific remit of nurses, for example maintaining head of bed elevation to a recommended angle. Several studies however identify that nurses' adherence to the guidelines is variable and can differ across countries and even between hospitals (Aloush et al. 2018; Jansson et al. 2018; Jones 2016; Jordan et al. 2014). Despite the importance of clinical guidelines, limited information is available regarding nursing practices directed at the prevention of VAP in Saudi Arabia (Al-Tamimi, Refaat & Issa 2022).

In Saudi Arabia, CPGs were only introduced in 2015, so the body of knowledge around the implementation of CPGs is still being developed; Alkhenizan and Khoja (2011) called for the establishment of a Saudi centre for the distribution and monitoring of evidence-based clinical practice guidelines and recommendations. Despite the importance of preventing VAP, factors that influence adherence to VAP prevention guidelines have received little attention. It is critical to identify and explore these factors to inform future strategies for improving overall adherence by ICU nurses. However, due to the need for consistency, as well as the potential for confusion among study participants with evidence-based terminology, the term clinical **guidelines** was used throughout this thesis, even though the terms bundle, protocol, recommendations and guidelines were all interchangeable.

The primary objective of this study was to investigate the factors influencing nurses' adherence with VAP prevention guidelines in adult intensive care units within two Saudi Arabian tertiary care hospitals. A sequential explanatory mixed-methods design was chosen as the most suitable framework to fulfill the study's aims and objectives. This research encompassed both quantitative and qualitative methodologies, leveraging this combined design to yield a more comprehensive comprehension of the research phenomena, as opposed to the use of singular qualitative or quantitative methods alone (Creswell & Clark, 2018). The sequential explanatory design, particularly effective for studies originating from quantitative research methods, was selected to enhance the depth and scope of understanding the influences on nurses' adherence to VAP prevention guidelines (Al-Mugheed et al., 2022). The findings from both the quantitative and qualitative phases were integrated using following a thread and join display techniques, facilitating a more profound understanding of the study problem. Finally, the assessment and discussion of the integrated data were conducted using the Integrated Promoting Action on Research Implementation in Health Services (i-PARIHS) framework, with the intention of deriving practical recommendations and solutions to address the issue (Harvey & Kitson, 2016). Further details on the research design are provided in section 3.9. A brief overview of the study problem and the study context, including the healthcare system and nursing profession, is provided in this introductory chapter.

1.3 Kingdom of Saudi Arabia context

Saudi Arabia is the largest country in the Middle East at over 2.149 million square kilometres and is divided into 13 administrated emirates or states (General Authority for Statistics 2021) (Figure 1.1). KSA is considered to be a leading oil exporter and a high-income country, which has facilitated the development of the current healthcare system (Asmri et al. 2020). The capital city of the kingdom is Riyadh, where this study was conducted. The most recent population

census was conducted in mid-2021 by the Ministry of Economy and Planning, which estimated the Saudi population to be almost 34.1 million, comprising 56.8% males and 43.2% females (General Authority for Statistics 2021). The total number of nurses working in KSA is around 184,565, of whom 70,319 (38%) are Saudi nationals (Alluhidan et al. 2020). It is estimated that the Saudi population might reach 40 million by 2025 and around 55 million by 2050 (Asmri et al. 2020). Hence, Saudi Arabia aims to increase the attractiveness of nursing and medical support staff roles as preferred career paths as a performance indicator for its "Saudi Vision 2030", emphasizing that nursing is an important part of the interdisciplinary healthcare team (Al-Dossary 2018).

Figure 1.1. Emirates of Saudi Arabia Map (Source: World Atlas 2022)

Expatriates represent around one third, 8 million, of the Saudi population (General Authority for Statistics 2021). A high percentage of the Saudi population is between 15 and 30 years old, comprising 45% of the total population (General Authority for Statistics 2021). Saudi Arabia's economy has grown overall, but there is a shortage of available employment for Saudi citizens, particularly in the nursing profession. The country has witnessed an increase in

expatriate professionals in recent years, but this has not yet resulted in adequate job opportunities for Saudi citizens. Consequently, there is a need to address this disparity and explore strategies to promote career advancement and career opportunities within the nursing profession (Alatawi, Niessen & Khan 2020). The adverse image of nursing directly affects the supply of nurses in Saudi Arabia. This is because the profession is not seen as a desirable career choice for most young Saudi people. A study by Al-Dossary (2018) found that the negative image of nursing profession is one of the main reasons why people do not choose to become nurses. For example, among the 316 nurses who participated in this PhD study survey, only 16 were Saudi nationals. This highlights the importance of implementing and strengthening recruitment strategies specifically targeted to attracting Saudi nationals in the nursing profession. More specific literature describing the appeal of the Saudi nursing profession is discussed below in section 1.3.3.

Prior to 1929, people in Saudi Arabia depended on traditional and spiritual medicine for treatment. For this, they used herbs and even scripts from the Holy Quran to heal their wounds or treat severe health conditions (Khan & Khan 2000). Traditional medicine was practised by healers on some occasions, such as deliberately burning wounded areas of the patient's body to accelerate healing. This method as well as other traditional medicine practices are still used today and are actually highly respected in some areas of Saudi Arabia (Al Akeel et al. 2018; Qureshi, Khalil & Alsanad 2020). In 1925 the Saudi government sought to control this type of medicine by creating a public health department to meet Saudis' healthcare needs (Almalki, FitzGerald & Clark 2011). The discovery of oil in 1938 significantly enriched the Saudi government, exerting a profound influence on the country's culture and its people. As a result, significant advancements were made in various aspects, including the provision of free education, healthcare, and tax exemptions (Al-Hanawi, Khan & Al-Borie 2019). These initiatives contributed to a noteworthy enhancement in the standard of living for numerous

Saudi citizens, fostering a more cohesive and unified national identity. However, the country faced challenges due to the growing population and fiscal deficits as a result of low oil revenues in recent years (Rahman & Qattan 2021). The Saudi government has demonstrated its commitment to comprehensive reform through recent initiatives such as the Saudi Vision 2030 and the National Transformation Program 2020. A major objective of Vision 2030 is to revolutionize various sectors of the economy, including healthcare, by restructuring the sectors and encouraging collaboration between the public and private sectors (Al-Hanawi, Khan & Al-Borie 2019). Despite the allocation of government funds to the healthcare system in Saudi Arabia, there has been a lack of investment in the establishment of a national practice institute for the dissemination of clinical practice guidelines (Memish et al. 2022). Further details on these reforms are provided in the subsequent section.

1.3.1 Saudi healthcare system

The modern healthcare system in Saudi Arabia began in 1929 when King Abdulaziz established and fully funded a separate government department, which subsequently became the Ministry of Health (MOH), to provide free health care for the Saudi people according to the national Constitution article 31 (Alatawi, Niessen & Khan 2020; Almalki, FitzGerald & Clark 2011). The Saudi government has made enhancing health care a priority and has developed primary, secondary and tertiary healthcare services (Almalki, FitzGerald & Clark 2011). In 2018, SAR 147 billion (AU$1 = SAR 2.55) was allocated to medical and social development by the Saudi government, which constituted 15% of the total governmental budget (Al-Hanawi, Khan & Al-Borie 2019). A reflection of this is an increase in the total number of hospitals within the kingdom. Health services have been made available to every part of Saudi Arabia as a result of significant investment and development. However, there are still fundamental issues to be

resolved in adopting evidenced based practices, especially in the provision of nursing care to mechanically ventilated patients and the prevention of VAP in critical settings.

Improvements in the healthcare sector have continued in Saudi Arabia, resulting in a modern healthcare system with an estimated 504 hospitals across Saudi Arabia in 2020 (Ministry of Health 2022). Medical services in Saudi Arabia are provided by the MOH, other government departments, such as the military hospitals, and private hospitals. Approximately 60% of health services are provided by the MOH, while 23% are provided by the private sector and 17% are provided by other government departments (Alasiri & Mohammed 2022). Saudi Arabia has prioritized the development of healthcare services in the country at all levels, primary, secondary and tertiary (Alasiri & Mohammed 2022). Even with these advances, there are still a number of health challenges that require attention. The identified challenges, which include barriers related to infection control, have led to a rise in mortality and morbidity rates in the country despite the significant improvements in some aspects of the Saudi healthcare system (Assiri et al. 2014; Haridi, Al-Ammar & Al-Mansour 2016; Rabaan et al. 2017).

As in other countries, health laws, health policies and planning are controlled by the government. There are twenty regions in the Saudi Arabian health system; each region is administered by a general director reporting directly to the Minister for Health (Al Yousuf, Akerele & Al Mazrou, 2002), providing 45,330 beds, which is 58.66% of total hospital beds 77,224, followed by the private sector with 17,889 (23.16%) beds and other governmental sectors with 14,009 (18.4 %) beds (Ministry of Health 2022). In contrast to many high-income countries, Saudi Arabia's public investment in healthcare is notably high, accounting for over 71.3% of the entire government expenditure, whereas other high-income nations allocate 61.2% on average. (Alatawi, Niessen & Khan 2020). Further, the current ratio of beds per 1000 population in Saudi Arabia is 2.2. However, this rate is considerably lower than the world average of 3.33 beds per thousand people (Alatawi, Niessen & Khan 2020). With the growing

Saudi population, and the current bed ratio, there is a need for an additional 10,200 hospital beds by 2025 (Al-Hanawi, Khan & Al-Borie 2019). The Saudi healthcare system, despite high levels of government support, still struggles to provide excellent healthcare services to its rapidly growing population due to challenges such as infrastructure investment, shortage of healthcare professionals and increasing demand (Al-Hanawi, Khan & Al-Borie 2019). The Saudi healthcare system is undergoing significant reforms under the "Vision 2030" adopted in 2016, as discussed in the following section.

1.3.2 Saudi Vision 2030

Saudi Vision 2030 has influenced many sectors in Saudi Arabia, including the healthcare system. Saudi Vision 2030 is a national growth strategy and plan for economic development to further the country's goal of becoming a pioneering nation globally (Chowdhury, Mok & Leenen 2021; Council of Economic and Development Affairs 2022). To achieve this, the National Transformation Program was launched to restructure the Saudi healthcare system to make it comprehensive and effective. Further improvements are expected to take place to meet the Saudi Vision 2030 which aims to implement and follow the best evidence-based standards, offer high-quality healthcare services, strengthen strategies to prevent diseases, and improve the total value of healthcare services in the kingdom (Council of Economic and Development Affairs 2022). In response to this national vision, the health system is now faced with new challenges and opportunities to revise its strategic imperatives and direction for the future. Several challenges face the Saudi government in relation to healthcare reform, including financing, workforce readiness, and the shortage of skilled professionals. There is a need to increase the number of Saudi nationals employed in the healthcare field, as only one out of every three healthcare practitioners are a Saudi national. By 2030, doubling the rate of Saudization for health specialists may result in the creation of an estimated 400,000 jobs, as

well as 50,000 management and support positions (Al-Hanawi, Khan & Al-Borie 2019). However, within these new challenges, there is a constant issue when it comes to raising the standards of care for critically ill patients, as the number of Saudi ICU nurses is insufficient to meet the demand (Alqahtani et al. 2022).

1.3.3 Nursing profession in Saudi Arabia

Nursing is an essential health profession that provides care for individuals, families, groups and communities throughout their lifespan. In Saudi Arabia, as in many other countries, particularly Gulf countries, the nursing workforce is mainly staffed by international expatriate nurses, who account for almost 55% (107,608) of the total nursing workforce of 196,701 (MOH 2020). However, the country is still heavily reliant on foreign nurses in all healthcare settings (Alluhidan et al. 2020). As in many other countries, Saudi Arabia suffers from a nursing shortage, with only 5.5 nurses per 1,000 people (Ministry of Health 2022). Compared to other countries, Saudi Arabia has a low nurse-to-patient ratio, even though the number of Saudi nurses has steadily increased over time (Alsayed & West 2019). This reflects the poor image of the nursing profession and the low enrolment rate in nursing schools (Al-Dossary 2018).

The image of the nursing profession in Saudi Arabia is influenced by various factors, such as low salaries, extended working hours, and the societal perception that nursing is predominantly a female profession (Alluhidan et al. 2020). In response to this, Saudi Arabia strives to enhance the appeal of nursing and medical support staff roles, positioning them as preferred career paths aligned with the objectives of "Saudi Vision 2030." This initiative underscores the significance of nursing as an integral component of the interdisciplinary healthcare team (Al-Dossary, 2018). In addition, Saudi nurses are reluctant to accept difficult work schedules and duties, or uncomfortable work conditions, such as low social status, low pay and risk of infection (Albejaidi & Nair 2019; Alluhidan et al. 2020; Almutairi 2015).

Gender segregation is a fundamental part of the culture and religion in Saudi Arabia. These values provide further challenges to nursing as it is not culturally acceptable in Saudi Arabia for female nurses to provide direct care for male patients or share a workplace with male colleagues (Al-Ahmadi 2002; Gazzaz 2009). Equally important, female Saudi nurses prefer not to provide care for male patients (el-Gilany & Al-Wehady 2001). This may be a factor hindering the Saudization of the healthcare system, and increasing dependence on expatriates. Correspondingly, with nursing staff representing 40 countries with different languages and cultures, the professional identity of nursing and the service quality offered to Saudi patients may be at risk (Aboul-Enein 2002; Abu-Zinadah 2006; Al Harbi et al. 2021; Marrone 1999). Nowadays, the nursing sector is faced with challenges including a lack of Saudi nurses and a general shortage of health professionals in both private and government healthcare centres and hospitals.

1.3.4 Intensive care services in Saudi Arabia

Hospitals today provide intensive care services that are essential to providing high-quality patient care (Booker 2015), providing a dedicated area for the management of critically ill patients with adequate resources and staff ratios, as well as advanced medical equipment (Arabi, Schultz & Salluh 2017). As defined by Arabi & Al Shimemeri (2006), an intensive care unit is an area where patients need frequent attention, monitoring and intervention. The demand for intensive care is growing worldwide and more specifically in Saudi due to increased prevalence of serious chronic diseases, high inpatient acuity and advancements in medical technology (Al-Hanawi, Khan & Al-Borie 2019; Al-Omari, Abdelwahed & Alansari 2015). By 2050, Arabi, Schultz and Salluh (2017) predict an increase in the number of patients who will need critical care due to the growing and aging population worldwide, posing a great challenge to other health services, as it puts a strain on resources, infrastructure and staffing. Al-Omari,

Abdelwahed and Alansari (2015) indicate that, despite the significant transformations that intensive care services have undergone in Saudi Arabia in recent decades, research activity in critical care departments has been slow to develop. This presents a significant challenge in terms of understanding the unique needs and contexts of the population, as well as identifying and implementing effective interventions and best practices. Additionally, without a strong research base and a culture of practice improvement, it is difficult to determine the effectiveness of current practices, monitor progress and identify areas for improvement.

The government has stepped up its investment in the health sector via Saudi Vision 2030. The MOH has the responsibility for providing health services to all residents of the country through primary, secondary and tertiary hospitals, which provide critical care services at three different levels (Al-Omari, Abdelwahed & Alansari 2015). In addition, if a patient's situation requires a level of care that exceeds what is available at the primary care level, they will be referred to a tertiary care facility. Intensive care patients often are severely ill, requiring multiple therapies aimed at treating respiratory failure, multiorgan failure and/or circulatory failure (Woodrow 2018). It is true that technology has enabled easier monitoring and treatment of critically ill patients, but in some cases, it may also have caused a sense of dehumanization (Woodrow 2018). A one-to-one nursing approach is usually provided to patients receiving mechanical ventilation and multi-system support at tertiary care level three. The use of monitoring technology to help support the care of critically ill patients is a cornerstone of evidence-based practice in the field of health care (Booker 2015). However, the complexity of intensive care services and the demand for high levels of clinical competencies, particularly in managing ventilated patients, create challenges for nurses. Meeting these challenges is further compounded by the imperative to adhere to healthcare accreditation requirements and meet international standards of care.

There is no doubt that ICUs are one of the largest clinical cost centres in hospitals (Kaier et al. 2020). A significant portion of this cost is attributed to ventilated patients. A consideration of the cost of ventilated patient care is a crucial factor in providing high-quality care to patients. In Saudi Arabia, cost containment has become one of the most important "movements" of the healthcare sector in recent years (Rahman & Qattan 2021). Critically ill patients who require such advanced medical treatment in the past had to travel abroad, but now it is feasible to obtain such treatment locally. However, another factor affecting patient care is that, as a consequence of the recent Coronavirus disease 19 (COVID-19) pandemic across the globe, the healthcare system has become overburdened (Alrashed et al. 2020).

1.4 Research aims and objectives

The primary research objectives that prompted this PhD study, including the literature review in the following chapter, are informed by the researcher's experience as a clinician and an academic nursing lecturer within the Saudi adult critical care system. The resulting desire is to assist in the promotion of the effective use of evidence-based practice (EBP) in Saudi adult ICUs, aiming to improve the quality of critical care services and enhance nursing care for ventilated patients. A central aim of the research was to gain an understanding of how adult ICU nurses adhere to clinical guidelines and apply them in practice, with a focus on VAP prevention guidelines in two tertiary care hospitals located in Riyadh, Saudi Arabia. The study focused on specific non-pharmacologic interventions to prevent VAP including oral hygiene (OH), elevation of head of bed (HOB), and hand hygiene (HH). This led the researcher to develop four specific research objectives as follows:

1. To describe ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia with a focus on OH, elevation of HOB and HH interventions.

2. To describe the characteristics of the guideline users, guideline quality, and the contextual factors influencing ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia.

3. To explore ICUs nurses' beliefs and experiences of the factors that influence their adherence to VAP prevention guidelines in Saudi Arabia.

4. To generate recommendations that facilitate the implementation of VAP prevention guidelines in the Saudi Arabian health system.

1.5 Research questions

The following research questions were addressed with sub-questions used to focus the answers:

1. What are the factors that influence adherence to VAP prevention guidelines in Saudi Arabia?

    a. What is the current level of ICU nurses' adherence to best practice recommendations for VAP prevention CPGs in Saudi Arabia?

    b. What is the difference between observed adherence and self-reported adherence of ICU nurses toward VAP prevention CPGs in Saudi Arabia?

    c. What factors influence ICU nurses' adherence to VAP prevention CPGs in Saudi Arabia?

2. What are the beliefs of nurses working in ICUs about VAP prevention CPGs in Saudi Arabia?

1.6 Potential significance of this study

To the researcher's knowledge, this study is the first of its kind to provide a deeper exploration of the factors influencing ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia. Moreover, it represents the first observational study conducted in Saudi Arabian intensive care units to investigate the uptake and use of VAP prevention guidelines by nurses.

The findings from this study will contribute to the nursing discipline by building on the available knowledge base about nurses' implementation of VAP prevention guidelines, and evidence-based practice (EBP) in general, in this cultural context. This study may be useful for future nursing studies that examine the optimal intervention for utilizing EBP. This research study is significant for policy makers and administrators in Saudi Arabia because it provides a valuable roadmap for healthcare policy makers and administrators to follow.

1.7 Definition of key terms

Outlined below are definitions of selected terms used in this PhD study to explore how ICU nurses working in adult care settings adhere to VAP clinical practice guidelines and incorporate them into their everyday practices in two Saudi tertiary care hospitals. Several definitions exist for these terms and concepts that need clarification within the context of the thesis, thereby reducing confusion and misinterpretation, and allowing for a clearer understanding of the research. The following terms were used in this PhD study:

Evidence-based Practice (EBP): The term is also known by various terms, including evidence-based medicine, evidence-based treatment, and evidence-based therapy. EBP was defined by Sackett et al. (1996, p. 72) as "*the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patient*". In the nursing profession, EBP can be more effective when it considers the nurse's clinical expertise, the patient's preferences and values, and the evidence derived from current research (Melnyk et al., 2017).

Clinical Practice Guidelines (CPGs): Initially, the Institute of Medicine (IOM) (1990, p. 8) defined CPGs as "… *systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances*". However, the IOM and committee group later revised the definition in 2011 to emphasize the importance of

rigorous methodology in the development of guidelines. The updated definition states that *"Clinical Practice Guidelines are statements that include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options"* (p. 15).

***Intensive Care*:** Intensive care, also referred to as critical care, is characterized as a structured system staffed by specialized medical, nursing, and allied health staff, with the primary goal of delivering proactive resuscitative and supportive care to severely and critically ill patients (Marshall et al. 2017). Within the Saudi healthcare context, intensive care requires specialised postgraduate training and examination for nurses holding a bachelor's degree.

Intensive Care Unit (ICU): Marshall et al. (2017, p. 274) defined ICU as *"… an organized system for the provision of care to critically ill patients that provides intensive and specialized medical and nursing care, an enhanced capacity for monitoring, and multiple modalities of physiologic organ support to sustain life during a period of acute organ system insufficiency"*.

***Mechanical Ventilation*:** Mechanical ventilation, which serves as a life support measure, is a device that used to assist critically ill patients who are unable to breathe adequately on their own (Cleveland Clinic 2023). The mechanical ventilation device, also known as a ventilator, respirator, or breathing machine, takes over the breathing process (Cleveland Clinic 2023).

***Ventilator-Associated Pneumonia (VAP)*:** VAP is a specific type of hospital-acquired infection characterized by inflammation in the lungs, commonly developing within 48 hours after the initiation of artificial airway or mechanical ventilation. (Coelho et al. 2023).

***Ventilator-Associated Pneumonia Prevention Bundle*:** The VAP prevention bundle consists of a set of **summarized** guidelines recommendations that healthcare professionals, especially nurses, must follow to prevent VAP in critically ill patients on respiratory support for over 48

hours; however, it is essential to acknowledge that VAP care bundles can vary among different healthcare institutions.

Ventilator-Associated Pneumonia Prevention Guidelines: VAP prevention guidelines comprise detailed evidence-based interventions and recommendations formulated by expert groups to enhance patient care, reduce VAP occurrences in healthcare settings, and effectively mitigate the risk of VAP in patients on mechanical ventilation or with an artificial airway, leading to improved patient outcomes.

1.8 Structure of the thesis

The research aimed to examine the current practice of ICU nurses in Saudi Arabia regarding VAP prevention guidelines for ventilated patients, using a mixed-methods research design. The research process involved conducting the two study phases independently, in order to gather specific types of data that would be useful for assessing the factors that influence ICU nurses' adherence to VAP prevention guidelines. The first study phase I comprised a cross-sectional design and involved two study components: an audit of current practice (including two observation checklists and medical record review) and a self-administered questionnaire. The results from this phase helped the researcher to develop phase II, where qualitative methods (Zoom interviews) were used to further examine and understand factors influencing ICU nurses' adherence to the VAP prevention guidelines. The following is an outline of this thesis.

In this **first chapter**, the background, aims and significance have been introduced. Research questions that guided the study were identified and the context of the Saudi Arabian healthcare delivery system and nursing profession has been discussed.

Chapter 2 presents a comprehensive review of the current literature related to ICU nurses' adherence to VAP prevention guidelines within critical care services, with the objective of identifying the specific research gap that this thesis aims to address and bridge.

Chapter 3 presents the methodological background and the methodology adopted for the current study, specifically the mixed-methods approach, including a justification of the selected sequential explanatory mixed-methods design. It concludes by outlining the research site and settings.

Chapter 4 describes and justifies the methods used for data collection and data analysis. It includes a presentation of the quantitative and qualitative approaches used in the two studies.

Chapter 5 presents the results of the quantitative study involving an audit of current practices and a survey.

Chapter 6 presents the findings of the qualitative study comprising interviews with ICU nurses.

Chapter 7 presents an integration of the mixed-methods findings. It presents the major findings of the mixed-methods study.

Chapter 8 discusses of the overall study findings. It interprets and discusses the integrated results based on the study questions and its related literature. It considers the implications/limitations of the study's findings. It provides recommendations in regard to intensive care nurses' adherence to clinical practice guidelines in Saudi Arabia.

1.9 Chapter summary

This introductory chapter introduced the research phenomenon and presented a brief background about the study context, the Saudi healthcare system. This chapter included a contextual information and the state of the Saudi nursing workforce and intensive care services. Contextual information pertaining to Saudi Arabia played a critical role in familiarizing myself as a researcher with the work environment of this study participants. It provided valuable insight into relevant issues that needed to be considered during the design of this research study.

Additionally, the study aims and objectives with terms definitions were presented, along with the potential significance of this study and structure of the thesis. The following chapter presents the comprehensive literature review related to ICU nurses' adherence to VAP prevention guidelines.

Chapter 2: Literature review

The previous chapter has provided an overview of the use of ventilator-associated pneumonia (VAP) prevention guidelines in Saudi Arabia. This perspective was examined by reviewing existing literature to identify areas where further research is needed. This chapter reviews the current literature related to ICU nurses' adherence to VAP prevention guidelines within critical care services. This literature review critically evaluates studies conducted worldwide on VAP prevention guidelines to identify factors that influence nurses' adherence. This review examines the origin and practice of evidence-based practice, and how Saudi healthcare providers differ from other countries. The review then examines relevant literature on the effect of VAP prevention guidelines as well as ICU nurses' adherence to those guidelines.

2.1 Search strategy

A comprehensive literature review was employed after a consultation with an expert librarian to find literature relevant to this study using five electronic databases: (1) CINAHL, (2) PubMed, (3) Cochrane, (4) Scopus, and (5) Google Scholar. A logic grid search strategy was created based on the 'Population/Patient, Intervention, Comparison, Outcome and Time (PICO-T)' format, to enhance the effectiveness of the literature search (Aromataris & Riitano 2014; Eriksen & Frandsen 2018; Riva et al. 2012) (Table 2.1). The following keywords were used for the literature search: ventilator associated pneumonia, VAP prevention guidelines, adherence or compliance or non-adherence or non-compliance, hand hygiene, oral hygiene, elevating or elevation the head of bed, critical care or intensive care, and nurses or nursing staff or nurse. Search strings implemented the Boolean operators "AND", "OR" and "NOT" strategy (example: "Ventilator-Associated Pneumonia" OR "VAP" AND "Critical Care Nurse" OR "intensive Care Nurses" AND "clinical practice guideline" OR "VAP guideline" OR "VAP

prevention guidelines" NOT "VAP prevention Bundle"). The key terms in the column were combined using "AND," while the terms in the rows of the table were combined using "OR" and "NOT" operators (Table 2.1). The use of Boolean operators allows researcher to broaden or narrow the literature search and to obtain the most relevant data (Polit & Beck 2012). To provide an up-to-date review on the adherence of ICU nurses to VAP prevention guidelines, articles published from 2003 to the current year were included with the exception of landmark and seminal research. The chosen timeframe allowed the researcher to examine the developments and more recent trends in the field of VAP prevention guidelines and specifically ICU nurses' adherence to the clinical practice guidelines. This literature search was limited to articles published in English and Arabi and was formed throughout the study from 2019 to February 2023.

The literature review was conducted in two stages: first, a literature search was conducted to identify and review research works on healthcare evidence-based practices. During this step, an overview of the EBPs, standard practices for preventing VAP, and factors influencing the efficacy of VAP prevention guidelines were identified. The common barriers to and facilitators of the efficacious implementation of VAP prevention guidelines were also assessed. In the second stage, a comprehensive search was done to identify the literature related to VAP prevention, with a special emphasis on the Kingdom of Saudi Arabia, which forms the context of this study. This literature search aimed to assess the relationship between VAP, ICU nurses' role in preventing VAP and the factors associated with it, with a special emphasis on the Saudi Arabian context. By doing so, the researcher attempted to understand the gaps in the present knowledge of VAP prevention in the Saudi Arabian context.

Table 2.1 Logic grid for literature search in "PICO-T" format

Population	Intervention	Comparison	Outcomes	Timeline
ICU nurses	VAP prevention guidelines	Alternative measures for maintaining hygiene and preventing VAP	Adherence to VAP prevention guidelines	Literature published from 2003 to February 2023
	Hand hygiene (HH)		Barriers to adherence	
	Oral hygiene (OH)		Facilitators of adherence	
	Elevation of head of bed (HOB)			
	VAP education		VAP prevention	
	Evidence based practice			

2.2 The concept of evidence-based practice

Evidence-based practice (EBP) was defined by Sackett et al. (1996, p. 71) as "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patient". This definition emphasizes the importance of evidence, while also emphasizing other factors, such as patient preferences and the context in which care

is provided. The concept of EBP emerged with increased recognition that research evidence was not routinely used in practice and patients were not getting the most effective care. There are significant challenges to implementing research evidence in clinical practice; it has been estimated that 40% of patients may be treated without following the best available evidence and 20% of patients may be treated with a procedure that does more harm than good (Grol 2001; Grol & Grimshaw 2003; Sheldon et al. 2004).

Since EBP makes use of the best evidence from research to guide clinical decision-making (Melnyk et al. 2017), the application of problem-solving techniques and incorporation of the most current healthcare literature is possible. The application of EBP considers the patient's clinical experience, preferences, and values in the provision of treatment. When EBP is implemented in daily practice, job satisfaction and autonomy are increased due to a higher level of professional competence (Boaz et al. 2015; Melnyk & Fineout-Overhold 2022). The implementation of EBP has been demonstrated to improve the delivery of health care, enhance medical outcomes and decrease healthcare costs (Jolley 2020; Woo, Lee & Tam 2017). The incorporation of EBP in daily practices decreases employee burnout (Melnyk et al. 2010). Although EBP has been emphasized for decades, yet it is not considered as the standard of care in Saudi healthcare systems (Alqahtani et al. 2022).

2.3 Evidence-based health care in Saudi Arabia

Despite the Ministry of Health's (MOH) emphasis on using research as a guide to practice, evidence-based practice is not consistently implemented in Saudi healthcare facilities (Alshehri et al. 2018). A previous study conducted by Bahammam & Linjawi (2014) in the Saudi Arabian context revealed satisfactory attitude and knowledge scores of Saudi Arabian nurses with regards to EBP; however, a gap between knowledge and **practice** was noted in Saudi healthcare due to limited time and resources (Alshehri et al. 2018). The main barrier to evidence-based

practice in Saudi Arabia are nurses' perceptions. Alshehri et al. (2018) suggest nurses are incapable of evaluating the research quality, do not any benefit and do not have a documented mandate to change practice. A key factor in ensuring the delivery of high-quality health care in Saudi healthcare is addressing these barriers and closing the knowledge–practice gap (Al-Sayaghi 2021).

Taking an EBP approach means gaining the tools to be change agents when advocating for a better medical outcome using the current evidence. Nurses who use EBP are the connection between healthcare research and clinical experiences (Melnyk & Fineout-Overhold 2022). Nurses can standardize medical care, reducing errors and fostering positive change for patients. There is a consensus among medical researchers that the implementation of EBP provides healthcare providers with the opportunity to take a more active role in shaping patient care in collaboration with other clinicians and medical care experts (Kim, Mallory & Valerio 2020). Despite its established status in nursing literature, there has been a slow adoption of EBP in nursing practice in Saudi Arabia and therefore Saudi hospitals have been slow to implement nursing practices based on evidence (AbuRuz 2018; Mutair 2015).

2.3.1 Clinical practice guidelines as tools for EBP

Clinical practice guidelines (CPGs) use published literature to develop a practical set of clinical recommendations, which can be used as EBP in healthcare settings (Beauchemin, Cohn & Shelton 2019). CPGs are defined as "systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances" (Lohr & Field 1992, p. 2). According to Kinsman et al. (2010), CPGs must satisfy five criteria: (a) have a structured multidisciplinary care plan; (b) translate guidelines or evidence into local structures; (c) provide detailed treatment plans, pathways, algorithms, guidelines, protocols or other "inventory of actions" which indicate how treatment will proceed; (d) include timeframes

or criteria-based progression; and (e) they should aim to standardize care for specific clinical problems, procedures or episodes of health care for specific populations. Thus, the main purpose of CPGs is to improve the quality, effectiveness and efficiency of patient care, thereby improving patient outcomes (Chong, Schultz & Donnelly 2019). Yet, despite the prevalence and availability of CPGs, evidence-to-practice gaps still exist, and the uptake of CPGs remains relatively low worldwide (Fischer et al. 2016; Stokes et al. 2016).

Challenges to CPG implementation include clinician- skills, knowledge and attitude (Cabana et al. 2001); external factors such as availability of resources for implementation, cultural values and workload; and factors related to the guidelines themselves such as the perceived trustworthiness of the CPG developers, and anticipated patient benefit from CPG use (Baiardini et al. 2009; Cabana et al. 2001; Fischer et al. 2016; Powell-Cope et al. 2004; Ricart et al. 2003). When looking at nurses' use of CPGs, administrative and organisational support is necessary for implementation (Rycroft-Malone et al. 2004), along with a change-supportive environment. Research on CPG uptake shows that local and broader contextual issues must be considered to foster implementation and adherence to CPGs (Fischer et al. 2016; Kredo et al. 2016). Al-Sayaghi (2021) notes that nurses' adherence to guidelines is influenced by factors that vary between countries and institutions.

Some scholars have proposed that the implementation of CPGs is a rational, linear, stepwise process (Melnyk & Fineout-Overholt 2011; Newhouse et al. 2007; Rosswurm & Larrabee 1999; Stevens 2004; Titler et al. 2001). Other researchers refute this view and, with more research being conducted on the implementation of CPGs, there is a growing argument that the real-world implementation of CPGs is a complex, unpredictable and multidimensional process, often involving interactions between organisations, teams, individuals and policy makers (Harvey & Kitson 2015; Kitson, Harvey & McCormack 1998). Theoretical approaches have accordingly been developed that represent this complex change process within the health

system, taking into consideration that successful implementation into practice is a multidimensional and challenging process (Cane, O'Connor & Michie 2012; Damschroder et al. 2009; Harvey & Kitson 2015). Therefore, successful implementation and adherence to CPGs can be achieved when the complexity of the healthcare system, which includes guidelines, individuals and organisational factors, is considered.

2.3.2 The use of EBP by nurses in Saudi Arabia

Evidence-based practice utilizes clinical expertise and recent research evidence along with a patient's values to make informed and personalized decisions about the best treatment options (Kim, Mallory & Valerio 2020). The use of EBP practice is beneficial to nurses and the nursing profession in general as it supports nurses to build their own knowledge and close the gap between theoretical education and practice (Jolley 2020). EBP can directly improve treatment outcomes and healthcare service quality as well as decreasing the cost of medical services (Emparanza 2015). Nursing in Saudi Arabia has shifted from dependence on nurses with basic nursing skills to employment of highly qualified clinically experienced nurses (Alshehry et al. 2019). The obligation to provide advanced healthcare services was one of the factors that drove the Saudi government to launch Saudi Vision 2030, which requires EBP implementation (Memish et al. 2022). As some aspects of "traditional" nursing may not be evidence based, more efforts are needed to support nurses to start implementing EBP in order to improve patient safety (Gifford, Lefebre & Davies 2014). Many government hospitals in KSA have started to implement EBP; however, the process is slow and many stakeholders of the implementation reported a lack of essential knowledge, skills and confidence (Alqahtani et al. 2020). The inadequacy of facilities, lack of cooperation with the implementation from physicians, and in some cases, the results of the studies not being generalizable to Saudi nurses' settings are barriers to the implementation of EBP (Alqahtani et al. 2022).

Such challenges imply that EBP implementation has not been addressed adequately. The literature shows a high correlation between nurses' experience and knowledge with the use of EBP (Olfat, Alamrani & Albloushi 2009). Accordingly, nurses who are knowledgeable about EBP and who hold realistic expectations about its potential value are likely to be successful in the implementation of EBP. A study by Olfat, Alamrani and Albloushi (2009) found that Saudi nurses working in accredited hospitals demonstrated high levels of knowledge and skill. However, the study also noted that differences in organisational culture can lead to variations in nurses' attitudes. Additionally, the study found a correlation between nurses' knowledge, attitudes and practice. The authors noted that nurses who have more experience are likely to implement EBP guidelines effectively and integrate them into practice in the healthcare setting. Following the same notion, it was found that the inability to evaluate research quality, a lack of awareness of recent research, an absence of self-benefit and a lack of official need to change practice are the highest scoring barriers to EBP (Gray & Grove 2018). A significant positive statistical correlation was found between nursing practice, knowledge and attitude towards EBP among Saudi nurses (Olfat, Alamrani & Albloushi 2009). This study found that Saudi nurses working in accredited hospitals scored highly on knowledge and skill, yet nurses might have different attitudes due to differences in organisational culture; the same study also supported a correlation between knowledge, attitude and practice (Olfat, Alamrani & Albloushi 2009). The study indicates that the highest scoring barriers to EBP are the inability to evaluate research quality, the lack of awareness of recent research, the absence of self-benefit, as well as the lack of an official necessity to change practice.

Understanding the relationship between the use of EBP by nurses and the provision of care for ventilated patients is of paramount importance in optimizing patient outcomes and advancing healthcare practices. Building upon this understanding, the following section will delve deeper into the current state of care for patients undergoing mechanical ventilation,

exploring key aspects such as the pathophysiology of ventilator-associated pneumonia, the incidence of ventilator-associated pneumonia, and the guidelines for VAP prevention.

2.4 Care for mechanically ventilated patients

Nursing care in critical care services requires proper understanding of advanced care techniques and processes, and is directly related to patient safety and healthcare service quality (Farokhzadian, Dehghan Nayeri & Borhani 2018). Mechanical ventilation is frequently required for patients suffering a critical illness or recovering from major surgery or trauma. Mechanical ventilation is seen to be life saving for around 71% of patients with a recognised critical condition (Stites 2013); however, mechanically ventilated patients require effective management by medical and nursing staff to reduce the risk of developing healthcare-associated infections (HAIs) (Grap, Blecha & Munro 2002). The incidence of healthcare-associated infections in ICUs is a serious health care safety concern (Al-Sayaghi 2021). There are consequently a high number of these infections occurring in ICUs, with the rate exceeding 30% of all admissions to ICUs (Humayun et al. 2021). VAP is the most common type of healthcare-associated infection that typically develops within 48 to 72 hours following the initiation of intubation and mechanical ventilation (Abu-Thuraya et al. 2022; Papazian, Klompas & Luyt 2020). Given that longer stays in ICUs are directly related to the chance of ventilated patients developing VAP (Papazian, Klompas & Luyt 2020), healthcare providers must prioritize proper ventilation techniques and infection control to minimize complications and improve patient outcomes. Poor ventilation management can lead to serious pulmonary and extrapulmonary difficulties.

For ventilated patients in ICUs who develop VAP, the crude mortality is reported to be 24% to 76%, a risk of death that is 2- to 10-times greater compared with patients without pneumonia (Eagye, Nicolau & Kuti 2009). Usage of different definitions, microbial sampling

methods, and the diagnostic limitations of some of the definitions are the primary reason for these large variations in reported VAP incidence (Ego, Preiser & Vincent 2015; Papazian, Klompas & Luyt 2020). The risk of developing VAP can be reduced by implementing best nursing practices and VAP prevention guidelines (Ferrazzano 2014). In USA, a study to identify the correlation between knowledge levels of staff nurses and implementing best practice, Bird et al. (2010) reported that implementation of the VAP bundle led to a significant decrease in VAP incidence (from 10.2 to 3.4 cases/1000 ventilator days), with compliance rising from 53% and 63% to 91% and 81% in respective SICUs, resulting in an estimated cost savings of $1.08 million. In Finland, (Jansson et al. 2018) conducted a cross-sectional survey within a 26-bed adult ICU involving 86 nurses. The study revealed that heightened awareness of VAP prevention guidelines among nurses was associated with a reduction in VAP risks. Furthermore, VAP rates were significantly decreased with educational interventions and there were even higher rates of success when a respiratory therapist was included (Kandee 2012). Rosenthal et al. (2012) found that nurses with less than one year of experience have less knowledge of VAP prevention guidelines than more experienced nurses. The study also showed that nurses, in general, have a low level of awareness regarding VAP prevention guidelines. By addressing these knowledge gaps and improving nurses' awareness of and adherence to VAP prevention guidelines, healthcare institutions can reduce the incidence of VAP and improve patient outcomes.

2.5 Pathophysiology of ventilator-associated pneumonia

Critically ill patients generally develop pneumonia because of aspiration of nasal, oropharyngeal and/or gastric microorganisms (Kollef, Marin H et al. 2014). Impaired host defences can facilitate these microorganisms to invade the lower respiratory system and lung tissues. The risk is even higher after the onset of respiratory conditions like the Coronavirus

disease 19 (COVID-19) pandemic (Boyd et al. 2022). Development of VAP is usually caused by the entrance of virulent organisms to the lower respiratory airway followed by an overcoming of the host immune response including damage to the mucus and ciliated epithelium. The bacteria then adhere to epithelial cells, starting colonization (Kalanuria, Zai & Mirski 2014; Xie et al. 2018). VAP-causing organisms include Acinetobacter species and aerobic gram-negative bacilli such as *Staphylococcus aureus* and *Pseudomonas aeruginosa* (Koulenti, D., Tsigou, E. & Rello, J. 2017). Aspiration from the gastrointestinal tract also plays a role in the onset of VAP as it can be a source of tracheal pathogens; this type of VAP is usually caused by methicillin-resistant *Staphylococcus Aureus* (MRSA) and occurs after a patient has spent at least 4 days on mechanical ventilation (Hunter 2012).

In mechanically ventilated patients, the existence of endotracheal and tracheostomy tubes bypass the primary innate defence mechanisms, such as mucociliary clearance, causing an unnatural passage between the trachea and the upper respiratory system (Rouzé et al. 2017). Because contaminated secretions accumulate around the tube cuff, they serve as ideal breeding grounds for harmful bacteria (Jaillette et al. 2015). Therefore, to prevent VAP in ventilated patients, it is necessary to carefully manage the endotracheal tube and monitor the patient's respiratory status on a regular basis (Rouzé et al. 2017). Implementing appropriate prevention measures and adhering to VAP prevention guidelines can assist healthcare professionals to reduce the incidence of VAP and improve patient outcomes (Branch-Elliman, Wright & Howell 2015; Papazian, Klompas & Luyt 2020).

2.6 Incidence of ventilator-associated pneumonia

VAP is the most common infection among ICU patients, and it is estimated that VAP affects 0.8%–7.5% of the patients who spend more than 24 hours in the ICU (Kollef, M. H. et al. 2008; Kollef, Marin H et al. 2014; Xie et al. 2018). Due to the use of VAP clinical

guidelines, the VAP rate in ICU patients in the United States decreased from 4.9 to 1.4 per 1000 ventilator-dependent days between 2002 and 2009, (Dudeck, M. A. et al. 2011; National Nosocomial Infections Surveillance 2004). Importantly, the incidence of VAP fluctuates widely depending on type of patient, duration of mechanical ventilation, comorbidities and preventive measures (Papazian, Klompas & Luyt 2020). These large variations in VAP incidence can be partly explained by differences in definitions, limitations in diagnostic criteria, and varying usage of microbiological sampling methods. In 2008, Arabi and colleagues conducted a study to estimate VAP prevalence in low- and middle-income countries and found VAP incidence ranged from 10 to 41.7 infections per 1000 ventilator days (Arabi et al. 2008). This VAP incidence is higher than the 1.2 to 8.5 infections per 1000 ventilator days reported in the United States by (Skrupky et al. 2012). It is important to point out that the latter study used the American College of Chest Physicians and National Healthcare Safety Network criteria to detect or diagnose the incidence of VAP. This surveillance criteria was developed in order to enhance the reliability of surveillance data for the improvement of patient safety. However, research has demonstrated that they are insensitive to VAP cases, leading to underestimation of rates and poor agreement between clinical criteria and diagnostic criteria (Gunalan et al. 2021).

The incidence of VAP can vary significantly depending on the diagnostic criteria used. Papazian, Klompas and Luyt (2020), reported VAP incidence ranges from 5 to 40%. Furthermore, there are large variations in VAP rates reported across countries and ICU types. For example, some studies have reported very low VAP rates in North American hospitals, with only 1 to 2.5 cases per 1000 ventilator days (Dudeck, Margaret A et al. 2015). However, other developed countries in the European Union have reported much higher VAP rates, at 18.3 VAP cases per 1000 ventilator days (Koulenti, D, Tsigou, E & Rello, J 2017). Similarly, hospitals in the USA and many other countries have reported a similar VAP incidence of 18.5

cases per 1000 ventilator days (Bonell et al. 2019; Xie et al. 2018). Additionally, variations in mortality rates from VAP can be observed, ranging from 10% to 50% (Xie et al. 2018).

These variations are evident in the Saudi Arabian context as well. For instance, a retrospective cohort study conducted by Gaid et al. (2018) in Saudi Arabia, based on data from 12 referral hospitals in different cities from 2013 to 2016, reported VAP rates varying from 0.9 to 51.6 episodes per 1,000 ventilator days. These results highlight the need for a universally acceptable definition and identification criteria for VAP. Currently, six published sets of criteria are used in different parts of the world, creating significant variations in the diagnosis and reported incidence of VAP within the same population (Ego, Preiser & Vincent 2015; Gunasekera & Gratrix 2016; Modi & Kovacs 2020). VAP prevalence serves as an indicator of healthcare quality and patient safety in Saudi Arabia, and prevention of VAP remains a top priority as the incidence remains high (Al-Sayaghi 2021). Therefore, proper implementation of effective prevention measures is essential to reduce the consequences of high VAP rates in Saudi Arabia and ensure high-quality critical care and improved ventilated patient treatment outcomes.

2.7 VAP prevention guidelines

Implementing CPGs to inform the prevention of VAP will help to decrease the incidence of VAP in Saudi Arabia (Berenholtz et al. 2011). Several VAP prevention CPGs have been developed by organisations such as the Centers for Disease Control and Prevention (CDC) (Tablan et al. 2004), Society for Healthcare Epidemiology of America/Infectious Diseases Society of America (SHEA/IDSA) (Klompas et al. 2022; Klompas et al. 2014), the Canadian Patient Safety Institute (CPSI) (The Canadian Patient Safety Institute 2012), the Strategy for the Control of Antimicrobial Resistance in Ireland (SARI) (SARI Working Group 2011), and the Institute for Healthcare Improvement (IHI) (Institute for Healthcare Improvement 2012).

Generally, VAP prevention guidelines aim to decrease bacterial colonization in the patients' lower respiratory and gastrointestinal tract and prevent contamination of respiratory tubes and other respiratory equipment. Within the CPGs there are several prevention recommendations that fall within the specific remit of nurses. These are as follows: elevation of the head of bed (HOB) to between 30° and 45° to prevent aspiration; hand hygiene (HH) before and after patient contact to prevent infection; and oral hygiene (OH) with 0.12% oral chlorhexidine solution to prevent colonization of the aero-digestive tract. These recommendations are safe, practicable and low cost (Kiyoshi-Teo et al. 2014; Tolentino-DelosReyes, Ruppert & Shiao 2007). Table 2.2 summarizes the recommendations in the best-known VAP prevention guidelines.

Among these five agencies, the CDC is regarded as the most authoritative and, consequently, the VAP prevention guidelines set by the CDC are the most widely accepted (Mastrogianni et al. 2023). The CDC was the first agency to publish guidelines for preventing nosocomial pneumonia in 1983, which were further specialized to form the VAP prevention guidelines in 2003 (Munro & Ruggiero 2014). The 2003 guidelines were further refined by the CDC and their supporting groups, which resulted in the formulation of new recommended criteria for adult ICU patients in 2013 (Magill et al. 2013), and for paediatric/neonatal ventilator-associated events in 2017 (Mourani & Sontag 2017).

2.7.1 Quality of VAP prevention guidelines

Guidelines for the prevention of VAP are established upon available scientific evidence and economic and theoretical rationales (Al-Tawfiq & Abed 2010). A systematic review conducted by Wan et al. (2019) aimed to evaluate the quality of evidence-based guidelines for the prevention and management of VAP in both adults and children. Wan et al. (2019) review included guidelines published from the inception, up to mid-2018 and identified thirteen unique

guidelines for VAP prevention, published between 2004 and 2018. Most of the identified guidelines were from Canada (four), followed by the United States and China (two each). Other countries that developed guidelines included Japan, South Africa, India, the United Kingdom, and one guideline resulted from a collaborative effort involving Europe and Latin America. Of these guidelines, only three were focused solely on the prevention of VAP, while three focused on treatment, and the remaining guidelines addressed both prevention and treatment The quality of the guidelines was determined to be moderate by Wan et al. (Wan et al. 2019). The management of VAP showed variation among the identified guidelines. However, there is a need for further high-quality evidence to enhance the recommendations provided in the guidelines. As such, institution-based guidelines should be developed to guarantee their applicability and relevancy in various hospital settings. Local and outer health regulations are also crucial in developing and implementing VAP prevention guidelines (Harvey & Kitson 2016). This highlights an area of potential development for VAP prevention guidelines in the context of Saudi Arabia, where no specific local guidelines for VAP prevention have been established.

2.7.2 VAP prevention recommendations

VAP is a common complication of mechanical ventilation (Mastrogianni et al. 2023). There have been many studies on VAP and strategies to prevent it (Kollef, Marin H et al. 2014; Ladbrook et al. 2021; Papazian, Klompas & Luyt 2020; Xie et al. 2018). Although the pathogenesis and epidemiology of VAP are well studied, the incidence remains considerably high in many countries including Saudi Arabia (Al-Sayaghi 2021). This points towards the need for proper implementation of VAP-prevention guidelines in the Saudi context. Among the VAP prevention recommendations described in Table 2.2, oral hygiene with 0.12% chlorhexidine solution, head of bed elevation between 30° to 45°, and hand hygiene are the

most recommended practices by the organisations concerned with the prevention of VAP (Institute for Healthcare Improvement 2012; Klompas et al. 2022; Klompas et al. 2014; Magill et al. 2013; SARI Working Group 2011; Tablan et al. 2004; Canadian Patient Safety Institute 2012). In Table 2.2, the symbol (✓) indicates that the recommendations are included in the VAP prevention guidelines, while the symbol (✕) signifies that the recommendations are not included in the VAP prevention guidelines.

Table 2.2 Summary of recommendations in VAP prevention guidelines

Recommendations	CDC 2004/2013	SARI 2011	IHI 2012	CPSI 2012	SHEA/IDSA 2014/2022
Oral hygiene with 0.12% oral chlorhexidine solution	✓	✓	✓	✓	✓
Elevation of HOB 30° to 45°	✓	✓	✓	✓	✓
Hand hygiene	✓	✓	✕	✓	✓

*(✓) Included in the VAP prevention guidelines; (✕) Not Included in the VAP prevention guidelines.

The following sub-sections describe evidence for the importance of and issues related to the VAP prevention recommendations of oral hygiene with 0.12% chlorhexidine solution, head of bed elevation between 30° to 45°, and hand hygiene.

2.7.2.1 Oral hygiene

Within 48 hours following hospitalization, ventilated patients with compromised oral health are at a higher risk of contracting VAP since potential respiratory pathogens could colonize the oral cavity (Kusahara, Peterlini & Pedreira 2012). The oral hygiene practices for VAP prevention include inspection of the oral cavity, routine oral cleansing and teeth brushing using chlorhexidine mouthwash or gel (Kusahara, Peterlini & Pedreira 2012). Suctioning and providing moisture to the mouth are common practices as well (Gupta, Singh & Saxsena 2016). Critically ill patients are at risk of developing dental plaque due to loss of fibronectin from tooth surfaces (Berry et al. 2011). Dental plaque is the main source of bacteria (Lev, Aied & Arshed 2015). Those patients are also at risk of bacterial colonization of the oropharynx due to a decrease in salivary secretions and self-cleaning (Gupta, Singh & Saxsena 2016). Microbial colonization is associated with severe complications such as bacteraemia, cardiovascular disease and endocarditis, among others and, is more relevant to the current study about the use VAP prevention guidelines (Gershonovitch, Yarom & Findler 2020; Zhao et al. 2020). Previous studies indicate that improving oral hygiene is directly associated with up to 70% reduced bacterial colonization and therefore it can be useful in preventing VAP (Gershonovitch, Yarom & Findler 2020; Gupta, Singh & Saxsena 2016).

Chlorhexidine is an antiseptic agent with a broad antibacterial spectrum against both gram negative and positive bacteria (Tran & Butcher 2019). In addition to being highly effective, chlorhexidine intervention is also cost-effective, easy to administer and has minimal side effects (Pobo et al. 2009). Several studies have reported a decrease in VAP incidence with the use of chlorhexidine (Beraldo & Andrade 2008; Tran & Butcher 2019; Zhao et al. 2020). Despite this, few institutions use written procedures for oral care that clearly specify the frequency, and tools involved (Cason et al. 2007; Sona et al. 2009). The recommended minimum frequency of oral care is twice a day, and moistening oral mucosa and lips every 2

to 4 hours (Gupta, Singh & Saxsena 2016). Oral care with 0.12% chlorhexidine is a recommended practice intervention in reviewed VAP prevention CPGs (Institute for Healthcare Improvement 2012; Klompas et al. 2022; Klompas et al. 2014; Magill et al. 2013; SARI Working Group 2011; Tablan et al. 2004; Canadian Patient Safety Institute 2012).

Oral care is perceived as a critical nursing activity in ICUs (Wei et al. 2022); however, the effectiveness of oral care practice relies on awareness and understanding of the significance of oral care by nurses (Chon & Yang 2015). Despite this, limited access to the oral cavity space due to the presence of the endotracheal tube and fear of displacing the tube are reasons reported for insufficient oral care (Yeung & Chui 2010). Consequently, tooth brushing rates are less than optimal among mechanically ventilated patients, leading to the development of VAP (Ames 2011; Cason et al. 2007). A meta-analysis by Veitz-Keenan and Ferraiolo (2017) evaluated 38 randomized controlled trials (6,016 participants) related to the efficacy of oral hygiene in preventing VAPs. Notably, they found a reduction of VAP incidence from 25% to 19%. However, this study did not report a significant reduction in VAP-associated mortality. Similarly, Zhao et al. (2020) report a reduction of VAP incidence from 26% to 18%. This study also did not report a statistically significant reduction in VAP-associated mortality rates. In conclusion, adhering to oral hygiene recommendations can reduce the risk of VAP in mechanically ventilated patients, by preventing the development of dental microbial plaque (Ames 2011; Gershonovitch, Yarom & Findler 2020).

2.7.2.2 Elevation of head of bed (30°–45°)

In the ICU, positioning is a specific treatment technique often used in combination with other physiotherapy techniques to improve lung function, clear airway secretions and achieve other benefits (Pozuelo-Carrascosa et al. 2022). In the ICU, ventilated patients develop VAP when gastric contents and oropharyngeal secretions are aspirated and contaminated with potentially pathogenic bacteria (Gunasekera & Gratrix 2016). A supine body position can increase the risk

of pulmonary aspiration by impairing respiratory protection mechanisms, such as coughing and mucociliary clearance (Güner & Kutlutürkan 2022). Extensive research has been conducted on preventing VAP in ventilated patients by positioning in a semi-recumbent position, where the head of the bed is elevated between 30° and 45° (Pozuelo-Carrascosa et al. 2022; Wang et al. 2016). Positioning patients at 30° or more showed a significant reduction in the risk of getting VAP, as compared to a supine position (Niël-Weise et al. 2011; Pozuelo-Carrascosa et al. 2022). Positioning ventilated patients between 30° and 45° degrees is included as a recommendation in all the reviewed VAP prevention CPGs (Institute for Healthcare Improvement 2012; Klompas et al. 2022; Klompas et al. 2014; Magill et al. 2013; SARI Working Group 2011; Tablan et al. 2004; Canadian Patient Safety Institute 2012) (see Table 2.2). Though some earlier studies suggested that more research is needed to discuss patients' comfort, feasibility of positioning and the risk of pressure ulcers (Burk & Grap 2012), recent studies, including large meta-analyses, indicate that head elevation is highly efficient in reducing the incidence of VAP. Furthermore, elevation of HOB is a common practice in hospitals; it is used in more than 80% of hospitals (Li Bassi et al. 2017; Pozuelo-Carrascosa et al. 2022; Wang et al. 2016). The extent to which ICU nurses adhere to the HOB recommendation for the prevention of VAP in Saudi Arabia is still unclear and requires further research.

2.7.2.3 Hand hygiene

Generally, the term hand hygiene refers to hand cleansing action with antibacterial soap or alcohol-based antiseptic (Sax et al. 2009). Direct contact between patients and healthcare staff is acknowledged to be the primary source of infection (Tschudin-Sutter, Pargger & Widmer 2010). Research has demonstrated that a considerable proportion of healthcare associated infections arise due to the transfer of microorganisms carried on the hands of healthcare professionals (King et al. 2016). A close physical proximity and regular exposure to respiratory

secretions between healthcare workers and patients contribute to the spread of these organisms. Consequently, hand hygiene practices are the first line of preventing nosocomial infections (Salmon et al. 2015). However, increasing adherence to hand hygiene practices among healthcare staff remains a challenge (Boltey, Yakusheva & Costa 2017).

The crucial role of direct contact between healthcare providers and ventilated patients in spreading nosocomial infections is widely recognised (Tschudin-Sutter, Pargger & Widmer 2010). The majority of CPGs emphasize hand hygiene as the fundamental measure for the prevention of VAP (Klompas et al. 2014; SARI Working Group 2011; Tablan et al. 2004; Canadian Patient Safety Institute 2012) (see Table 2.2). Yeganeh et al. (2019) indicate that an inability to maintain consistent hand hygiene practices can result in the spread of harmful pathogens and bacteria, increasing the risk of infection, particularly VAP, in patients. Therefore, VAP and other hospital-acquired infections may be more prevalent in hospitals that fail to adhere to proper hand hygiene guidelines (Koff et al. 2011; Safavi et al. 2023). The extent to which ICU nurses adhere to the hand hygiene recommendations for the prevention of VAP in Saudi Arabia is still unclear and requires further research.

2.8 ICU nurses' adherence to VAP prevention guidelines

A systematic review of studies conducted in the eastern Mediterranean region reported that inadequate education, time, insufficient nursing staff, and lack of policies and protocols are major barriers to implementing VAP prevention guidelines (Al-Mugheed et al. 2022). The review determined that implementing tailored educational training programs might mitigate these barriers (Al-Mugheed et al. 2022). Nevertheless, the review was limited to studies conducted in a small region; thus, the generalizability of the findings is limited.

2.8.1 The role of ICU nurses in preventing VAP

Dosher et al. (2014) suggest implementation of the VAP prevention guidelines and other healthcare measures to prevent VAP will not be feasible if the factors impeding ICU nurses' adherence to VAP prevention guidelines are not addressed. Interestingly, Dosher et al (2014) employed a nurse-led infection control team to inspect and evaluate the VAP prevention measures in a hospital in Texas, USA. The inspection was scheduled twice per week. The researchers observed that the nurse-led team could significantly reduce the incidence of VAP ($p < 0.001$). Similarly, Ceballos et al. (2013) report on a nurse-driven quality improvement system for ensuring adherence to VAP prevention guidelines and standardized infection control practices. The nurse leaders performed compliance audits on intubated neonatal ICU patients to confirm VAP bundle implementation, on a weekly basis. A central line–associated blood stream infection (CLABSI) checklist was also developed. Notably, this system was able to reduce CLABSI by 92% and VAP incidence by 71%. The estimated total cost savings for CLABSI was US$348,000 and for VAP was US$300,000. These two studies pinpointed the essential role of ICU nurses in the successful implementation of VAP prevention guidelines.

Boltey, Yakusheva and Costa (2017) suggest five nurse-oriented strategies for reducing the incidence of VAP in critical care settings. These strategies are: 1) reduce continuous usage of ventilator exposure, 2) provide excellent oral hygiene care, 3) ensure efficient subglottic suctioning, 4) optimal positioning of the patient and ensure patient mobility and finally, 5) ensure adequate staffing. The final point of this plan is not within the control of the nurse. However, the first four points from earlier literature, describe the role of ICU nurses in preventing VAP. Osti et al. (2017) provide an excellent review on the role of nurses in preventing VAP. This review suggests that nurses can play a vital role in VAP prevention such as education about VAP prevention guidelines, coordination of VAP prevention measures, and as evaluation of the process. However, lack of knowledge regarding the guidelines and

inadequate experience in nursing care are major barriers for nurses implementing EBP to prevent VAP (Al-Mugheed et al. 2022; Getahun et al. 2022). Osti et al. (2017) suggest that educational interventions can act as facilitators for improving nurses' knowledge scores and therefore will ensure proper implementation of VAP prevention guidelines. As mentioned above, the role of the ICU nurse in preventing VAP is multifaceted. Therefore, the role of nurses in the prevention of VAP in mechanically ventilated patients, their degree of adherence to VAP prevention guidelines and influencing factors influencing are discussed in the following sections.

2.8.2 Knowledge of VAP prevention guidelines among ICU nurses

Previous studies in the Saudi Arabian context have suggested that inadequate knowledge of VAP prevention guidelines among ICU nurses is a hindering factor, which prevents proper implementation of VAP prevention guidelines in ICUs (Al-Sayaghi 2021; Aloush & Al-Rawajfa 2020). A systematic review study by Al-Mugheed et al. (2022) aimed to examine critical care nurses' knowledge, practices, compliance and barriers to VAP prevention in the eastern Mediterranean region. Of the 23 studies analysed, 14 studies utilized knowledge of VAP as the highest measure. The results consistently indicated that most nurses had a low, inadequate or poor level of knowledge of VAP. Among the 14 studies, only one study by Alkhazali, Bayraktar and Al-Mugheed (2021) reported that nurses had adequate knowledge of VAP. Among the other studies, four categorized the knowledge level as low, three studies found it to be inadequate, and three studies observed a significant improvement in knowledge after educational interventions. Furthermore, two studies reported poor knowledge, and one study found unsatisfactory knowledge. However, the overall study findings indicated that nurses in the eastern Mediterranean region generally had a low level of knowledge regarding VAP.

This lack of knowledge can be attributed to low levels of education, inadequate experience, and insufficient management support. VAP education should be offered continuously to ensure that intensive care nurses are competent and aware of any updates to VAP prevention guidelines (Darawad, Sa'aleek & Shawashi 2018). This will ensure that experienced nurses share updated knowledge with new graduate nurses. As such, there is a need for tailored educational programs for new graduate nurses (Madhuvu et al. 2020).

2.8.3 Availability and accessibility of resources for implementing VAP prevention guidelines

Lower rates of compliance with prevention guidelines are pronounced in resource-limited countries. In a study conducted in Tanzania, the self-reported rate of compliance to protocols for the prevention of VAP was 60.8% (Bankanie et al. 2021). This compliance rate is below that of high-income countries such as Spain and the USA at 77.7% and 83%, respectively. Insufficient resources result in lower nurse-to-patient ratios and consequently an increased nurse workload (Al-Sayaghi 2021; Aloush et al. 2018; Aloush & Al-Rawajfa 2020). Higher nurse-to-patient ratios, such as 1:1, are linked to higher compliance rates among intensive care nurses (Aloush 2017). The increase in VAP incidence has been linked to nursing staff shortages and insufficient equipment due to increased hospitalizations (Al-Mugheed et al. 2022). In low-resource settings, the strict implementation of recommended guidelines for the prevention of VAP might lead to nurse burnout (Bruyneel et al. 2023; Hansen, Sverke & Näswall 2009; Ramírez-Elvira et al. 2021). Specific convenient measures could be taken to alleviate the situation in low-income countries because excess workload is a common due to lack of adequate staff. This scenario can lead to more than 8 hours work schedules and therefore, less adherence to guidelines (Atashi et al. 2018; Hugonnet, Uçkay & Pittet 2007). In such cases, implementation of shift-based working schedules   and using institution-specific

VAP prevention protocols may be helpful. Moreover, comprehensive education and training can also mitigate the inadequacy of resources for implementing VAP prevention guidelines (Aloush & Al-Rawajfa 2020). Nevertheless, Aloush (2017) reports that the impact of increased nurse workload on compliance outweighs the benefits of educational programs. As such, hospital management should review their expenditure to strike a balance between the benefits of educational training and intensive care unit staffing.

2.9 Gaps identified in the current literature

Very few studies have been conducted in the Saudi Arabian context regarding ICU nurses' adherence to VAP prevention guidelines and the factors influencing their adherence. Most of the research about EBP conducted in the Saudi Arabian context revolves around the knowledge and awareness of clinicians towards EBP and the ICU nurse's role is often neglected (Alshehri et al. 2018; Brown et al. 2009; Hamaideh 2017). Although attitude-related issues in the implementation of EBP were observed among Saudi Arabian nurses by some studies (Almoajel 2021; Alshehri et al. 2018), the factors influencing adherence to VAP prevention guidelines, including the reasons behind non-compliance and potential solutions for improving nurse' adherence, have not been thoroughly explored. However, there were no identified studies that investigated more in-depth of what factors influence nurses' adherence to VAP prevention CPGs. Previous studies that studied nurses' adherence to VAP prevention guidelines have employed only a quantitative or only a qualitative research technique, which has provided an opportunity to explore the subject matter with a mixed-methods approach. Thus, a mixed-methods approach was adopted in the present study to address this limitation, incorporating both qualitative and quantitative methods in order to gain a comprehensive understanding of the study phenomenon through a more holistic, detailed analysis, and by addressing the limitations inherent in any single approach. Since ICU nurses have a crucial role in the

implementation of VAP prevention guidelines, it is essential to investigate the factors influencing adherence to VAP prevention guidelines in the Saudi Arabian context. Therefore, this study aims to gain a deeper understanding of the factors that influence ICU nurses' adherence to VAP prevention guidelines in the Saudi Arabian context.

2.10 Chapter summary

This chapter reviewed the current literature relating to nurses' experiences in the use of evidence-based VAP prevention guidelines and the factors that impact adherence with these guidelines. The present knowledge regarding the barriers to and facilitators of implementing VAP prevention guidelines were also assessed. The factors that influence ICU nurses' adherence to VAP prevention guidelines in the Saudi Arabian context remain mostly underexplored and is therefore a gap in knowledge. The facilitators of and barriers to ICU nurses' adherence to VAP prevention is also missing from the literature and needs to be studied in detail. Therefore, this study aims to explore ICU nurses' adherence to VAP prevention guidelines and the barriers to adherence in the Saudi Arabian context.

Chapter 3: Methodology

3.1 Introduction

The previous chapters have provided an overview of the study, reviewed the current literature on nurses' use of clinical practice guidelines in relation to VAP, and identified the research gaps. This chapter presents the researcher's personal and philosophical perspectives that influenced the methodology of the study. Further details on the research methods will be presented in Chapter 4.

The primary focus of this study was to examine how ICU nurses working in adult care settings adhere to VAP clinical guidelines and incorporate them into their everyday practices in two Saudi tertiary care hospitals. To achieve the research objectives, a mixed-methods approach was adopted to achieve a deep understanding of the study problem. Quantitative data was collected first, followed by qualitative data. The four research objectives, as outlined in Chapter 1, were:

1. To describe ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia with a focus on OH, elevation of HOB and HH interventions.

2. To describe the characteristics of the guideline users, guideline quality, and the contextual factors influencing ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia.

3. To explore ICU nurses' beliefs and experiences of the factors that influence their adherence to VAP prevention guidelines in Saudi Arabia.

4. To generate recommendations that facilitate the implementation of VAP prevention guidelines in the Saudi Arabian health system.

This chapter provides an overview of the methodological approach, the design employed, and appropriateness for the study. This chapter is organized as follows. Sections 3.2 and 3.3 review the philosophical foundations of mixed-methods research. Sections 3.4 to 3.8 discuss the nature of mixed-methods research, how it has developed, the common types of mixed-methods research, as well as advantages and challenges associated with mixed-methods research. Sections 3.9 and 3.10 discuss the research design, and the ethical considerations in mixed-methods research.

3.2 Methodological pluralism

The philosophy of methodological pluralism suggests that, rather than identifying one best research method, methods are selected according to the research questions being addressed (Barker, Pistrang & Elliott 2015). Barker and Pistrang (2005) explain that the philosophy of pluralism implies that knowledge is accumulated from various sources and in different ways. The methodological pluralist believes that no single research method is intrinsically better than another. For the purpose of answering the research questions, it is essential to select the appropriate research methods and methodologies. Lincoln, Lynham and Guba (2018) describe that the researchers' values, beliefs and assumptions about truth and knowledge influence a large part of the direction they take in their research, including how they choose the topic, use methods, present results, or use them in a specific way. Thus, it was essential for the researcher to examine his own personal and philosophical stance in order to select the research methods that were appropriate for this study.

The use of multiple methodological approaches is appropriate to consider the complexity of the healthcare system, according to Mesel (2013), who argues that methodological pluralism utilizing both qualitative and quantitative approaches is indispensable. The issues related to the implementation of clinical practice guidelines in ICUs

are complex and context-specific, and a wide variety of research methods are required to address issues that are this complex (Harvey & Kitson 2016). The path to understanding how complex interventions work requires the use of multiple evaluation methods (Creswell & Clark 2018; Minary et al. 2019). The insights gained from quantitative and qualitative approaches complement each other to provide a more comprehensive understanding of the intervention (Nieswiadomy & Bailey 2018). As a result of methodological pluralism, the researcher can gain a comprehensive understanding of the study phenomenon through a more holistic, detailed analysis, and by addressing the limitations inherent in any single approach (May, Hunter & Jason 2017; Venkatesh, Brown & Bala 2013).

Methodological pluralism, with its philosophy of providing a more diverse, comprehensive and holistic understanding of a situation, reduces the limitations inherent in any single technique. Furthermore, pluralism encourages a more comprehensive and textured analysis than any single methodology can. A pluralistic approach to methodology involves applying more than one method and methodology and, in some cases, more than one epistemological position (May, Hunter & Jason 2017). This means that researchers can approach reality in a variety of ways, and there is no single lens for understanding reality. Thus, employing mixed methods has the advantage of methodological pluralism, which encourages broader and alternative perspectives when studying complex research problems which may not be understood by one perspective (Regnault, Willgoss & Barbic 2018).

3.3 Research paradigm and the philosophical foundations of mixed-methods research

3.3.1 Mixed-methods philosophy and worldviews

A worldview is a broad perspective or framework that shapes an individual's understanding of the world and the way they interpret and engage with it. This perspective is often shaped by a set of philosophical beliefs or assumptions that inform an individual's understanding of reality.

These philosophical assumptions can be grouped into four main categories: axiology, epistemology, ontology and methodology (Creswell & Clark 2018; Hesse-Biber & Johnson 2016). According to Creswell and Clark (2018), researchers employing mixed methods have a pluralistic worldview derived from their beliefs and assumptions about the world. Axiology deals with the nature of human nature and ethics, while epistemology deals with the philosophical study of knowledge and the nature of knowledge itself (Hesse-Biber & Johnson 2016). Ontology deals with the nature of reality, and methodology deals with inquiry decisions (Hesse-Biber & Johnson 2016). Furthermore, philosophical beliefs are not fixed and may change over time and across different contexts (Creswell & Clark 2018). For example, the concept of "reality" has been interpreted differently by different philosophers. Therefore, the philosophy of reality should be approached critically and open-mindedly, understanding that there may be multiple perspectives and interpretations (Shan 2022).

A paradigm refers to a set of beliefs that shape how individuals act and reflect their perspective on the world. The debate over the philosophical foundations of mixed-methods research emerged as a result of the broader paradigm debate in the academic community (Hesse-Biber & Johnson 2016). Mixed-methods research, as a methodology, has been shaped by the ongoing discourse surrounding paradigms and the assumptions they entail (Shan 2022). Mixed methods developed as a methodological alternative to the single use of quantitative and qualitative approaches in the 1980s in order to "bridge the gap" between these two traditions (Timans, Wouters & Heilbron 2019). Teddlie and Tashakkori (2009, p. 79) define a research paradigm as "a worldview, together with the various philosophical assumptions associated with that point of view". This definition highlights the connection between a paradigm and an individual's worldview. A research paradigm provides researchers with direction for their research and serves as a guide to their work. Kivunja and Kuyini (2017, p. 26) explain that a research paradigm is "The conceptual lens through which the researcher examines the

methodological aspects of their research project to determine the research methods that will be used and how the data will be analysed".

This means that a research paradigm can be described as a philosophical position about the world and how we approach the world for the purpose of understanding it (Dawadi, Shrestha & Giri 2021). Hence, the paradigm of a research study is a set of assumptions concerning ontology and epistemology that are fundamental to the research process (Creswell & Clark 2018). Guba and Lincoln (1994) suggest that the basis of all science is paradigmatic thinking, involving distinctive assumptions about the nature of reality and how we come to know about it on a daily basis (ontology), how we come to discover it through epistemology, and how we can make use of what can be learned about it through methodology (Guba & Lincoln 1994). This has traditionally resulted in researchers taking a methodologically positivistic or interpretive approach to building theories. Because of the rigidity of this point of view, especially when it comes to researching complex phenomena, researchers have reconsidered the possibilities of combining quantitative and qualitative data to investigate complex phenomena, leading to a mixed-methods approach (Creswell & Clark 2018).

3.3.2 Mixed-methods research paradigms

Since quantitative and qualitative methods are generally not similar, some perceive that integration of these methods is unreasonable (Shan 2022). Advocates of mixed-methods research have been working to develop distinctive philosophical paradigms that motivate and justify the combined use of quantitative and qualitative methods (Shan 2022). The literature has highlighted that consideration of paradigms is important in understanding the complexity of mixed-methods research (Dawadi, Shrestha & Giri 2021). Creswell and Clark (2018) provide and describe four paradigm stances that are useful in designing mixed-methods research. These four paradigm stances are postpositivism, constructivism, transformative and

pragmatism (Creswell & Clark 2018). These four paradigmatic perspectives, which they refer to as "umbrella terms", encompass the different ways in which researchers approach knowledge formation. Researchers who intend to employ mixed methods must have a thorough understanding of each paradigm's strengths and limitations (Dawadi, Shrestha & Giri 2021). Further explanation of the four paradigm stances and the specific paradigm employed for this study follows.

3.3.3 Pragmatism and mixed-methods research

The philosophy or paradigm has a significant impact on determining the methodology, the analysis of data, and the interpretation of results in research (Mertens & Hesse-Biber 2013). Postpositivism is often associated with quantitative research methods since it assumes that all knowledge is objective and that reality can be observed and measured (Creswell & Clark 2018). Some scientists believe that reality can be discovered objectively and independently of human perceptions. Constructivism, on the other hand, assumes that knowledge is subjective, and that reality is constructed in part by human perception and interpretation. Constructivism holds that reality is determined by human perception, and that scientific methods can only provide a limited interpretation of the world. The transformative paradigm places a strong emphasis on social justice and empowerment in research. Transformative worldviews are subcategories of constructivism in which the researcher facilitates change in research participants and emphasizes social justice and empowerment throughout the research process. The final paradigm, pragmatism, advocates the mixing of different methods and has been embraced by a large number of researchers working in mixed-methods research (Creswell & Clark 2018; Dawadi, Shrestha & Giri 2021). As a philosophy, pragmatism holds that knowledge needs to be applied to the real world, and theories need to be evaluated by action and observation in order to determine their utility.

Feilzer (2010) and Mertens and Hesse-Biber (Mertens & Hesse-Biber 2013) claim that pragmatism encourages the use of mixed methods because it emphasizes the practical application of knowledge, with a focus on finding solutions to real-life issues. Pragmatism embraces knowledge that originates from multiple ways of interacting with the social world, and holds that there is no single truth (Creswell & Clark 2018). Pragmatism places a strong emphasis on the outcomes of research and the primary importance of the research question as one of its main features (Shannon-Baker 2016). The importance of this paradigmatic approach is to prioritize the research question over the method used and to use multiple methods to triangulate, integrate and validate the findings of the research study. Shannon-Baker (2016, p. 322) states that "The pragmatic researcher is similarly able to maintain both subjectivity in their own reflections on research and objectivity in data collection and analysis".

Guided by a pragmatic paradigm, a mixed-methods approach involving the use of both quantitative and qualitative methods to answer the research questions was selected for this study. Mixed methods has the advantage of allowing researchers to gain a more comprehensive understanding of a research problem through the use of both quantitative and qualitative data (Halcomb 2019). A description of the mixed-methods approach used in this study can be found in Section 3.4.

3.3.4 Ontological and epistemological reflective account

My role as a researcher tended to lead my research in a certain direction, so it was crucial that I examined my own philosophical stance in order to situate my research findings, since my assumptions could influence the way my research was conducted. As the purpose of this study was to explore the adherence of intensive care nurses to VAP prevention, the researcher's nursing experience as a lecturer and critical care instructor influenced his understanding of the reality of ICU nursing practice. The researcher has been involved in developing and teaching

nursing programs that incorporate evidence-based practices in the critical care setting for critically ill patients including ventilated patients. Engaging in teaching nursing practices helped the researcher observe that there are challenges to implementing clinical practice guidelines in Saudi Arabia. My diverse knowledge and experience enabled me to take a distinctive ontological and epistemological position towards the research questions and phenomena under investigation. This distinct perspective subsequently influenced the methodology employed for the study, allowing for a comprehensive and deeper understanding of the research problem. Therefore, a mixed-methods approach was adopted, shaped by the researcher's ontological and epistemological position, to delve into the factors that influence the adherence of ICU nurses to VAP prevention guidelines in Saudi Arabia.

The researcher's *epistemology* is informed by pragmatism through the experience of working in a community of other ICU trained nurses. This is because the pragmatism philosophy values both subjective and objective observations when determining the most appropriate answers to a research phenomenon (Creswell & Clark 2018). Taking this into account, it was decided to use a mixed-methods approach to gain a deeper understanding of the issues that influence ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia. This is because mixed-methods research promotes the use of multiple worldviews (Creswell & Clark 2018), as opposed to the traditional association of certain paradigms with quantitative or qualitative research (e.g., philosophical beliefs and values) (Morgan 2007; Shannon-Baker 2016). Consequently, the researcher's ontological and epistemological position and the choice of a mixed-methods approach to explore the study phenomena were influenced by the researcher's background and experiences. The following section discuss the mixed-methods approach employed in this study.

3.4 Mixed-methods approach

A mixed-methods approach is a combination of both quantitative and qualitative research methods into one study (Creswell & Creswell 2018; Halcomb & Hickman 2015; Wisdom et al. 2012). In today's complex world, quantitative as well as qualitative data, when integrated, are often useful in the study of complex phenomena (Timans, Wouters & Heilbron 2019). Schoonenboom and Johnson (2017, p. 108) point out that "A mixed methods design is characterized by the combination of at least one qualitative and one quantitative research component". A mixed-methods approach is defined by Johnson, Onwuegbuzie and Turner (2007, p. 123) as: "The type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches for the broad purposes of breadth and depth of understanding and corroboration."

The textual data obtained in a mixed-methods study is typically subject to qualitative data analysis methods while numerical data is used in quantitative data analysis (Creswell & Clark 2018). This mixed data can produce a comprehensive understanding of the research problem through these research methods (Dawadi, Shrestha & Giri 2021). Mixed-methods approaches are increasingly acknowledged as a major field of research, incorporated into research practices, and classified as one of the three major research approaches, alongside qualitative and quantitative methods (Doorenbos 2014; Johnson, Onwuegbuzie & Turner 2007). The application of mixed-methods research in health care can be rooted in the widely accepted definition provided by Tashakkori and Creswell (2007, p. 4), which states that it is "a research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or program of inquiry".

An important aspect of this definition highlights the use of mixed-methods research in order to enhance the understanding of research questions. Mixed methods are increasingly used

as the combination of quantitative and qualitative approaches results in stronger inferences than might be possible from a single source of data (Timans, Wouters & Heilbron 2019; Wasti et al. 2022). Although there has been a great deal of enthusiasm among researchers on mixed-methods research, no mixed-methods study could be found in nursing-related research examining the factors that influence nurses' adherence to VAP prevention guidelines in the eastern Mediterranean or more particularly in Saudi Arabia (Al-Mugheed et al. 2022).

There are criticisms of mixed-methods research, including Dawadi, Shrestha and Giri (2021), who argue that the literature on mixed-methods approaches lacks sufficient information on how to choose an effective design and understand its rationale. Furthermore, mixed-methods research may be considered difficult to implement by some researchers (Regnault, Willgoss & Barbic 2018). When deciding to use qualitative and quantitative approaches together in a study, researchers should consider if they have the skills to work with both approaches (see Sections 3.7 and 3.8). The mixed-methods approach adopted in this study is based on the pragmatic knowledge claims of (Creswell & Clark 2018). This involved conducting and implementing quantitative and qualitative data collection and analysis, followed by data integration to provide a comprehensive and overall conclusion on the study phenomena (Creswell & Clark 2018). Chapter 7 provides further information about the data integration techniques and results for this study.

3.5 Development of mixed-methods approaches

Mixed-methods research approaches can be traced back to the early 20th century, but it was not until at the end of that century that they were recognised as a distinct research approach and, as a result, began to gain traction as a distinct research method (Shan 2022). In the early 1960s, mixed methods were used in anthropology and sociology (Doorenbos 2014; Morse & Niehaus 2009), and were used to explore multidimensional phenomena to achieve more

comprehensive knowledge than what might come from only a single method (Halcomb & Hickman 2015). This has led to a growing belief among researchers that a single-method approach is inadequate to answer a complicated research question (Creswell & Clark 2018; Shannon-Baker 2016). Subsequently, the mixed-methods approach has been embraced by many researchers in health care and social sciences (Glogowska et al. 2015; Wasti et al. 2022). When compared to a single method, a mixed-methods approach can provide answers to research questions that are not addressed by other approaches (Dawadi, Shrestha & Giri 2021; Shan 2022). Mixed methods provide a stronger inference and allow for a greater diversity of opinions (Tashakkori & Teddlie 2021). One of the key characteristics of mixed methods is the inclusion of individual lived experiences (Halcomb & Hickman 2015; Lipscomb 2008). The research is often oriented to the needs and priorities of the study participants by incorporating their views into the research in the qualitative strands (Regnault, Willgoss & Barbic 2018).

3.6 Types of mixed-methods design

A significant amount of attention has been devoted by methodologists to classifying the various types of mixed-methods research. Timans, Wouters and Heilbron (2019) argue that the research community in mixed methods appears committed to designing a standardized methodological framework for the combination of methods. However, Dawadi, Shrestha and Giri (2021) suggest that the mixed-methods approach should be treated as one methodological approach rather than kept epistemologically separate within mixed methods due to the possibility of causing difficulties at the stage of integrating and interpreting the data. Despite differences of opinion as to how mixed-methods design should be accomplished, there is agreement that a common conceptual and methodological foundation of mixed-methods research is required (Timans, Wouters & Heilbron 2019).

Creswell and Clark (2018) have summarized and categorized mixed-methods designs into three core types: the convergent parallel design, the sequential exploratory design and the sequential explanatory design. These three core designs are efficient and practical since they help researchers identify the optimal mixed-methods study design possibilities (Creswell & Clark 2018; Fetters, Curry & Creswell 2013). Importantly, researchers need to choose an appropriate mixed-methods design based on the characteristics of their research, for example, understanding the procedural differences between designs and the specific approach used, and the amount of time they have for data collection and analysis (Dawadi, Shrestha & Giri 2021). In this section the three common types of mixed-methods designs are presented. This study applied the sequential explanatory design, and further details will be provided in Section 3.9.

3.6.1 Convergent parallel design

The convergent parallel mixed-methods design combines quantitative and qualitative methods at the same time, to obtain an integrated result (Creswell & Creswell 2018; Dawadi, Shrestha & Giri 2021). This design can gather both types of data sets concurrently, and then integrate the results in order to gain a deeper understanding of the research problem (Creswell & Creswell 2018). A convergent design, which takes pragmatism as a theoretical base, is a common and efficient technique for doing mixed-methods research (Creswell & Clark 2018; Dawadi, Shrestha & Giri 2021). Figure 3.1 illustrates a convergent design, in which two different methods, namely qualitative and quantitative methods, are combined to obtain triangulated results (Creswell & Clark 2018). Two types of data sets are collected simultaneously, and then separately analysed using quantitative and qualitative analytical methods (Creswell & Clark 2018; Schoonenboom & Johnson 2017). Thus, the combination of both data sets in a convergent design aids the researcher in gaining a thorough comprehension of the research problem (Dawadi, Shrestha & Giri 2021).
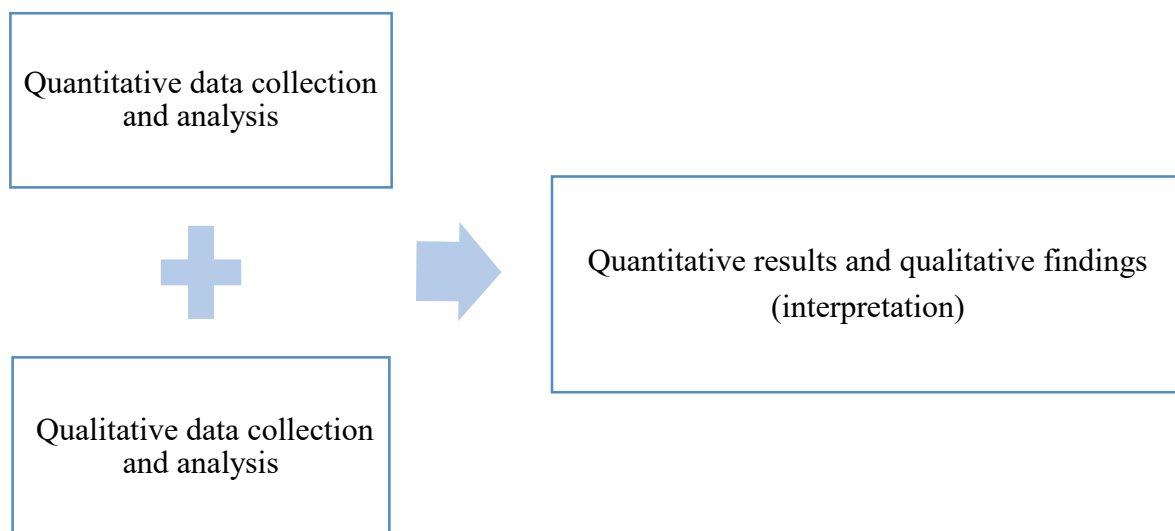
Figure 3.1. Convergent parallel design (adapted from Creswell & Clark 2018)

A convergent design is a method of combining two data sets to acquire a complete picture of the topic under investigation and to cross-validate one set of findings with the other (Creswell & Clark 2018; Dawadi, Shrestha & Giri 2021). For example, a convergent design can be useful when researchers want to validate the findings from one method with those from another (Creswell & Creswell 2018). Therefore, the integration of the two databases can be accomplished by, for example, merging both databases in a side-by-side approach, or by translating qualitative data into counts and integrating the transformed qualitative information into quantitative data, known as a transformation approach (Creswell & Clark 2018; Dawadi, Shrestha & Giri 2021). Given that the purpose of this study was to investigate more deeply the factors that influence ICU nurses' adherence to VAP prevention guidelines, this study design was not appropriate, as a convergent design may not have added the depth required.

3.6.2 Exploratory sequential design

An exploratory sequential design is a two-phase design in which supplementary quantitative methods are carried out after the core qualitative methods have been completed (Morse &

Niehaus 2009). The exploratory sequential design starts with and emphasizes the collection and analysis of qualitative research data in the first phase (Dawadi, Shrestha & Giri 2021). A researcher investigates a topic in depth in the first phase, then uses the findings of the qualitative data to identify and measure variable and statistical trends in the second quantitative phase (Creswell & Clark 2018). The exploratory sequential design begins with qualitative data collection and analysis, and study themes are used as a basis for developing a quantitative instrument or theory to further explore the research phenomenon (Schoonenboom & Johnson 2017). Figure 3.2 illustrates the two-phase exploratory sequential design, which begins with the collection and analysis of qualitative data followed by quantitative data collection and analysis (Creswell & Clark 2018). A quantitative measure or instrument is created by building upon the qualitative findings. Researchers begin by collecting and analysing qualitative data, and then they use the insights gained from this analysis in order to develop a quantitative measure (Dawadi, Shrestha & Giri 2021) that tests the variables that they have identified and interpreted in order to generalize and extend the qualitative findings (Creswell & Clark 2018).
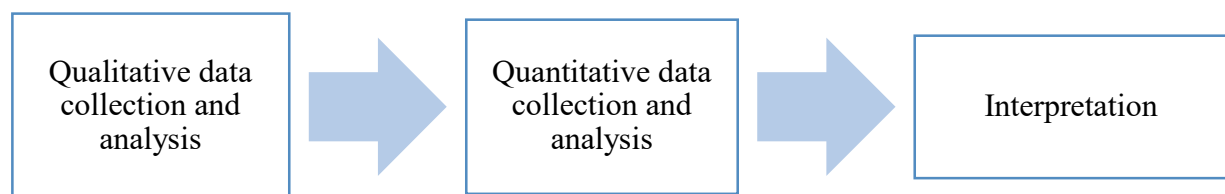
Figure 3.2. Exploratory sequential design (adapted from Creswell & Clark 2018)

This design is particularly advantageous when studying sensitive or complex issues as it allows researchers to consider the perspectives of participants (Dawadi, Shrestha & Giri 2021). This design is commonly referred to as an instrument development design as well as a quantitative follow-up design (Creswell & Clark 2018). This study did not utilize an

exploratory sequential design since the objective was to determine the level of adherence of ICU nurses via audits of current practices and self-reported questionnaires in a quantitative manner rather than to develop an instrument to assess adherence.

3.6.3 Explanatory sequential design

An explanatory sequential design involves collecting and analysing both quantitative and qualitative data in a specific order (Creswell & Clark 2018; Dawadi, Shrestha & Giri 2021). In contrast to the exploratory sequential design, the sequential explanatory design starts with and emphasizes the collection and analysis of quantitative research data in the first phase (Dawadi, Shrestha & Giri 2021). According to Creswell and Creswell (Creswell & Creswell 2018), the explanatory sequential design is intended to enable the qualitative data to provide a greater level of explanation of the quantitative findings. The sequential explanatory design highlights the participants' voices and how they perceive the study problem (Shannon-Baker 2016). Thus, the second phase of the sequential explanatory design involves the collection and analysis of qualitative data in order to further understand the research problem (Creswell & Clark 2018). The researcher uses this design to follow up specific quantitative findings and explain them using qualitative data (Creswell & Clark 2018) (Figure 3.3).
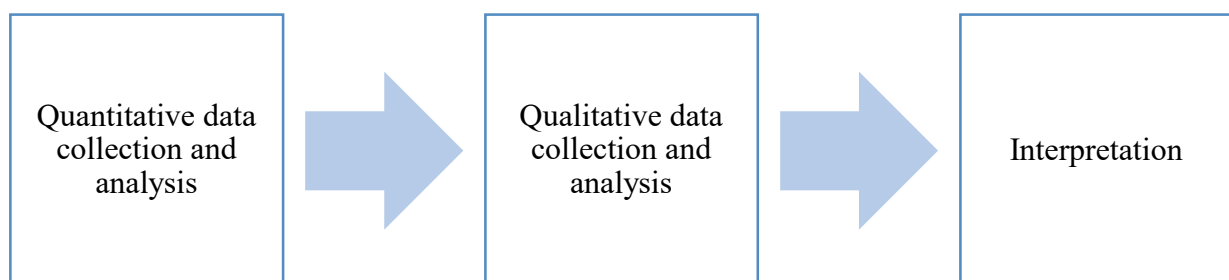
Figure 3.3. Explanatory sequential design (adapted from Creswell & Clark 2018)

To perform the explanatory sequential design, a quantitative study must first be designed and implemented, followed by determining what specific findings will be investigated in the second phase. An in-depth qualitative study is then conducted in order to understand the significance of the quantitative results (Dawadi, Shrestha & Giri 2021). According to Creswell and Clark (2018), integration occurs in this approach in two ways, by connecting quantitative findings to qualitative data gathering, and by drawing integrated conclusions after combining two sets of results once the qualitative phase is completed. Schoonenboom and Johnson (2017) claim that this design is more applicable to fields dominated by quantitative research methods. Accordingly, it was decided that a sequential explanatory design was appropriate for this study since the qualitative data gathered was intended to explain and expand upon the findings of the initial quantitative data. This approach is generally suggested for studies in which there is little existing knowledge about the subject matter (Creswell & Clark 2018; Dawadi, Shrestha & Giri 2021; Schoonenboom & Johnson 2017). A further description of the research design employed in this study will be presented in Section 3.9.

3.7 Advantages of a mixed-methods approach

A mixed-methods approach holds the advantages of both qualitative and quantitative research methods, while overcoming their weaknesses to understand the research problem more comprehensively (Andrew & Halcomb 2009; Creswell & Clark 2018; Wisdom et al. 2012). The benefits of mixed-methods research include being able to use quantitative research to guide the qualitative method by identifying the most suitable pool of participants to be recruited in the qualitative stage. Quantitative data helps the researcher identify the target interview group in the qualitative phase (Creswell & Clark 2018). Qualitative methods, on the other hand, provide insight and a comprehensive understanding of the problem under investigation.

The use of a mixed-methods approach promotes the use of multiple paradigms (e.g. beliefs and values) rather than the traditional association of quantitative research with certain paradigms, and qualitative research with others (Creswell & Clark 2018). According to Shannon-Baker (2016), different types of methods (including mixed methods) are associated with different worldviews and philosophical perspectives. However controversy exists among researchers who use mixed methods regarding the applicability of paradigms to mixed-methods research (Shannon-Baker (2016). Given the above, one of the major benefits of using a mixed-methods approach is that the findings of both the quantitative and qualitative methods can be integrated to be complementary. However, there are challenges and limitations to applying a mixed-methods approach.

3.8 Challenges of a mixed-methods approach

A mixed-methods study may not always achieve its aims as the mixing of quantitative and qualitative methods can result in several problems (Creswell & Clark 2018). Researchers such as Creswell and Clark (2018); Dawadi, Shrestha and Giri (2021); Regnault, Willgoss and Barbic (2018); and Teddlie and Tashakkori (2009) have pointed out some practical challenges that have been associated with mixed-methods research approaches. Other researchers have examined problems with specific mixed-methods designs, for example, Ivankova, Creswell and Stick (2006) have examined the sequential explanatory design and they highlight the challenges they faced when conducting their mixed-methods study. Some of these challenges include deciding how to balance quantitative and qualitative methods, determining how to collect and analyse data, and determining how to effectively integrate and present the different forms of data. In the end their decisions were influenced by the purpose and research questions of the study, as well as relevant literature on the methods to be used (Ivankova, Creswell & Stick 2006).

A number of research challenges associated with a mixed-methods approach have been reported by Dawadi, Shrestha and Giri (2021). The first challenge is to determine which mixed-methods design is best for the research topic. For some researchers, the decision is often challenging since they may need to fully understand the specific strengths and limitations of each mixed-methods design. The second challenge is collecting and analysing two different data set styles, as this can lead to a very lengthy research process. Creswell and Clark (2018) highlight that research using a mixed-methods approach requires considerable time, costs and resources for the data collection and analysis of both sets of research data. Third, combining and integrating both quantitative and qualitative research data can pose further challenges for many researchers. According to Halcomb (2019), mixed-methods research produces large volumes of data that are difficult to analyse and disseminate. Fourth, research combining quantitative and qualitative methods can be challenging due to the differences in epistemological and philosophical perspectives. Combining two different methods can be challenging when the results derived from one method are inconsistent with those drawn from the other, which can raise questions regarding the validity and reliability of the latter results (Dawadi, Shrestha & Giri 2021; Timans, Wouters & Heilbron 2019). Lastly, using a mixed-methods approach requires researchers to work effectively within a group; this can present a challenge to graduate students undertaking mixed-methods research for their degree.

Researchers who intend to adopt a mixed-methods approach must become familiar with both quantitative and qualitative methods separately prior to undertaking mixed-methods research, as the two methods require different skills to be applied (Creswell & Clark 2018; Halcomb 2019). Research involving mixed methods requires a range of skills, such as the ability to design studies that effectively combine quantitative and qualitative techniques, to analyse and interpret data collected from both methods, to possess strong critical thinking skills, to be familiar with different types of mixed-methods research designs, to be proficient

in data analysis software, and to work well as a team member (Creswell & Clark 2018). Additionally, researchers should be aware of ethical considerations and implications when using both quantitative and qualitative methods (Creswell & Clark 2018). It is recommended that researchers be familiar with both quantitative and qualitative research procedures for collecting and analysing data. Furthermore, a comprehensive understanding of how qualitative and quantitative data can be combined is also critical for those involved in mixed-methods research (Creswell & Clark 2018). Therefore, this type of research requires researchers to have skills in both qualitative and quantitative research methodologies. This is because the difference between mixed methods and other research approaches (e.g. multimethod) can be misinterpreted by researchers without the appropriate skills (Halcomb 2019). The difference between mixed methods and multimethod can be expressed as the fact that multimethod involves gathering a variety of qualitative or quantitative data, without integrating them until inferences are drawn (Anguera et al. 2018; Johnson et al. 2007). However, management and analysis of mixed-methods studies require more resources since two types of data must be collected, as well as a large volume of data.

3.9 Research study design

Creswell and Clark (2018) claim that employing mixed methods is challenging and designs should be utilized based on their advantages. The overall aim of this research study was to explore the factors that influence the adherence of nurses in intensive care units in Saudi Arabia to VAP prevention guidelines. Based on pragmatic knowledge, the sequential explanatory mixed-methods design was selected as the most applicable design to achieve the goals and objectives of this study. This study conducted and implemented a quantitative study followed by a qualitative study. The use of this design provided a deeper understanding of the research phenomena than if qualitative or quantitative methods were solely utilized (Creswell & Clark

2018). The sequential explanatory design is most appropriate for research studies initiated by quantitative research methods (Creswell & Clark 2018). Thus, utilizing a mixed-methods approach in this study strengthened the breadth and depth of the study of the factors that influence nurses' adherence to VAP prevention guidelines (Al-Mugheed et al. 2022).

Figure 3.4 illustrates the research design of this study. In phase I, quantitative data were collected to assess ICU nurses' current adherence to three recommendations from VAP prevention CPGs. This provided the researcher with statistical evidence and numerical data for this study. Two data collection methods were used in this phase: an audit of current practice (including two observation checklists and medical record review) and a self-administered questionnaire. The results from this phase helped the researcher to develop phase II, where qualitative methods (Zoom interviews) were used to further examine and understand factors influencing ICU nurses' adherence to the VAP prevention guidelines. The integrated findings from phase I and phase II helped the researcher to present a holistic view and comprehensive summary of the level of ICU nurses' adherence to VAP prevention guidelines and generate recommendations and strategies for the implementation of VAP prevention CPGs in Saudi Arabia. Since little research has been conducted on nurses' adherence to VAP prevention guidelines in Saudi Arabian ICUs, a study design that integrated multiple perspectives was needed.

Quantitative techniques enabled the researcher in this study to collect data from ICU nurses in two participating hospitals. Qualitative techniques, on the other hand, allowed for a more in-depth understanding of the subject under investigation while also honouring the participants' opinions. The quantitative data added breadth to the study, but the qualitative data added depth to it. Subsequently, both findings were merged together via an integration technique to provide a comprehensive understanding and to draw an overall conclusion regarding the research phenomenon (Dawadi, Shrestha & Giri 2021) (Figure 3.4). By merging

two sets of strengths while adjusting for the flaws of each approach, a mixed-methods design offers the highest chance of answering research questions (Johnson, Onwuegbuzie & Turner 2007).
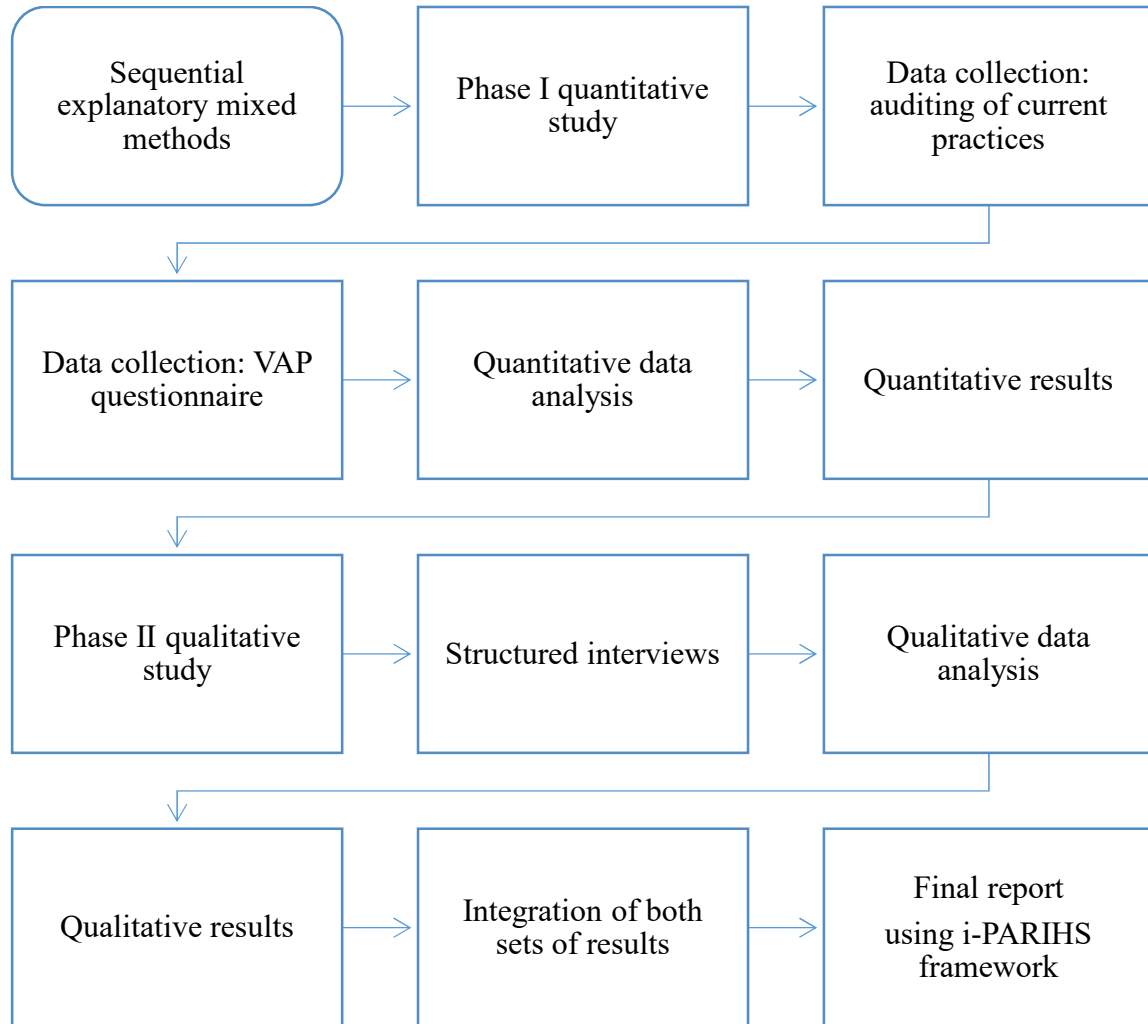
Figure 3.4. Current study sequence utilizing a mixed-methods explanatory sequential design (adapted from Creswell & Clark 2018)

This PhD study was carried out to advance the field of implementation science in the healthcare context of Saudi Arabia, focusing specifically on the factors influencing ICU nurses' adherence to VAP prevention guidelines. This effort is expected to positively impact ventilated patient outcomes and enhance the practices of ICU nurses (Al-Mugheed et al., 2022; Al-Tamimi, Refaat & Issa 2022). Emphasizing the importance of theoretical frameworks in implementation science, Nilsen (2020) highlights their role in offering a structured and

systematic approach to understanding the factors contributing to the success or failure of such efforts. To achieve this, the study utilized the integrated Promoting Action on Research Implementation in Health Services (i-PARIHS) framework to assess and discuss the integrated study findings, facilitating a comprehensive exploration of the factors influencing ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia.

The i-PARIHS framework has derived from the original PARIHS framework (Harvey & Kitson 2016; Kitson, Harvey & McCormack 1998; Kitson et al. 2008; Rycroft-Malone et al. 2002; Rycroft-Malone et al. 2004), which was developed to help explain the complexity of successfully implementing evidence into clinical practice (Kitson, Harvey & McCormack 1998). The i-PARIHS framework is an established framework within the nursing profession which is most commonly used in clinical practice (Birken et al. 2017; Mekki et al. 2017). The i-PARIHS framework is a multidimensional theoretical framework that illustrates the complexity of factors associated with implementing evidence-based practice (Harvey & Kitson 2015). The framework attempts to identify and comprehend the crucial elements involved in the implementation of evidence-based practices, by synthesizing information obtained from previous projects aimed at enhancing practice development, improving quality and conducting research (Harvey & Kitson 2015; Rycroft-Malone et al. 2004). Further detail on the employed framework is presented in chapter 8.

3.10 Mixed-methods ethical considerations

A successful research study requires consideration and implementation of ethical considerations. This means that in all phases of the research process, from the creation of the research questions to the interpretation of the results, researchers must consider research ethics (Creswell & Clark 2018). Wong and Nather (2015) argue that ethics has to be a primary concern when planning a study, and should be carried through to the fieldwork and the final

report. While Stadnick et al. (2021) agree that researchers should be familiar with research ethical conduct guidelines, they should also ensure that they implement these guidelines. Furthermore, Preissle et al. (2015) have claimed that ethical issues in mixed-methods research continue to remain unexplored in the field of health science and this is supported by Stadnick et al. (Stadnick et al. 2021) in their comprehensive review that revealed no empirical studies on mixed-methods ethics that contribute to the advancement of ethical mixed-methods research practices. Consequently, attention needs to be paid to the ethical considerations and the practice of ethics within mixed-methods studies.

This PhD study was carried out in accordance with the principles of ethical research in human subjects and these were followed throughout all study phases. Preliminary ethics approval was obtained from the Saudi Ministry of Health in advance of the commencement of the research (Appendix 7). This was due to the nature of data collection in the phase I study, which involved an audit of current practice, using a combination of direct observation and medical record review, and a questionnaire survey. Later ethics approval was obtained from the Human Research Ethics Committee (HREC) at the University of Adelaide (Approval Number: H-2019-100) (Appendices 8 and 9). Ethics approval from the HREC was obtained in two stages, so separate ethics applications were submitted for each phase of the study. Further details on these ethical approvals are provided in the following chapter 4.

An amended ethics application was submitted and approved for the phase II study. This was due to the nature of the study design that the qualitative study was built upon the results of the quantitative study. In addition, the phase II study was originally planned to be conducted via face-to-face interviews. However, due to the ongoing global pandemic and the restrictions imposed by the Saudi government to prevent the spread of the Coronavirus disease (COVID-19), it was necessary to get an amended approval to alter the interviews data collection methods using online meeting software (Zoom). Thus, all ethics approvals were obtained in accordance

with the National Statement on Ethical Conduct in Human Research 2007 (updated 2018) involving no more than low risk for research participants. Further specific ethics considerations for the quantitative and the qualitative phases are discussed in the following chapter of this thesis, where each study method is discussed in more detail.

3.11 Chapter summary

This chapter provided an overview of the study methodology. A sequential explanatory design was selected in order to guide the study and to answer the research questions that were presented in Section 1.5. An overview of the study's research paradigm was presented, including its appropriateness and fit within the study. The chapter outlined the rationale behind using a sequential explanatory design to examine the factors that influence the adherence of Saudi Arabian ICU nurses to VAP prevention guidelines. The study used two types of data, quantitative and qualitative, which incorporated the benefit of the generalizability of the quantitative data and the ability to explore insights in depth in the qualitative data. This provided a comprehensive and thorough understanding of ICUs nurses' adherence and produced recommendations and strategies for the implementation of VAP prevention guidelines in Saudi Arabia. The following chapter describes the methods used in the quantitative and qualitative components of this study.

Chapter 4: Methods

This chapter details the research methods used for data collection and analysis. This chapter describes the quantitative methods used for phase I and then the qualitative methods for the phase II study. In this study, the research process was undertaken sequentially by employing an explanatory sequential design. An overview of the study design, setting, recruitment process, sample size and data analysis is provided in this chapter. Further details on the results along with a discussion of the integrated findings will be presented in the following chapters.

4.1 Research process

The research process was designed to sequentially gather both quantitative and qualitative data to address the research questions. The research process involved conducting the two study phases independently, in order to gather specific types of data that would be useful for assessing the factors that influence ICU nurses' adherence to VAP prevention guidelines. Table 4.1 presents an overview of the sequential explanatory design based on a pragmatic approach and is discussed in Section 3.3.3. The findings of the two studies were integrated to provide a broader context and deeper understanding of the research questions and phenomena under investigation (Dawadi, Shrestha & Giri 2021).

4.2 Phase I: Methods for the quantitative study

This section presents details on the quantitative research study, which corresponds to phase I of the sequential explanatory mixed-methods design studying factors that influence ICU nurses' adherence to VAP prevention guidelines. In phase I of the study, the primary objectives were:

1. To describe ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia with a focus on OH, elevation of HOB and HH interventions.

2. To describe the characteristics of the guideline users, guideline quality, and the contextual factors influencing ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia.

To guide the data collection and analysis, a quantitative cross-sectional design was employed. Further details on phase I study is provided in the following sections.

Table 4.1. Research process overview

Study phase	Approach	Method	Setting	Sample	Data collection	Data analysis
1	Quantitative	Cross-sectional audit & direct observation	Two hospitals	ICU Nurses	Audit of current practice observation checklists and medical record review	Descriptive statistics
	Quantitative	Cross-sectional survey	Two hospitals	ICU nurses	Questionnaire survey	Descriptive & inferential statistics
2	Qualitative	Exploratory interviews	Two hospitals	ICU nurses	Structured interviews	Inductive content analysis

4.2.1 Study design

A quantitative phase was the first step in the sequential explanatory mixed-methods design. Quantitative research methods have been developed in the natural sciences with the aim of studying both natural and social phenomena (Gray & Grove 2018), as well as describing, comparing and attributing participant opinions (Grove, Gray & Burns 2014). Apart from this, Nieswiadomy and Bailey (2018) describe that nursing research using quantitative methods is intended to describe new cases, events or concepts, to analyse relationships among variables, and to assess the effectiveness of treatment or intervention on healthcare outcomes worldwide. Researchers may select a quantitative method in order to collect, analyse, interpret and present information in a numerical form since the results will be based on objectivity, rigour and control (Teddlie & Tashakkori 2009). In cases where a researcher relies heavily on narrative information, the research method will usually be classified as qualitative (Bradshaw, Atkinson & Doody 2017).

This study began by using quantitative methods as it was important to determine the correlation between variables related to ICU nurses' adherence to VAP prevention guidelines in the first phase of the investigation. Creswell and Creswell (2018) point out that quantitative methods are less capable of obtaining an in-depth understanding of a specific "fact" or exploring its details. Quantitative research can, for instance, identify a correlation between people's level of adherence to clinical practice guidelines, but it does not explain the significance of their differences (Polit & Beck 2020). Creswell and Clark (2018) have pointed out that quantitative research is frequently subject to criticism due to its limited capability in capturing the complete spectrum of individual experiences. This method limitation is minimised in this PhD study by the use of mixed-methods study that includes qualitative research. Quantitative methods are therefore the process of analysing data and gaining knowledge about phenomena of interest (Nieswiadomy & Bailey 2018). Therefore, with little

research conducted on nurses' adherence to VAP prevention guidelines in the ICUs of Saudi Arabia, a design that would contribute to knowledge from multiple perspectives was necessary.

The phase I study employed a cross-sectional design. The choice of this method was initially driven by the research study's aim (Nieswiadomy & Bailey 2018). The design was seen to be appropriate for this study as numerical research data were collected from participants. The data collection procedure involved an audit of current practice, using a combination of direct observation and medical record review using a non-participant approach (Twycross & Shorten 2016), and a self-administered questionnaire. The design used in this study enabled the researcher to formulate a surface understanding of the underlying issues through an organized process of handling the research problem and collecting and analysing data. Using such a design enabled the researcher to assess ICU nurses' adherence to VAP prevention guidelines at a certain point in time.

4.2.2 Research site and setting

The phase I and II studies were both undertaken in two tertiary healthcare services, Hospital 1 and Hospital 2, that have large critical care services in the capital city of KSA, Riyadh City. Other types of hospitals, including primary and secondary healthcare services, were excluded based on the size, number of ventilators and number of critical care nursing staff. Furthermore, it is important to note that I, as the researcher, am also involved in teaching and working at these two hospitals included in this PhD study. The two hospital administrations provided support and cooperation to facilitate the conduction of this research. Additionally, the scope of this PhD study was limited to the two hospitals, as obtaining ethics approvals for including other tertiary healthcare services in Riyadh were not granted, particularly for the phase I study, which involved observation and auditing of nurses' practices. The two participating hospitals are Saudi governmental tertiary care hospitals under the management of the Ministry of Health

(MOH), offering a mix of free public healthcare services and those covered by private insurance. The two hospitals have achieved prestigious recognition for their healthcare services, having received accreditation from the Saudi Central Board for Accreditation of Healthcare Institutions, Joint Commission International accreditation and Accreditation Canada. Having these accreditations demonstrates the hospitals' commitment to providing accredited healthcare services at the highest level. Despite the presence of evidence-based centres in those two hospitals, the hospitals' implementation of clinical practice guidelines in relation to the prevention of VAP remains underexplored.

4.2.2.1 Participating hospitals' specifications

Hospital 1 is a tertiary healthcare centre with a total capacity of 1215 beds and consists of eight hospitals/centres. Hospital 1 has one of the most developed critical care services in Saudi Arabia and Middle East, with approximately 76 ICU beds that are equipped with mechanical ventilators in four ICUs: Neuro Critical Care, Cardiovascular Intensive Care, General Intensive Care and High Dependence Intensive Care. Based in Riyadh, Saudi Arabia, Hospital 1 is recognised as one of the largest advanced healthcare hospitals in the Middle East and has a special continuing educational training nursing department for nurses. Hospital 2 is a tertiary healthcare centre with a total capacity of 1200 beds. It is one of the largest hospitals in Riyadh City, and has advanced health care, an evidence-based centre and continuing nursing education health research department and a multidisciplinary health research centre with several specialty healthcare departments. Hospital 2 has four adult ICUs including Medical, Cardiac, Cardiac Surgical and Neurosurgical ICU with a total number of 97 ICU beds. Of these, 58 ICU beds are equipped with mechanical ventilators. Both hospitals adopted a work schedule system in ICUs, with clinical nursing staff working 12-hour shifts and ICU nurse managers and educators working 8-hour shifts. This consistent approach to scheduling ensures that staffing levels and

resources are optimized to provide high-quality patient care in all ICUs, promoting a high standard of care across ICUs.

4.2.3 Study population

The population of interest of this study were registered nurses working in adult ICUs in the two participating hospitals. Registered nurses or clinical staff nurses are responsible for direct care of patients. At the time of the study, there were approximately 562 staff nurses working in the adult ICUs in both participating hospitals. ICU nurses who attended patients undergoing mechanical ventilation and/or spontaneously breathing using a mechanical ventilation airway (e.g. endotracheal tube or tracheostomy) were eligible for inclusion. Those nurses who were not a part of the ICU staff (i.e. those who worked in the ICU only occasionally/part time), and those who were assistant nurses, nurse educators or managers and other healthcare professionals were excluded from the study. To gain an understanding of what is happening in everyday nursing practice in ICUs, the researcher collected data in all 8 ICUs of the participating hospitals by auditing current practice and medical record review using non-participant observation. Because the aim of the study was to assess the level of ICU nurses' adherence to the VAP prevention guidelines, the study population included all registered nurses who provided direct care to critically ill patients requiring mechanical ventilation with no absolute contraindication (e.g., pelvic fracture, suspected or confirmed spinal injury and prone positioning) were included in the study to assess nurses' OH, elevation of HOB and five moments HH practices.

4.2.4 Study sample

The research approached a non-probability convenience sample by inviting all accessible and eligible adult ICU nurses to participate in order to provide a snapshot picture of the current

practice of ICU nurses in Saudi Arabia. The convenience sampling technique is a non-random sampling technique that allows the researcher to collect information from participants who are easily accessible. A convenience sampling technique is a method of non-probability sampling that entails selecting participants based on their level of availability, and it is generally considered to be an easy method to implement since it is relatively inexpensive and accessible (Bryman 2016; Polit & Beck 2012). Choosing alternative sampling methods, such as random sampling, was deemed inappropriate for this study. This decision was driven by the apprehension that, given the total staff nurse population of 562, such a method might limit the study participants. Consequently, opting for a convenience sampling technique becomes imperative to ensure a more thorough inclusion of available participants and to minimize the risk of undersampling specific segments of the population. A convenience sample is a widely accepted sampling technique in nursing studies (Cruz et al. 2016; Nieswiadomy & Bailey 2018; Schallom et al. 2015); and in studies that examine nurses' adherence to VAP prevention guidelines (Aloush 2018; Jansson et al. 2013; Jansson et al. 2018). The following section discuss the study instruments employed in this study.

4.2.5 Study instruments

4.2.5.1 Audit of current practice tools

A clinical audit is a quality improvement method that aims to enhance patient care and outcomes by systematically reviewing care against predetermined criteria and implementing changes. A clinical audit is a method of determining if healthcare practices are being provided to patients in accordance with standards of care, and it helps care professionals to see where a service is performing effectively and where improvements in patient care are needed (Esposito & Dal Canton 2014). Internal audits are an important part of every organisation's internal control. When they are effective, the organisation's internal control is effective (Malakia &

Angula 2021). Auditing of current practice can assist the entire practice team to objectively evaluate the care they provide and improve outcomes (Mosedale 2019).

The researcher developed two audit tools to collect research data for OH and elevation of HOB practices. In addition, a validated observational form for HH practices that was adopted from Hand Hygiene Australia (HHA) and the National Hand Hygiene Initiative (Ryan et al. 2012) was utilized, as recommended by the World Health Organisation (WHO) (Sax et al. 2009). The use of a validated observation tool for assessing HH adherence has been considered a gold standard by the WHO (Gould, Drey & Creedon 2011; Haas & Larson 2007). The two audit tools were developed based on the evidence-based recommendations for OH and elevation of HOB recommendations from VAP prevention guidelines (Institute for Healthcare Improvement 2012; Klompas et al. 2022; Klompas et al. 2014; Magill et al. 2013; SARI Working Group 2011; Tablan et al. 2004; Canadian Patient Safety Institute 2012). These two audit tools were designed to gather data on the implementation of the two key recommendations for VAP prevention, as outlined in the guidelines. By using these audit tools, the researcher was able to collect research data for OH, elevation of HOB, and HH practices in ICUs and to provide a snapshot of what is happing in practice with ventilated patients. The following section presents a detailed description of the components of the audit tools developed and used to assess nurses' adherence to the three key recommendations from the VAP prevention guidelines.

4.2.5.1.1 Components of two developed auditing tools

The two VAP prevention recommendations that were audited were: the provision of OH with 0.12% oral chlorhexidine solution to prevent colonization of the aero-digestive tract, and elevation of HOB between 30° and 45° to prevent aspiration (Institute for Healthcare Improvement 2012; Klompas et al. 2022; Klompas et al. 2014; Magill et al. 2013; SARI Working Group 2011; Tablan et al. 2004; Canadian Patient Safety Institute 2012). . See

Appendices 1 and 2 for the developed tools for auditing of current practice. The observational checklist had two parts. The first consisted of general items: day and time, type of ICU unit, hospital name, and the nursing shift (day/night and week/weekend). The second part included the VAP prevention recommendations with one option item: 'performed' as per recommendations and for 1 mark and 'not performed' for zero marks (see Appendices 1 and 2). The audit tools were in the English language as per the participating hospitals' English language policy. The initial draft of the observational checklist was revised and validated by a panel consisting of two nursing faculty members, one infection control specialist, and two ICU nurses. The panel agreed with the content of the checklist and recommended adding a column of notes to document the reasoning for non-performance if the nurse missed or was inconsistent with the recommendations.

4.2.5.1.2 Hand hygiene observation tool

The HHA hand hygiene observation form was utilized to assess the implementation of the HH recommendations. The HHA observational form was adopted based on the original WHO "My Five Moments for Hand Hygiene" to complement the Australian definitions and avoid ambiguous terminology (Ryan et al. 2012) (see Figure 4.1). As an example, the term "contact" was changed to "touching" in order to improve clarity. Therefore, the phrase "Moment 1 – Before Patient Contact" was changed to "Before Touching a Patient". The reason for employing the HHA observation form was it was considered appropriate for this study as HHA provides auditors with a comprehensive training/learning package, and free online resources. In addition, HHA offers a coding sheet that functions as a guide to accompany the data collection form, with the purpose of improving the accuracy of data entry. The coding sheet provides clear instructions and examples to help ensure the accuracy of the collected data. Thus, the HHA Five Moments for HH observational tool was used in this study to collect research data on nurses' HH practice. The adopted HHA observational form allowed the
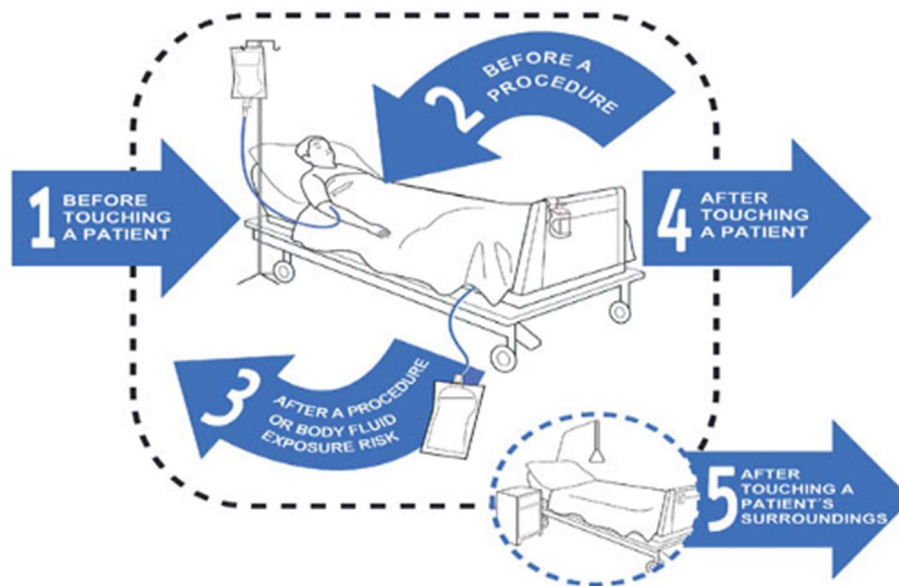
researcher to record the type of healthcare worker being observed, the moment being observed, the HH action being used, and whether disposable gloves were worn during the episode of care. Appendix 3 is the utilized HHA observation form for HH.

Figure 4.1. HHA Hand Hygiene Five Moments (Source: Hand Hygiene Australia 2019)

4.2.5.2 Questionnaire

An existing and validated VAP questionnaire developed by Kiyoshi-Teo (2011); Kiyoshi-Teo et al. (2014) was used to examine four domains of interest: guidelines user attitude, guidelines adherence, guidelines quality and contextual factors (see Appendix 4). The VAP questionnaire was piloted by Kiyoshi-Teo et al. (2014) via several steps, assessing face and content validity and critical care nurses' expert feedback. Kiyoshi-Teo et al. (2014) performed preliminary analysis to test survey reliability and validity with 1 hospital (n = 122), as well as to enhance the survey further. The VAP prevention questionnaire has been used in several studies to capture nurses' perceptions and factors relating to VAP prevention adherence (Kiyoshi-Teo et al. 2014; Luna 2015; Zand et al. 2017). Permission to use VAP questionnaire was obtained and

it was appropriately modified by excluding the Spontaneous Breathing Trial (SBT) section as it was not relevant to the study aim (see Appendix 17).

The VAP prevention questionnaire consisted of two parts: socio-demographic background data and VAP prevention questionnaire items. The socio-demographic data (8 questions) included data related to individual characteristics, namely age, gender, nationality, years of nursing experience, years of clinical experience in ICUs, number of ventilated patients cared for in the last 2 weeks, educational qualifications and speciality nursing status (Kiyoshi-Teo 2011; Kiyoshi-Teo et al. 2014). The VAP prevention questionnaire comprises sixty-eight questions that are divided into four main components in relation to each of the three recommendations from the VAP prevention CPGs: guidelines user, guidelines self-reported adherence, VAP prevention guidelines quality and contextual factors (Kiyoshi-Teo 2011; Kiyoshi-Teo et al. 2014). Each section on the prevention recommendations begins with questions around prioritizing awareness followed by questions addressing user attitude about the guidelines, questions about guidelines quality, questions regarding contextual factors of the VAP prevention guidelines and concludes with questions to capture adherence to the guidelines for the prevention of VAP. The VAP prevention questions on nurses' adherence to guidelines and contextual factors are rated with a 4-point Likert scale and are presented in Appendix 4.

4.2.6 Ethical considerations

Ethics approvals from all concerned organisations were obtained and the researcher complied with their specifications as described in Section 3.10. Before seeking ethical approvals from the hospitals involved, a preliminary ethics approval was obtained from the Saudi Ministry of Health prior to initiating the research. (Appendix 7). This quantitative study was approved by the Human Research Ethics Committee at the University of Adelaide and the institutional review board (IRB) in both participating hospitals (see Appendices 8, 10 and 11). The study

was anonymous in that responses were linked to the ICU unit and not to individuals. Participants were told that participation in the study was completely voluntary and that they could withdraw at any time.

4.2.6.1 Obtaining consent

Nurses' participation was voluntary, and an opt-out consent process was performed. This consent procedure was seen be less disruptive to nursing staff during their care with ventilated patients compared to individually requesting them to sign a written consent form. During the audit of current practice, no identifying data were collected, ensuring low-risk involvement in the research. Thus, ICU nurses who provided direct care to ventilated patients and agreed to participate in the audit were not required to sign a consent form. However, those who chose not to participate had the option to opt out by contacting a member of the research team using the contact information in the participant information sheet and data collection flyer (see Appendices 5 and 6). A waiver of consent was obtained for the audit of medical records in this study as no identifying information was collected, and the data of interest was limited to documenting oral hygiene practices within the last 24 hours. This was because obtaining direct consent from acutely unwell and intubated patients was impractical. This approach prioritized patient care, privacy and confidentiality while ensuring the research's feasibility and integrity.

Completion of the questionnaire was considered as consent to participate in the survey. No personal information was accessed or collected during the research. ICU nurse participants were not required to provide personal information when completing the questionnaire. The researcher affirmed that participation in this research study did not pose any anticipated risks to the participants involved. However, the primary burden of participation for the nursing staff was the time required to complete the questionnaire, which took approximately 30 minutes. There were no expected risks to the patients involved in the study. Because the sample size for the questionnaire survey was relatively small and included the collection of some demographic

information, participants were informed that complete anonymity could not be guaranteed. However, every effort was made to ensure that no personal identifying details were disclosed. Confidentiality and privacy were strictly maintained, and participants' views and opinions were not publicly accessible in a personally identifiable manner.

4.2.7 Pilot study

A pilot study has been defined by Nieswiadomy and Bailey (2018, p. 65) as a "miniature trial version of the planned study". A pilot study refers to a small-scale version of a research study or a series of actions taken to ensure the quality of the future data collection efforts (Hertzog 2008). This can be seen as an initial step towards data collection, which consists of gathering a limited amount of data before approaching study participants and conducting the actual study (Nieswiadomy & Bailey 2018). A pilot study provides a means of testing new or modified instruments and can reveal unforeseen issues. A pilot study may indicate that participants of different age groups are facing difficulties in understanding a questionnaire, even though the researcher may assume that the questionnaire is easy to understand.

Prior to commencing data collection, the current study was piloted within one ICU (Surgical ICU). The purpose of this pilot was to examine the practicability of implementing the developed study tools and permit the researcher to identify potential refinements or preemptive solutions for challenges in the data collection process. A primary objective of the initial stage was to assess the feasibility and lucidity of the two observation tools (OH and HOB elevation), as well as the HH Five Moments questionnaire. In addition, the questionnaire was administered to 6 ICU staff nurses and 3 nurse managers who were distinct from the main study. This step aimed to solicit participant feedback to unearth potential challenges, ambiguous sections, or redundancies. The outcomes from this stage informed the fine-tuning of the definitive research tools, ensuring their feasibility and suitability for incorporation into

the main study. Furthermore, the results of the pilot study were not taken into account when analysing the data for the study.

4.2.8 Data collection

The study data collection process began after obtaining ethics approval from the University of Adelaide and the institutional review board in both participating hospitals (see Appendices 8, 10 and 11). Prior to the data collection, the researcher approached the managers/directors of the ICUs to introduce the study and discuss conducting the study in their units as well as to arrange a time to deliver information sessions to the staff nurses. The researcher presented the overall goals and objectives of the study and expressed the belief that participants would not be harmed by participating in the study. During an information session, the researcher visited each ICU in the two participating hospitals and distributed Participant Information Sheets (PIS) and flyers (see Appendices 5 and 6). The flyer was used to raise awareness of the study. The presentation aimed to describe the overall study objectives, benefits and risks, and to answer any related questions about the study. The researcher attended each ICU during day and night shift on both weekdays and weekends and delivered a short presentation (approximately 5 minutes) at the beginning of the working shift. The information sessions provided potential participants with an overview of the study and addressed any questions they had. The PIS were distributed to nurses who attended the information session. For those staff who did not attend the information sessions, extra copies of the PIS and flyers were placed at the nursing station to invite them to participate. In addition, extra copies were available from nurses' managers to share with nursing staff. Nursing staff were informed that participation in this study was voluntary.

The researcher collected audit data using the developed audit tools. When auditing was completed on each unit, the questionnaire was distributed to all potential nurses to minimize

the potential for a Hawthorne effect (Nieswiadomy & Bailey 2018). Data collection for phase I occurred over 12 weeks; one week for the pilot study, one week for each ICU (8 ICUs in total) and two more weeks for collecting questionnaires. The researcher conducted a comprehensive audit of the three recommendations from the VAP prevention CPGs in all participating ICUs, attending each ICU four times within a week. These visits included two visits during weekdays, with one during the day shift and one during the night shift, lasting 12 hours each. Additionally, two visits were conducted during the weekend, encompassing one day shift and one-night shift. In total, the researcher performed 62 ICU visits to thoroughly assess adherence to the VAP prevention guidelines. Each data collection visit lasted 12 hours, covering the entire nursing shift, as the researcher audited ICU nurses' adherence to the three recommendations from VAP prevention CPGs (OH, HOB and HH). The auditing day commenced by consulting the head nurse to determine which patients were on ventilation and which patients were contraindicated for head elevation. Once this information was established, the researcher proceeded to audit bed heights and observed HH opportunities, while periodically reviewing the patients' medical records retrospectively for oral hygiene.

On the final day of auditing in each ICU, survey packages were distributed to the ICU nurses. These packages consisted of a participant information sheet, which included information about the purpose and ethical considerations of the study, as well as the VAP prevention questionnaire (see Appendix 4). The questionnaire survey tool was distributed as a printed hard copy in English. The survey packages were placed at each ICU nursing station so that participants could complete the survey in their own time. The researcher placed a secure box at each ICU nursing station for the return of anonymous completed questionnaires. Each week, the researcher followed up to collect the completed questionnaires and reminded other participants to maximize the response rate.

4.2.9 Data analysis

In consultation with a biostatistician, the researcher used Statistical Package for Social Sciences (SPSS), version 25.0 (SPSS Inc, Chicago, Ill, USA) for statistical analysis of the quantitative data. The first stage of data entry involved constructing the entry base and coding of variables, followed by actual data entry. At the analysis stage, data cleaning and data management for the variables of interest were performed. Descriptive analysis including figures, frequency tables and cross-tabulation were used to describe the main features of the data. Multivariable multi-level binary logistic generalized estimating equation models were applied using socio-demographic and clinical factors as independent variables and OH, elevation of HOB and HH adherence as the dependent variables. The regression model was tested with a full set of predictors and the predictors with highest p value were eliminated in turn. This analysis technique continued until the remaining predictors in the model reached the stopping rule of a p value less than 0.5. A chi-square test was used to examine the relationship between ICU nurses' self-reported adherence and observed adherence to the three recommendations from VAP prevention CPGs. A confidence interval of 95% and p-value ≤ 0.05 was considered statistically significant. The quantitative study analysis benefited from the consultation and expertise of a statistician from the University of Adelaide who provided valuable guidance and assistance in the analysis of the collected research data.

4.3 Phase II: Methods for the qualitative study

This section presents details on the qualitative research study, which corresponds to phase II of the sequential explanatory mixed-methods design studying factors that influence ICU nurses' adherence to VAP prevention guidelines. Since phase II aimed to gain a deeper, more comprehensive understanding of the key results from the quantitative phase I study. In phase II of the study, the primary objective was:

1. To explore ICUs nurses' beliefs and experiences of the factors that influence their adherence to VAP prevention guidelines in Saudi Arabia.

A qualitative descriptive exploratory approach was employed to guide the data collection and analysis. Further details on the phase II study are provided in the following sections.

4.3.1 Qualitative research

Following the explanatory sequential design, a descriptive qualitative approach was employed in the second phase of the study. Qualitative research is defined by Holloway and Galvin (2016, p. 3) as a "form of social inquiry that focuses on the way people make sense of their experiences and the world in which they live". Qualitative research is primarily designed to focus on listening carefully to respondents in order to gain greater insight into the study topic (Bradshaw, Atkinson & Doody 2017). The use of qualitative interviews is one of the primary methods of collecting qualitative data in research studies (Creswell & Creswell 2018). In contrast to quantitative research methods a qualitative approach allows for a more contextualized exploration of subjective experiences (Crowe, Inder & Porter 2015). Even though the procedures for interpreting texts differ from those for statistical analysis, robust and transparent principles of analysis are of equal concern (Malterud 2001). What is different is that qualitative and quantitative approaches differ significantly in terms of acceptable sample size and the terminology describing individuals taking part in a study (Boswell & Cannon 2022). Rather than being viewed as incompatible, qualitative and quantitative research can be viewed as complementary (Jamshed 2014).

4.3.2 Choosing a qualitative approach

The approach and methodology selected by researchers is primarily based on scientific logic, not on a sense of ease or intrigue. To construct a deep and holistic understanding of the issue

under investigation, a descriptive exploratory approach using structured interviews was employed for this qualitative study (Creswell & Creswell 2018). This approach plays a crucial role in capturing the unique experiences of individuals and gaining a deeper understanding of the surrounding context (Polit & Beck 2020). This design has gained significant acceptance in healthcare settings because it provides a holistic perspective and thorough overview of specific phenomena (Grove, Gray & Burns 2014). According to Lambert and Lambert (2012) a qualitative descriptive approach is designed to describe everyday events experienced by individuals or groups of individuals in a qualitative manner. This approach can be ideal when describing a unique phenomenon. The main goal of this approach is to obtain an in-depth understanding of a phenomenon, focusing first on textual description (Sandelowski 2010) and then studying the phenomenon by analysing and interpreting the meaning that individuals attribute to certain situations (Bradshaw, Atkinson & Doody 2017). The use of this approach is particularly relevant where information is required directly from participants, where time and resources are limited and perhaps as part of a mixed-methods design (Neergaard et al. 2009).

4.3.3 Structured interviews

Qualitative interviews provide researchers with the opportunity to delve deeply into issues with participants, enabling the emergence of new insights and perspectives (Bradshaw, Atkinson & Doody, 2017). While there are different types of interview data that researchers can collect, it is crucial to identify the most suitable data forms that offer rich information about the phenomenon under investigation (Creswell & Clark, 2018). By selecting the appropriate data collection methods, researchers can obtain valuable and comprehensive insights into the topic of interest (Nieswiadomy & Bailey 2018). Mitchell (2015, p. 45) indicates that there are three types of interviews in nursing research, ranging from structured, semi-structured and

unstructured interview. Structured interviews constituted the main data collection technique used in this phase II study. This choice was made to gather comparable data from all participants regarding straightforward information, ensuring consistency for data analysis and comparison (Lincoln, Lynham & Guba 2018). Structured interviews involve asking the same questions, in the same order, and in the same manner of all respondents in a study. Structured interviews are most appropriate when straightforward information is desired (Bryman 2016). The use of the structured interview is particularly relevant where information is required directly from those experiencing the phenomenon under investigation, where time and resources are limited and perhaps as part of a mixed methods approach (Neergaard et al. 2009).

4.3.4 Interview guide

Study participants were asked to reflect on the issues in their own words, which provided more credibility and face validity for the data. The researcher developed an interview questions guide that has been planned in detail because one of the main purposes of this type of interview is to produce data that can be compared across respondents. The interview guide was designed to build on the results of the phase I study to explore ICU nurses' experience of the VAP prevention guidelines in more depth (Appendix 12). The quantitative results described the level of ICU nurses' self-reported and observed adherence to three recommendations from VAP prevention guidelines. Self-reported adherence was significantly higher than observed adherence for each of the three recommendations. While there was no significant variation in observed adherence to OH and elevation of HOB between time of the week or the nursing shift, HH was significantly better on weekdays and during daytime shifts. Hospital 2 was better in observed adherence across all three recommendations. One factor was found to be statistically associated with self-reported adherence to all three recommendations from the VAP prevention guidelines, namely nursing experience. Therefore, the study results indicated the need to better

understand the factors that influence ICU nurses' adherence to the three recommendations in the VAP prevention guidelines.

The intentional structuring of the interview guide in this study aimed to facilitate a comprehensive exploration of the factors influencing nurses' adherence to VAP prevention guidelines. This structured approach was adopted to ensure a thorough investigation of the subject matter. Ethical considerations were duly considered during the design phase, specifically recognising that inquiring about the disparity between participants' self-reported adherence and reported adherence could potentially be inappropriate and cause discomfort or confusion. Consequently, the interview question guide focused on gaining insights into the underlying factors affecting adherence, without directly probing participants about any potential inconsistencies between their self-reported and reported adherence.

4.3.4.1 Interview guide structure

The interview guide was structured into three main sections (Appendix 12). The questions covered various aspects, including general inquiries about caring for ventilated patients, awareness of guidelines, and specific recommendations for oral hygiene, elevation of the head of bed, and hand hygiene. The first section focused on gathering information about the participants' nursing experience and practices in caring for ventilated patients. The main objective of this section was to gain insights into their expertise and knowledge regarding VAP prevention guidelines. The second section consisted of specific questions related to the recommendations for oral hygiene, elevation of the head of bed, and hand hygiene as outlined in the VAP prevention guidelines. The purpose of this section was to explore the participants' perspectives on the importance and priority of these recommendations, the challenges they faced in adhering to them, and any suggestions they had for addressing barriers. The third section aimed to capture the participants' overall views and experiences regarding the VAP prevention guidelines. This section allowed the researcher to gather the participants' opinions

on the significance of the three recommendations, their prioritization in preventing VAP, and any additional insights or practices they found effective in VAP prevention. Probing questions were included to ensure a smooth flow of the interview and to prompt the participants for further details or insights. The interview guide facilitated open-ended discussions and encouraged the participants to share their experiences and thoughts on VAP prevention guidelines.

4.3.5 Research site and setting

Interviews were conducted in the two tertiary care hospitals in the capital city of Saudi Arabia as described in Section 4.2.2.

4.3.6 Qualitative sampling

In order to explore and gain a deeper understanding of the key findings from the quantitative phase I study, the most appropriate participants needed to be selected, and decisions made about how and where the interviews ought to be conducted. The sample size in qualitative research is typically smaller than in quantitative research (Boswell & Cannon 2022). The findings from phase I, following the sequential exploratory mixed-methods design, assisted the researcher in identifying the relevant participants who were most conveniently accessible. Hence, to comprehensively forge a profound and all-encompassing comprehension of the matter under investigation, a purposive sampling technique was strategically employed. This method involved targeting selected participants recognized for their possession of significant information. Within the realm of qualitative research, purposeful sampling serves as an approach to pinpoint and cherry-pick individuals or collectives distinguished by their reservoir of insightful knowledge (Polit & Beck, 2020). This method revolves around the purpose-driven selection of individuals who harbor comprehensive expertise or extensive hands-on familiarity linked to a particular phenomenon (Creswell & Plano Clark, 2011).

The study population consisted of registered ICU nurses, whose primary bedside responsibility is delivering direct care to ventilated patients in the two participating hospitals. The researcher obtained the sample from registered nurses in different ICUs, such as general, cardiac coronary, medical and surgical trauma ICUs. The researcher was able to obtain many information-rich cases through the sampling technique. The inclusion criteria were registered nurses with a current primary role of delivering critical nursing care to ventilated patients in the two participating hospitals. The sample population consisted of registered nurses with one year or more nursing experience in the direct care of ventilated patients, in adult intensive care settings. Due to the COVID-19 crisis, the original plan underwent adjustments, leading to the modification of the recruitment approach. Instead of in-person interactions, the study participants were recruited via Zoom to ensure safety and compliance with pandemic-related restrictions. All participants required access to and comfort in using Zoom video conferencing technology. The exclusion criteria applied to non-ICU nurses and other healthcare workers.

4.3.7 Ethical considerations

Ethics approvals from all concerned organisations were obtained and the researcher complied with their specifications, as described earlier in Section 3.10. This qualitative study was approved by the Human Research Ethics Committee at the University of Adelaide and the institutional review board in both participating hospitals (see Appendices 9, 18 and 19). The study was anonymous in that responses were linked to the ICU unit and not to individuals. Participants were told that participation in the online Zoom interview was completely voluntary and that they might withdraw at any time. Participants were informed that participating in the research may require approximately 30–45 minutes. The researcher worked with participants to schedule sessions at convenient times, ensuring they had enough time to prepare. The researcher followed the University of Adelaide guidelines on the use of Zoom software, such

as using a password for the interview meeting and a waiting room for the participant. A convenient time for the Zoom interviews was agreed upon with each participant, and a reminder was sent 24 hours before the scheduled interview.

4.3.7.1 Obtaining consent

Participants who agreed to be involved in the Zoom interviews were asked to sign the consent form and return it to the researcher by email, as described in the consent form (Appendix 16). Additionally, the researcher verbally confirmed consent at the start of each Zoom meeting with participants. The researcher asked participants whether they consented to have their Zoom interviews audio and video recorded. If participants did not agree to video recording, they were asked to turn off their camera, and only audio recording was conducted. This ensured that participants had control over their level of participation and maintained their privacy during the interviews. However, participants were informed that the research findings could contribute to the improvement of implementation of VAP prevention guidelines in Saudi Arabia. To minimize social discomfort, the interviews were conducted in a private and confidential setting, ensuring participants' privacy.

4.3.8 Pilot Interview

Qualitative studies delve into personal experiences, using interviews as a primary data collection method (Polit & Beck, 2020). Unlike quantitative methods, qualitative research makes the researcher the primary data collection instrument (Nieswiadomy & Bailey 2018). The researcher needs to be trained in the art of asking questions in such a manner that participants will be able to respond meaningfully and insightfully (Creswell and Clark 2018). Piloting interviews is crucial to refine interview questions and enhance interviewer skills (Creswell & Creswell 2018). This process not only facilitates the assessment of the interview question guide's effectiveness but also offers an opportunity for honing interview skills through

practice interviews. Following the refinement of the interview guide, it becomes imperative for the researcher to ascertain its alignment with the study objectives and appropriateness (Lincoln, Lynham & Guba 2018). A pilot interview was undertaken involving an ICU nurse, along with two nursing researchers. The primary objective of this pilot interview was to enhance the researchers' skills and refine the clarity and comprehensibility of the interview questions. However, the data collected from the pilot interview were not used in the analysis of the interview data. Consequently, as the interview guide questions were deemed suitable for eliciting the requisite data to fulfil the research objective, no substantive modifications were introduced.

4.3.9 Recruitment and data collection

Responding to the COVID-19 pandemic restrictions, all interviews were conducted via video conferencing platform. Originally, the data collection plan was to gather data through face-to-face interview. However, due to the constraints imposed by the pandemic, conducting in person data collection became unfeasible. As a consequence, the data collection approach for this study was adapted to utilize an online video conferencing tool, specifically Zoom. This decision was made considering the practicality and effectiveness of the Zoom software, as it has been successfully employed by other researchers in conducting in-depth interview studies (Gray et al. 2020).

Once all the required ethical approvals were collected, the researcher-initiated contact with the nursing administration department in each hospital and provided them with the ethical approvals and the referral letter from the IRBs to facilitate the qualitative data collection process (Appendices 9, 18 and 19). Subsequently, the researcher sent an email to the managers/directors of each ICU, providing them with the study's written information, including an invitation letter (Appendix 15), advertising flyer (Appendix 14), participant information

sheets (PIS) (Appendix 13), and consent form (Appendix 16), and requested them to forward these documents to potential ICU nurses. Additionally, the researcher requested the ICU educators to distribute and post the study PIS and flyer on the nursing station in each ICU. The study PIS contained details about the study's objectives, potential benefits or risks associated with participation, and the measures taken to ensure participant anonymity. The PIS and flyer were used to raise awareness of the study and encourage the recruitment of the study participants. The provided documents contained the researcher's contact details and those of the principal supervisor, allowing potential participants to reach out via phone or email if they were interested in taking part in the study or had any inquiries.

A total of 20 ICU nurses reached out to the researcher, demonstrating their interest in taking part in this study. All participants who were contacted the researcher were asked to read the PIS, sign the consent form provided, and return it to the researcher. In addition, they were encouraged to coordinate a suitable Zoom interview time with the researcher. Out of the 20 ICU nurses, twelve ICU nurses responded affirmatively, expressing their willingness to participate in the study. All interviews were conducted in the English language and lasted between 30 and 45 minutes on average. The interview data were collected between December 2020 and March 2021 by the researcher using the interview guide.

4.3.10 Qualitative data analysis

Content analysis was used to analyse the interview data. It is the process of analysing the content of narrative data, objectively and systematically, which involves identifying prominent themes and patterns of different types of communication, such as verbal and non-verbal, written or visual. Content analysis is a form of inquiry recommended by several qualitative nursing research experts (Bengtsson 2016; Bradshaw, Atkinson & Doody 2017; Graneheim & Lundman 2004; Krippendorff 2018; Kyngäs 2020). Krippendorff (2018, p. 24) describes

content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use". An inductive approach to content analysis was determined to be effective in obtaining direct information from participants (Kyngäs 2020; Vears & Gillam 2022). In accordance with a qualitative descriptive design, content analysis facilitated a close alignment between the data and the experiences of participants with the VAP prevention guidelines. A description of the steps taken in analysing the interviews will be provided in the following section.

4.3.10.1 Analysis steps

In this study, all audio-recorded interviews were transcribed verbatim using an electronic automated transcription service called "Sonix", which allowed the researcher to immerse himself in the text and gain an empathic understanding of the participants' experiences with the VAP prevention guidelines. In this manner, the opinions expressed by the respondents were adequately documented (Krippendorff 2018). According to Polit & Back (2020), self-transcription offers researchers first-hand experience based on their participation in the interview steps. The transcripts were crossed-checked against the audio files following the initial transcription to ensure the accuracy and clarity of the data (Creswell & Clark 2018). Carefully transcribing responses allows for accurate documentation of opinions expressed by study participants (Krippendorff 2018).

The transcribed interview data were analysed using the five-step process of inductive content analysis (ICA) outlined by Vears and Gillam (Vears & Gillam 2022): read and familiarize, first-round coding – identify big-picture meaning units, second-round coding – developing subcategories and fine-grained codes, refining the fine-grained subcategories, and synthesis and interpretation (Figure 4.1). It is important to emphasize that analysis is ultimately a thought process. Qualitative analysis software NVivo, version 12, was used to manage the transcribed data electronically for the purpose of analysis. This software was not used to

conduct analysis but was helpful in the process of coding all interviews. The analysis was carried out in several steps as follows.


Step 1
- Read and familiarise
- *Open coding process (big-picture) through comprehensive reading*

Step 2
- First-round coding – identify big-picture meaning units
- *Looking for big-picture meaning and line-by-line coding (first round)*

Step 3
- Second-round coding – developing subcategories and fine-grained codes
- *Making refinements/revisions (second-round coding)*

step 4
- Refining the fine-grained subcategories
- *Developing refined coding schema*

Step 5
- Synthesis and interpretation
- *Completion and writing up the results*

Figure 4.2. An overview of the analysis process from planning to reporting (adapted from (Vears & Gillam 2022)

Step 1: Read and familiarize

The researcher familiarized himself with the transcribed data through comprehensive reading to gain an understanding of the whole situation and to determine its significance. The researcher was able to become immersed in the enormous amount of collected data as a result of these steps. During the reading process, some words and passages were interpreted tentatively by the

researcher, and associated thoughts or reflections were highlighted with colours and assigned codes. This step resulted in a more holistic understanding of the meaning behind texts (Vears & Gillam 2022).

Step 2: First-round coding – identify big-picture meaning units

The researcher involved himself deeply by identifying and labelling sections of texts into big-picture meaning. The big-picture is the description of wording used by (Vears & Gillam 2022). Vears & Gillam (2022) stated that "We use the term 'big-picture meaning' to refer to a 'class' or 'type' of content—a broad category of content that is relevant to the research question/s" (p. 117). Thus, the big-picture process was done by looking and reading carefully to find the big picture meaning relevant to the research question. As the researcher became immersed in the data and developed ideas about the categories, all the data was then categorized. The first round of coding involved working through the transcripts in a small section of data and a full set of transcripts were labelled with an initial big picture schema. Starting with a big-picture schema allowed the researcher to move towards the second-round coding without feeling overwhelmed (Vears & Gillam 2022).

Step 3: Second-round coding – developing subcategories and fine-grained codes

The researcher in the second coding step examined the text within each of the sections that were coded as a particular big-picture schema. In each of these sections, coding was performed at a finer level, by going line by line through the text. It is important to keep in mind that second-round coding results in the creation of codes and subthemes within the big-picture schema. A flexible interpretation of the codes was necessary in this step to avoid rigid interpretations. It was after the completion of these initial steps that line-by-line coding (i.e. every line has its own code) was achieved by breaking down the big picture schema into subcategories. This is one of the key steps of qualitative analysis described by many authors (Bengtsson 2016; Krippendorff 2018; Vears & Gillam 2022).

Step 4: Refining the fine-grained subcategories

The next step was summarizing the coding that resulted from the previous step, followed by a comparison and refinement of those fine-grained subcategories. During this comparative process, codes that were repeated and shared common aspects were grouped into new subcategories. The researcher determined whether each set of verbatim data text within each code was appropriate for its respective code after a detailed review. Previously coded data that was considered more appropriate for another subcategory was transferred accordingly. This process revealed codes essentially describing very similar subcategories, which resulted in the merging of the higher level codes. A final stage of the process involved reviewing, refining and defining major categories and subcategories as part of the production of the refined coding schema. A copy of each stage of the development of the final coding schema, three in total, was given to the supervisory team for review and feedback. This method ensured that the analysis was conducted in a logical and consistent manner (Vears & Gillam 2022).

Step 5: Synthesis and interpretation

A critical step in the analysis process is the interpretation of data. The final step consisted of examining the merged refined coding schema to determine if there were any connections between the research aims and each category. A memo supporting this process was prepared. The ICA concluded by determining the abstracted meaning of the refined coding schema, which provided a descriptive summary of the results. Authentic quotations that linked the results with the raw data were selected. This gives the reader a clear picture of how the participants viewed the research problem. All steps of the process were discussed with the supervisors in order to ensure accuracy and agreement of interpretation, thus ensuring the dependability of the findings.

4.3.11 Qualitative data quality

4.3.11.1 Establishing qualitative data rigour and trustworthiness

The term "trustworthiness" refers to the degree to which researchers have confidence in the findings of a qualitative investigation (Connelly 2016). The essential question is whether the instrument(s) used, generated valid data for analysis in order to answer the research question(s). An effective research instrument must provide qualitative measures that ensure that the research results are highly reliable, credible, consistent and transferable (Polit & Beck 2012). Choosing the research sample carefully and allowing the participants to express their views and opinions freely is the key to ensuring accurate qualitative data collection. In qualitative research, rigour refers to the thoroughness and competency of the research. A significant contribution to validity criteria has been made by Lincoln and Guba (1985), who have established the importance of credibility and authenticity as quality indicators. The ability to confirm the information gathered is a sign of rigour in qualitative enquiry. The rigidity or trustworthiness of a qualitative study is assessed by its credibility, dependability, confirmability and transformability (Lincoln & Guba 1985). The following subsections provide more details on these criteria and their applicability to the current study.

4.3.11.2 Credibility

The term credibility refers to the truthfulness and the level of confidence that researchers have in their interpretations and findings. Any measures that are taken in order to enhance the likelihood of credible conclusions are considered credible (Carboni 1995). Lincoln and Guba (1985) highlighted that credibility is the most important aim of qualitative research, reflecting the interpretivist tradition's belief in the relativistic nature of truth claims. The researcher allowed the participants to speak freely and present their own words in order to explain their opinion. In order to ensure the credibility of the findings, ICU nurses' views were incorporated

into the qualitative analysis as quotations. Further effort was made to enhance and maximize the credibility of this study by "member checking" with the analysis process (Tracy 2010; Polit & Beck 2012). Each participant received their interview transcripts and was asked to verify the accuracy of the data, reinforcing its validity. This verification process was not to introduce new information, but rather to ensure the accuracy of the participants experiences. This was done by having regular meetings with the supervisory team to discuss each step-in detail.

4.3.11.3 Dependability

The dependability of a study is the stability and reliability of quantitative research findings, which enables readers to follow the researcher's reasoning (Guba & Lincoln 1994; Polit & Beck 2012). To achieve dependability in qualitative studies, the research process must be clearly reported to allow the results of research studies to be reproducible and consistent (Shenton 2004). In conjunction with the supervisory team, this qualitative study was carefully examined and evaluated throughout the analytical process and the production of the final report. Their critical thoughts and suggestions strengthened the study's dependability. In addition, data reliability relies on the competence and skill of the interviewer and is affected by any research bias (Guba & Lincoln 1994; Appleton 1995). Therefore, the qualitative interview guide was developed based on the results of the phase I quantitative study. In addition, practising interview skills can minimize the researcher's bias, but it is unlikely it can be completely eliminated. In this study, dependability was achieved by carrying out three pilot interviews to ensure the researcher's interview skills were sufficiently developed for this study, and to assess the clarity of the interview guide. Lastly, all interviews were digitally recorded, further ensuring the reliability of the data gathered throughout the interviews (Tuckett 2005).

4.3.11.4 Confirmability

Confirmability refers to the extent to which a study's findings can be supported by other studies (Guba & Lincoln 1994). Confirmability refers to the fact that the findings are based on real information and not simply theoretical speculation or intuition (Polit & Beck 2012). Hoskins and Marion (2004) posit that, for a study to be considered confirmable, the investigator must demonstrate that their findings, conclusions and interpretation are in accord with the data. Understanding what was expressed by the study participants was greatly assisted by the knowledge and experience of the researcher and his supervisory team. A comprehensive review examination was conducted to ensure that the research process in this study was fairly conducted, recorded and confirmed with the supervisory team. Furthermore, as part of the data analysis, all stages involved in extracting the initial codes, subcategorise and categories were carefully examined with the research supervisors.

4.3.11.5 Transferability

Research transferability refers to the degree to which the findings can be used in different settings or populations, and it is an indication of the trustworthiness of the study (Guba & Lincoln 1994; Polit & Beck 2012). While the generalisability of quantitative research measures can be determined by the authors, the decision regarding the transferability or "fitness" of qualitative findings in other contexts is the responsibility of potential users, not the authors (Graneheim & Lundman 2004). However, as the goal of this qualitative study is not to generalize results to other populations, but rather to discover how and in what settings data can be shared and applied (Malterud 2001), this study intends to produce findings that can be extrapolated beyond the study context. Among the ICU nurses taking part in this study, characteristics such as age, gender, education level, nursing experience, critical care experience and nationality varied. Furthermore, the participants in this study were employed by adult

ICUs, both at the same time and in similar facilities, and were therefore considered to be representative of this working environment. In terms of transferability, it may be possible to relate the categories emerging from the analysis of the nurses' views to other adult ICUs. Therefore, this enables readers to assess the potential transferability of the study findings to different contexts.

4.3.11.6 Maintaining reliability in qualitative interviews

When conducting a qualitative study, maintaining integrity criteria can be challenging for researchers. Tracy (2010) claimed that the proliferation of concepts suggesting qualitative excellence can be confusing for researchers who are new to the field. This is because of the complexity of the quality assurance process of qualitative research. However, Polit and Beck (2012) explain that strategies to enhance the quality of qualitative research, as proposed by Lincoln and Guba (1985) and Whittemore, Chase & Mandle (2001), can be applied at different stages as follows: (a) throughout the data generation, (b) during the data coding and analysis, or (c) in the presentation of the study findings. This could assist the qualitative community in communicating the value of their studies to a wide variety of audiences more clearly.

In this study, a number of quality measures were applied before, during and after conducting this study, including prolonged engagement, which was achieved by giving adequate coverage to the data during this PhD study; reflexivity, performed by the researcher as a qualified academic critical care nurse in the context; comprehensive and vivid record keeping; audiotape recording of interviews for transcription rigour; and member checking by inviting the participants to double check the transcripts, and sharing codes and themes with the supervisory team.

4.4 Chapter summary

This chapter provided an overview of the study's methods. This chapter provided a comprehensive overview of the research methods employed in this study for data collection and analysis. The chapter was organized into two main sections, detailing the quantitative methods used in phase I and the qualitative methods used in phase II. The research process followed a sequential explanatory design, allowing for a deeper exploration of the research phenomena, namely the factors that influence ICU nurses' adherence to VAP prevention guidelines. In summary, this chapter served as a guide to the research methods employed, offering insights into the design, data collection, analysis processes and ethical considerations for each method. While this chapter provided a detailed description of the research methods in this study, the subsequent chapters will delve into the results and discussion, presenting a more detailed analysis of the findings from both the quantitative and qualitative components of the study.

Chapter 5: Quantitative results

This chapter presents the results of an audit on adherence to the VAP prevention clinical practice guidelines (CPG) and a survey evaluating ICU nurses' adherence to three specific recommendations from these guidelines. The chapter starts by outlining the audit findings to assess observed adherence to the recommendations, followed by the questionnaire results.

5.1 Audit of current practice

5.1.1 Demographic characteristics

Two tertiary care hospitals were enrolled in the study, each with four adult ICUs. Of the 8 ICUs, four were coronary/cardiac, two medical/surgical, one neurology-surgical and one general unit. The total number of ICU beds was 114. Individual unit capacity ranged from 5 to 36 beds (Table 5.1). The number of nurses working in each unit ranged from 30 to 145. All participating ICUs applied the model of one nurse per patient as standard nursing care; however, this is not the case in all units. Various factors, including limitation on resources, patient acuity levels, and resource availability, contributed to the non-implementation of the one nurse per patient model in all ICU units. Clinical staff nurses worked 12-hour shifts, while managers and directors worked 8-hour shifts. The researcher attended the ICUs between July and October 2019 and collected audit data on weekdays and weekends, on both day and night shifts. A total of 62 ICU visits occurred to audit three recommendations from the VAP prevention CPGs in all participating ICUs (Table 5.1).

Table 5.1. Participating hospitals' characteristics

Hospital	Intensive care unit	Number of beds	Number of nurses	Number of beds audited	Number of medical records reviewed	Number of hand hygiene opportunities
Hospital 1	A	36	145	40	40	200
	B	14	50	40	40	200
	C	10	45	40	40	200
	D	16	75	40	40	200
	Total	76	315	160	160	800
Hospital 2	E	13	60	40	40	200
	F	10	45	40	40	200
	G	10	45	40	40	200
	H	5	26	40	40	200
	Total	38	176	160	160	800

5.1.2 Results of audit of current practice

Observed adherence to the three recommendations from the VAP prevention guidelines is described here in sections 5.1.2.1 to 5.1.2.3. Figure 5.1 illustrates the adherence level of ICU nurses to the three recommendations from the VAP prevention guidelines, categorized by

settings. Appendix 20 provides the overall descriptive statistical results of the audit assessing the adherence of ICU nurses to the three recommendations from the VAP prevention guidelines.
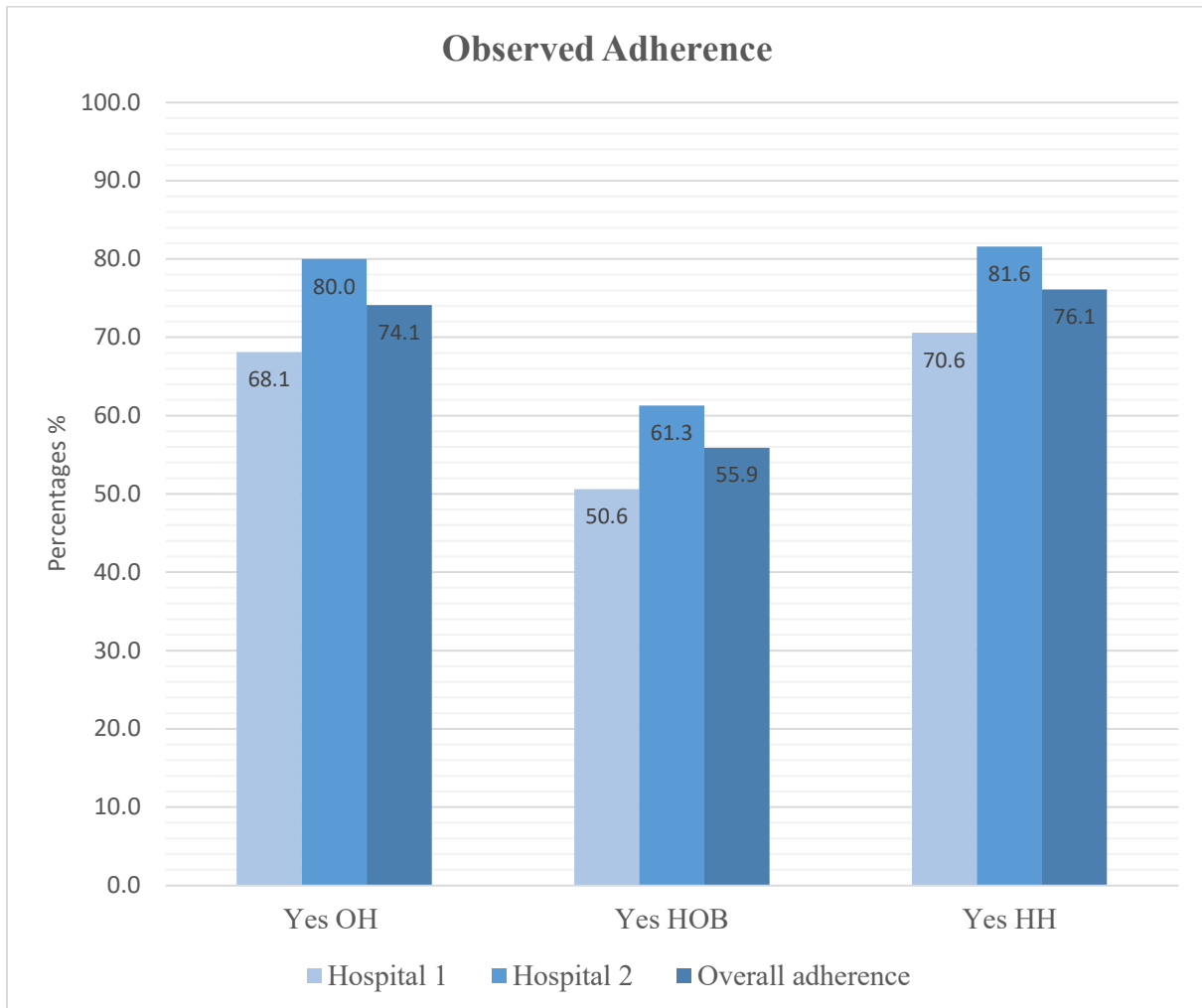
Figure 5.1 Overall auditing hospital level adherence

5.1.2.1 Oral hygiene with 0.12% chlorhexidine

A total of 40 oral care opportunities were reviewed at each unit, a total of 320 observations. Overall adherence to performing oral hygiene (OH) at least once per shift with 0.12% chlorohexidine was 74.1% (n = 237), with adherence at individual sites ranging from 60.0% to 87.5%. There was no difference in adherence to OH recommendations based on the day of the week or the time of the nursing shift (Figure 5.2). Hospital 1 had an 80% adherence to the OH

guidelines which is significantly higher (chi-square = 5.873 df = 1, p = 0.015), than the 68.1% adherence in hospital 2.

5.1.2.2 Elevation of the head of bed between 30° to 45°

Each patient who was on mechanical ventilation was observed once per shift until 40 observations per unit had been completed. There was an overall adherence of 55.9% (n = 179) to the recommendation to elevate the head of the bed (HOB) between 30° and 45°. Adherence at individual units ranged from 32.5% to 70.0%. No significant differences in adherence to HOB recommendations were observed between the two hospitals, nor between weekends and weekdays, but adherence was found to be higher during the day shifts (chi-square = 5.591 df = 1, p = 0.018) (Figure 5.2). Adherence to elevation of HOB recommendation was higher in hospital 2 (n = 98, 61.3%) than in hospital 1 (n = 81, 50.6%) (Appendix 20).

5.1.2.3 Hand hygiene Five Moments

There were 1600 hand hygiene (HH) 'Five Moments' opportunities directly observed, with an overall adherence rate of 76.1% (n = 1218) with adherence at individual sites ranging from 66.5% to 87.5%. HH adherence was significantly higher on weekdays (80.9%, n=647) and during daytime shifts (78.8%, n=630) (Appendix 20). Adherence to HH was observed to be higher (81.6%, n = 653) in hospital 2 (Figure 5.2). There were significant associations between observed adherence to HH and the hospital (chi-square = 26.630 df = 1, p = 0.000), weekdays/weekends (chi-square = 19.863 df = 1, p = 0.000), and nursing day/night shifts (chi-square = 6.066 df = 1, p = 0.014).
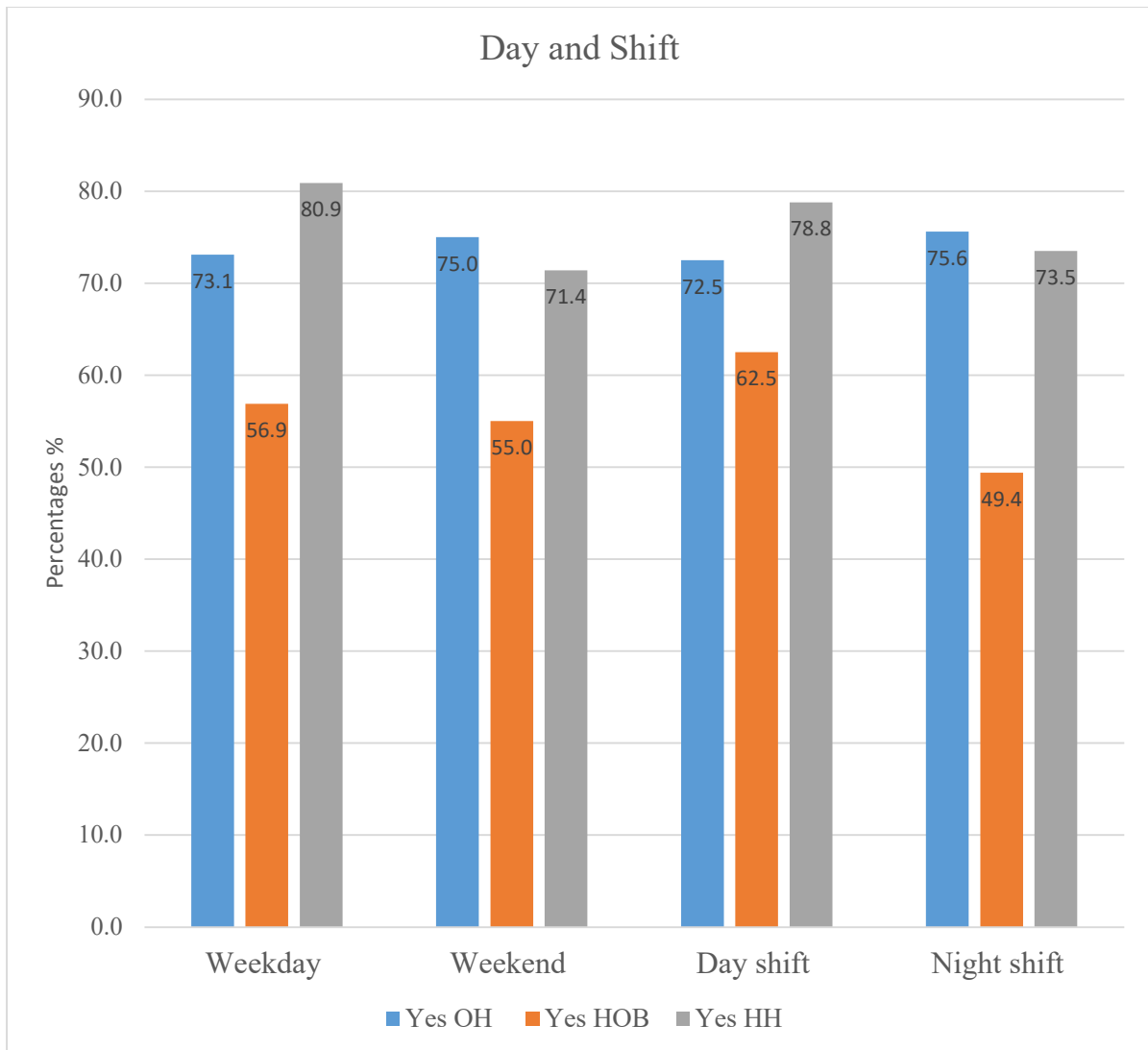
Figure 5.2 Overall auditing adherence by working shift schedule

5.2 Questionnaire results

5.2.1 Response rate

There were 383 surveys distributed to ICU nurses in the two participating hospitals. With a response rate of 89.6% (n=343). The response rate from each unit of the two hospitals ranged from 70% to 100%. Returned surveys were checked for data analysis eligibility. 27 surveys were excluded from the data analysis because less than 30% of the survey was completed (n = 26), or the person completing the survey was not an ICU nurse (n = 1). Data from 316 ICU nurses were included in this study.

5.2.2 Participant socio-demographic characteristics

The majority of the study respondents were female (n = 288, 91.8%) and the mean age of the respondents was 36.64 years (range 23–61, SD 6.002). Of the study respondents, the majority (n = 300, 94.9%) were non-Saudi, reflecting the low numbers of Saudi national ICU nurses. Just over half of the study respondents (n = 178, 56.3%) were educated to university degree level or higher and 77.2% (n = 244) had a specialized critical care registration certificate (Table 5.3). Among the respondents, a considerable number (n = 192, 60.7%) reported having more than 10 years of experience in the nursing profession. The mean nursing experience was 12.78 years (SD = 5.85), indicating a significant level of professional expertise. In the context of intensive care settings, only 24.05% (n = 76) of the respondents reported having more than 10 years of experience. The mean ICU experience was 7.36 years (SD = 4.76), reflecting the participants' substantial experience specifically in ICU settings. In the previous two weeks prior to data collection, the majority of respondents (n = 197, 62.3%) reported they had cared for mechanically ventilated patients (Table 5.3).

The following section presents the results from each of the questionnaire domains. It starts by outlining the responses for self-reported adherence. Next, it presents the descriptive results about the possible factors influencing guidelines adherence in the following order: guidelines user characteristics, guidelines quality and contextual factors. Lastly, it presents the relationship between adherence to the recommendation in the VAP prevention guidelines and the domains measured in this study.

Table 5.2. Summary of key socio-demographic characteristics of the survey participants

Variable	Nurses N (%) = 316
Gender	
Male	28 (8.9)
Female	288 (91.1)
Age (Y)	
30 and below	63 (19.9)
31–40	193 (61.1)
41 and above	60 (19.0)
Nationality	
Saudi	16 (5.1)
Non-Saudi	300 (94.9)
Nursing experience (N = years)	
10 and below	124 (39.2)
11–20	167 (52.8)
21 and above	25 (7.9)
ICU experience (N = years)	
10 and below	240 (75.9)
11–20	74 (23.4)
21 and above	2 (0.6)
Highest educational level	
Diploma	138 (43.7)
Bachelor	167 (52.8)
Master	9 (2.8)
Doctoral degree	2 (0.6)
Nursing specialty qualification	
No critical care qualifications	72 (22.8)
Critical care qualification	244 (77.2)
Number of mechanically ventilated patients cared for during the last two weeks	
None	23 (7.3)
1–2 patients	96 (30.4)
3–5 patients	124 (39.2)
6 and above	73 (23.1)

***Note.** Y: years; SD: standard deviation

5.2.3 Self-reported adherence

Self-reported adherence to each recommendation in the VAP prevention guidelines was measured by a single survey item. A four-point Likert scale (always, most of the time, some of the time, never) was used to assess nurses' self-reported adherence to each recommendation (Figure 5.1). For the purposes of further analysis, the adherence score was grouped into "adherence" (4 = always and 3 = most of the time) and "non-adherence" (2 = some of the time and 1 = never) (Table5.4).
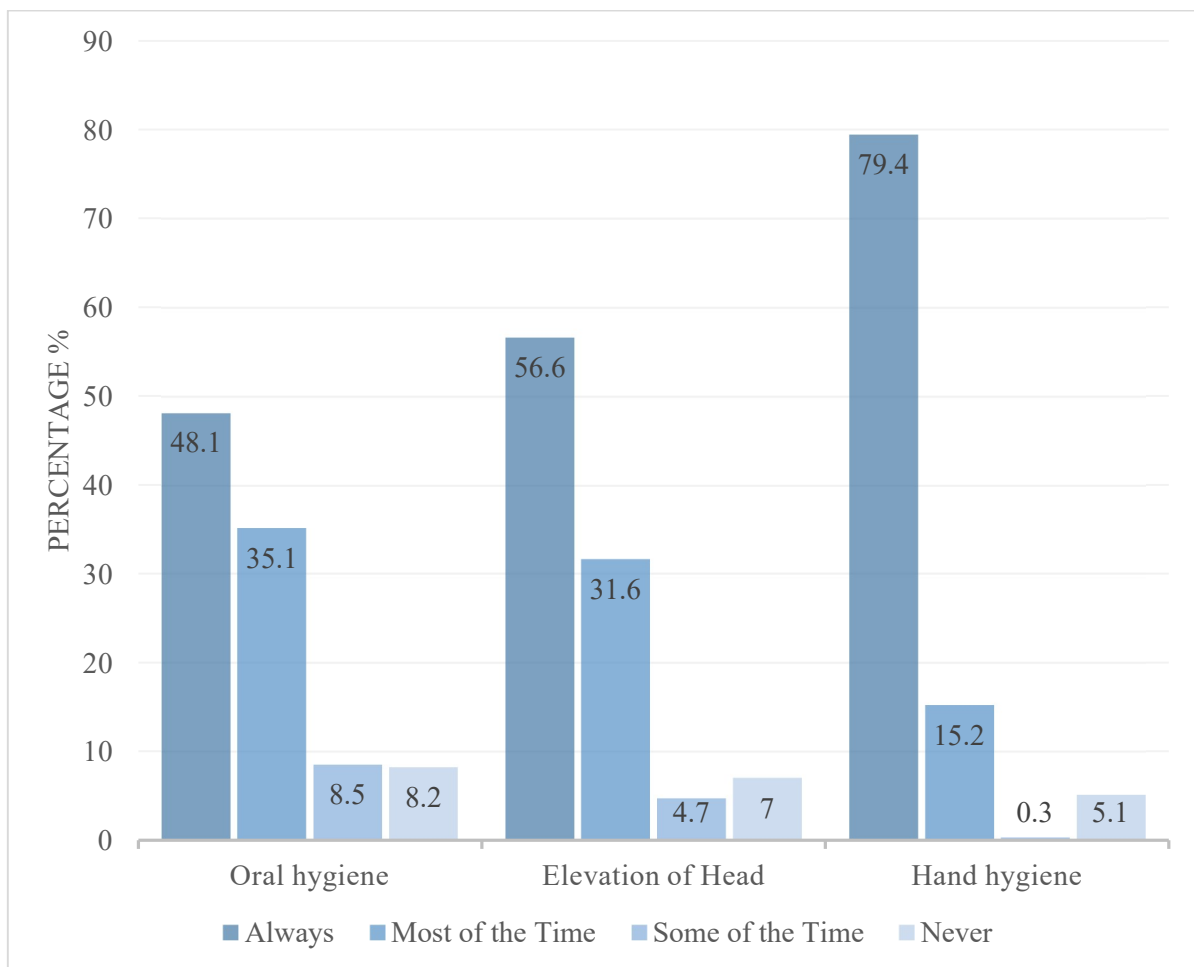
Figure 5.3. The percentage of self-reported adherence to each recommendation

Table 5.4 presents the respondents' self-reported adherence when the adherence scores were grouped. The highest adherence score was for the hand hygiene recommendation (94.6%), followed by elevation of HOB (88.3%) and oral hygiene (83.2%). Across the eight ICUs, the

respondents in two units reported 100% adherence to oral hygiene recommendations, respondents in one unit reported 100% adherence to elevation of HOB recommendations and respondents in four units reported 100% adherence to hand hygiene recommendations.

Table 5.3. Percentage of self-reported adherence to the three recommendations

Guidelines recommendation	Adherence N (%)	Percentage adherence across ICUs (%)
Oral hygiene	263 (83.2)	(69.4–100.0)
Elevation of HOB	279 (88.3)	(79.2–100.0)
Hand hygiene	299 (94.6)	(87.9–100.0)

5.2.4 Guidelines user characteristics

Five sub-dimensions were used to capture user characteristics for each of the VAP recommendations, encompassing guidelines awareness, attitude towards individual recommendations, overall attitude towards the VAP prevention guidelines, guidelines prioritization, and accountability and responsibility for implementing the practices.

5.2.4.1 Guidelines awareness

The guidelines awareness sub-dimension was measured by one item. The corresponding response scale was: had read all sections multiple times; had read all sections at least once; had read some sections; and had not read the guidelines at all. The responses were grouped as "aware" when respondents had read at least some sections, and "not aware" when respondents

had not read the guidelines at all (Table 5.5). The findings indicate a generally high level of awareness of all three recommendations.

Table 5.4. Awareness of the three recommendations from the VAP prevention CPGs

VAP recommendations	Guidelines awareness	Aware N (%)
Oral hygiene	Read OH section	273 (86.4)
Elevation of HOB	Read HOB section	282 (89.2)
Hand hygiene	Read HH section	284 (89.9)

5.2.4.2 Attitudes towards individual recommendations

The attitude sub-dimension comprised 4 items to measure the nurses' attitudes towards implementing each VAP recommendation (oral hygiene, elevation of HOB and HH), namely agreement, self-efficacy, plan to use and outcome expectancy. The four corresponding responses (true; somewhat true; slightly true; not true) were dichotomized as "agree" (true and somewhat true) and "disagree" (slightly true and not true). Table 5.6 presents the results for each VAP recommendation. The majority of the respondents appeared to have positive attitudes towards the VAP recommendations, with agreement for each item ranging from 78.8 to 94.3%.

Table 5.5. Attitudes towards the 3 recommendations from the VAP prevention guidelines

VAP recommendations	Attitude dimension 4-items	Agreement
		N (%) = 316
Oral hygiene	Agreement with the guidelines content	277 (87.7)
	Self-efficacy	281 (88.9)
	Plan to use the guidelines	275 (87.0)
	Outcome expectancy	281 (88.9)
Elevation of HOB	Agreement with the guidelines content	291 (92.1)
	Self-efficacy	284 (89.9)
	Plan to use the guidelines	249 (78.8)
	Outcome expectancy	283 (89.6)
Hand hygiene	Agreement with the guidelines content	298 (94.3)
	Self-efficacy	292 (92.4)
	Plan to use the guideline	278 (88.0)
	Outcome expectancy	282 (89.2)

An overall score for the attitude towards individual recommendations sub-dimension was calculated as a composite score of all 4 items for each recommendation for further

regression analysis (Table 5.7). The most positive attitudes were reported for the hand hygiene recommendation, followed by oral hygiene and elevation of HOB (Table 5.7).

Table 5.6. Attitude composite score

VAP recommendations	Attitude composite score	Agreement
		N (%) = 316
Oral hygiene	Sum OH attitude scale	239 (75.6)
Elevation of HOB	Sum HOB attitude scale	229 (72.5)
Hand hygiene	Sum HH attitude scale	245 (77.5)

5.2.4.3 Attitude towards VAP prevention guidelines overall

The overall attitude to the VAP prevention guidelines sub-dimension was measured by three items: the VAP prevention guidelines do not interfere with professional autonomy (reverse coded question), are helpful in practice, and decrease variation of care. The responses were dichotomized as agreement (true, somewhat true) and disagreement (slightly true, not true). The majority of the respondents agreed that the VAP prevention guidelines are helpful in nursing practice (n = 308, 97.5%), decrease inappropriate variation in care (n = 287, 90.8%), and do not interfere with their professional autonomy (n = 196, 62%). The overall attitude to the VAP prevention guidelines sub-dimension was calculated as a composite score of sums of all three items for further regression analysis. Most of the respondents (n = 170, 53.8%) had a positive attitude to the VAP prevention guidelines.

5.2.4.4 Guidelines prioritization

The priority accorded to the recommendations sub-dimension was measured by two items concerning the level of priority the respondents attached to each recommendation and the level of priority assigned by their colleagues. The corresponding response scale was: highest priority; high priority; moderate priority; low priority. The responses were dichotomized as high priority level for highest and high, and low priority level for moderate and low priority. The respondents rated the hand hygiene recommendation as the highest priority for both their own and their colleagues' practice (Table 5.8). For all three recommendations, the respondents rated that their own priority level was higher than that of colleagues.

Table 5.7. Level of prioritization of the three recommendations from the VAP prevention CPGs

VAP recommendations	Guidelines prioritization	Agreement
		N (%) = 316
Oral hygiene	High priority level – self	290 (91.8)
	High priority level – colleagues	262 (82.9)
Elevation of HOB	High priority level – self	284 (89.9)
	High priority level – colleagues	261 (82.6)
Hand hygiene	High priority level – self	302 (95.6)
	High priority level – colleagues	285 (90.2)

5.2.4.5 Accountability and responsibility for practice

Accountability for implementing the recommendations sub-dimension were measured by two items: accountability for delivering care in line with the recommendations and responsibility of colleagues for the practice. The response options for accountability for delivering care were yes; no; and don't know, and the responses were dichotomized as agree (yes) and disagree (no, don't know). The rationale behind grouping "don't know" and "no" together was based on their distinct meanings. "Don't know" signifies a lack of knowledge or uncertainty regarding available options, whereas "no" indicates a definite refusal or absence of options. Colleagues' sense of responsibility had two possible responses, nurses' responsibility or shared responsibility. The respondents reported their sense of individual accountability higher than their sense of shared responsibility (91.5–98.1% vs 28.5–50.3%). Large numbers of respondents reported that the responsibility for performing oral hygiene was shared between nurses and other health professionals (49.7%), and a significant proportion reported that the responsibility for elevating the HOB was also shared (79.5%) (Table 5.9).

Table 5.8. Accountability and responsibility for the practice of the three recommendations from the VAP prevention CPGs

VAP recommendations	Accountability and responsibility (2 items)	Agreement
		N (%) = 316
Oral hygiene	Accountable for practice	310 (98.1)
	Nurses' responsibility	159 (50.3)
Elevation of HOB	Accountable for practice	294 (93.0)
	Nurses' responsibility	90 (28.5)
Hand hygiene	Accountable for practice	289 (91.5)
	*Nurses' responsibility (NA)	NA*

*Note. HH responsibility item was not included in the survey because it is a routine daily practice for nurses.

5.2.5 Factors related to the quality of the guidelines

The participants assessment of the quality of the guidelines was measured by three items: ease of understanding, practicality to use, and absence of conflicting guidelines. The responses were dichotomized as agreement (true, mostly true) and disagreement (sometimes true, not true). Around 70% of the respondents indicated that the OH, HOB and HH guidelines were easy to understand and practical to use. However, nearly half of the respondents (42.1% and 47.5% respectively) disagreed with the statement that there were no conflicting guidelines regarding OH and HOB (Table 5.10).

Table 5.9. Factors related to the quality of the guidelines for the three recommendations from the VAP prevention CPGs

VAP recommendations	Guidelines quality factors	Agreement
		N (%) = 316
Oral hygiene	Easy to understand	224 (70.8)
	Practical to use	254 (80.4)
	No conflicting guidelines	183 (57.9)
Elevation of HOB	Easy to understand	223 (70.6)
	Practical to use	281 (88.9)
	No conflicting guidelines	166 (52.5)
Hand hygiene	Easy to understand	226 (71.5)
	Practical to use	287 (90.8)

*Note. HH conflicting guidelines was omitted as a question, as only the WHO Five Moments guidelines are used.

The calculation of regression analysis from composite scores of the quality dimension were calculated from a sum of the questions for each guideline recommendation. Table 5.11 presents the overall guidelines quality composite score.

Table 5.10. Guidelines quality-related factors composite score

VAP recommendations	Composite score	Agreement
		N (%) = 316
Oral hygiene	Sum OH guidelines quality-related factors	137 (43.4)
Elevation of HOB	Sum HOB guidelines quality-related factors	134 (42.4)
Hand hygiene	Sum HH guidelines quality-related factors	222 (70.3)

5.2.6 Contextual factors

5.2.6.1 Contextual factors affecting adherence

The contextual factors affecting adherence to the recommendations sub-dimension was measured by 3 items for OH and 2 items for each of elevation of HOB and HH. The majority of the respondents reported they had enough time to practice OH (226, 71.5%;), HOB elevation (n = 225, 71.2%) and HH (n = 239, 75.7%). Most survey respondents (n = 299, 94.6%) reported

that supplies were available for hand hygiene in contrast to 75.3% (n = 238) reported that the

supplies required for oral hygiene were available. Over half of the respondents reported that

the patient's condition or preferences may contradict the practice of OH (n = 223, 71.2%) and

elevation of HOB (n = 182, 57.6%) (Table 5.12).

Table 5.11. Contextual factors affecting ICU nurses' adherence to the VAP prevention CPGs

VAP recommendations	Individual	Agreement
		N (%) = 316
Oral hygiene	Sufficient time for practice	226 (71.5)
	Availability of supplies (tooth swab, brush, flashlight and paste)	238 (75.3)
	Patient condition or preference contradicts practice	225 (71.2)
Elevation of HOB	Sufficient time for practice	236 (74.7)
	Patient condition or preference contradicts practice	182 (57.6)
Hand hygiene	Sufficient time for practice	239 (75.7)
	Availability of supplies (sink, soap and alcohol)	299 (94.6)

5.2.6.2 Contextual factors enhancing adherence

The contextual factors that enhance the use of VAP prevention guidelines were measured by 7 items. The responses were dichotomized as agreement (true, mostly true) and disagreement (sometimes true, not true). Most of the respondents (87% or more) agreed with the 7 statements, indicating that VAP prevention is a priority at their hospital and that systems and processes are in place that support the implementation of the guidelines (Table 5.13).

Table 5.12. Contextual factors enhancing adherence to/implementation of the VAP prevention CPGs at the hospital

	Contextual factors enhancing adherence	Agreement
		N (%) = 316
1	VAP prevention is a priority at my hospital.	309 (97.8)
2	I had adequate education on VAP prevention.	299 (94.6)
3	The role of the infection control department has been important in VAP prevention.	299 (94.6)
4	I know who to ask if I have VAP-related questions.	293 (92.7)
5	Pre-printed orders help me do VAP prevention in the right way.	296 (93.7)
6	Designated documentation makes me more conscious of VAP prevention.	296 (93.7)
7	Knowing that I'll be audited makes me do VAP prevention as recommended.	275 (87.0)

The VAP prevention contextual enhancer sub-dimension was calculated as a composite score of the 7 items. The composite score indicated that 77.8% of respondents (n = 246) reported that VAP prevention enhancing factors were in place.

5.2.7 The relationship between adherence to the recommendations in the VAP prevention guidelines and study predictors

To identify the factors significantly associated with adherence to the guidelines, a multivariable multi-level binary logistic regression model using generalized estimating equation models was applied. In this model socio-demographic and clinical factors were used as independent variables and OH, elevation of HOB and HH adherence as dependent variables. Each model was adjusted to account for clustering at the hospital and unit level for multi-level regression analysis. A backward stepwise selection (backward elimination) approach was used to measure which independent variables significantly predicted the investigated study outcomes and was used to develop this multiple regression model with a cut-off value of 0.5 (Harrell 2015; Heinze & Dunkler 2017). A p-value less than 0.05 was used as the measure of statistical significance. The results for each VAP recommendation are presented separately.

5.2.7.1 Oral hygiene with 0.12% oral chlorhexidine solution

Independent factors tested for association with self-reported adherence to the OH recommendation were years of nursing experience (less experience was associated with better self-reported adherence), nurse-to-patient ratio, positive attitude towards the OH recommendation, awareness of the guidelines, perceived quality of the guidelines, and the VAP prevention enhancer score (Table 5.14). Male nurses were found to be less likely to adhere to regulations than female nurses, but this difference was not statistically significant. On the other hand, nurses caring for two or fewer patients had a 4.6 times higher likelihood of adhering, which was statistically significant (p<0.05). Compared to those with critical care certification,

nurses without certification had a slightly lower likelihood of adhering, about 0.8 times, but this difference was not statistically significant.

The likelihood of adherence increased by 4.6 times for every unit increase in attitude composite scores. Nurses who were unaware had a statistically significant 3.6 times higher likelihood of adherence than those who were aware. The Guidelines quality score, in particular, demonstrated a strong positive relationship with adherence, with a 4.2 times higher likelihood. Similarly, the VAP prevention enhancer composite score was associated with a statistically significant 2.6 times higher likelihood of adherence. The length of nursing experience had a diminishing effect, with a statistically significant decrease in adherence likelihood for each additional year worked (Table 5.14).

Table 5.13 Multivariable binary logistic generalized estimating equation model results: ICU nurses' adherence to oral hygiene recommendation versus study predictors

Outcomes	Independent variables	Odds ratio* (95% CI*)	P value**
Self-reported adherence to OH recommendation	Gender	0.661 (0.379–1.153)	0.145
	Nursing experience (continuous)	0.921 (0.883–0.961)	< 0.001
	Number of Ventilated Patient per two weeks	0.201 (0.058–0.699)	0.014
	Nursing specialty qualification	0.809 (0.598–1.094)	0.168
	Attitude towards OH recommendation	4.563(1.400–14.868)	0.012
	Guidelines awareness	3.636 (1.621–8.156)	0.002
	Guidelines quality score	4.246 (2.038–8.846)	< 0.001
	VAP prevention enhancer score	2.575 (1.012–6.553)	0.047
	Attitude towards VAP guideline	1.573 (0.992–2.493)	0.054

*CI = confidence interval

** $p \leq 0.05$

5.2.7.2 Elevation of head of bed between 30° and 45°

The respondents were more likely to self-report adherence to the recommendation about elevating the HOB if they had a negative attitude to the guidelines, were not aware of the guidelines, perceived the guidelines to be of low quality, reported not enough time or had a low VAP prevention enhancer score. Saudi nurses had an odds ratio of 0.089 (95% CI: [0.203, 1.121]), indicating a lower chance of adhering than Saudi nurses. However, this difference did not reach statistical significance (p = 0.089), indicating that nationality did not affect HOB adherence. Nurses caring for two or fewer patients had an odds ratio of 2.787 (95% CI: [1.27, 6.116]), indicating that they were 2.8 times more likely than those caring for three or more patients to follow HOB elevation instructions (p = 0.011).

There is a statistically significant association between adherence to elevation of HOB and number of years as a nurse, numbers of patients seen, attitude towards elevation of HOB, guidelines awareness, guidelines quality score, time availability, and the VAP prevention enhancer score (Table 5.15). The odds ratio for towards elevation of HOB was 2.933 (95% CI: [1.527, 5.634]), implying a nearly threefold increase in adherence likelihood for each unit increase in attitude composite scores. Similarly, awareness of the ventilated patient posture policy resulted in an odds ratio of 2.968 (95% CI: [1.451, 6.072]), indicating a nearly threefold higher likelihood of adherence among those aware versus those unaware.

Table 5.14. Multivariable binary logistic generalized estimating equation model results: Head of bed elevation adherence versus study predictors

Outcomes	Independent variables	Odds ratio* (95% CI*)	P value**
Self-reported adherence to elevation of HOB recommendation	Age	1.043 (0.976–1.115)	0.213
	Nationality	0.477 (0.203–1.121)	0.089
	Nursing experience	0.899 (0.829–0.974)	0.010
	Number of Ventilated Patient per two weeks	2.787 (1.270–6.116)	0.011
	Nursing specialty qualification	0.362 (0.111–1.181)	0.092
	Attitude towards elevation of HOB	2.933 (1.527–5.634)	0.001
	Guidelines awareness	2.968 (1.451–6.072)	0.003
	Guidelines quality score	2.836 (1.610–4.996)	< 0.001
	Time availability	3.505 (1.815–6.770)	< 0.001
	VAP prevention enhancer Score	2.685 (1.371–5.258)	0.004
	Attitude towards VAP guidelines	1.250 (0.738–2.119)	0.407

*CI = confidence interval

** $p \leq 0.05$

5.2.7.3 Hand hygiene Five Moments

Factors independently associated with better self-reported adherence to the HH recommendation were more years of nursing experience, a nursing speciality certification, time availability, and a low VAP prevention enhancer score (Table 5.16). Each unit increase in nursing experience resulted in a 1.657-times increase in adherence likelihood (p 0.001). Critical care certification was also significant, with an odds ratio of 4.706, implying that certified

people have a significantly higher likelihood of adhering (p = 0.006). Time availability was critical, with significantly higher odds of adherence when time was available (p 0.001). ICU experience was also significant, with those with ICU experience having a 0.817 lower likelihood of adhering (p<0.001). On the other hand, age, highest nursing degree, awareness of guidelines, quality scores, and attitude toward VAP guidelines had no statistical significance (Table 5.16).

Table 5.15. Multivariable binary logistic generalized estimating equation model results: Hand hygiene adherence versus study predictors

Outcomes	Independent variables	Odds ratio* (95% CI*)	Global P value**
Self-reported adherence to HH recommendation	Age	0.805(0.613-1.056)	0.117
	Nursing experience	1.657(1.357-2.023)	< 0.001
	ICU experience	0.817(0.758-0.880)	< 0.001
	Educational level	0.047(0.012-0.188)	< 0.001
	Nursing speciality qualification	4.706(1.550-14.281)	0.006
	Guidelines awareness	4.362(0.733-25.972)	0.106
	Guidelines quality score	0.473(0.142-1.570)	0.221
	Time availability	53.320(9.616-295.636)	< 0.001
	VAP prevention enhancer score	8.374(2.558-27.407)	< 0.001
	Attitude towards VAP guidelines	0.541(0.226-1.294)	0.168

*CI = confidence interval

** $p \leq 0.05$

5.2.8 Summary of the relationship between adherence to the three recommendations and the influencing factors

Factors associated with self-reported guidelines adherence varied for the three recommendations (Table 5.17). Nursing experience was found to be statistically associated with self-reported adherence for all three recommendations from the VAP prevention guidelines, but in different directions, with a negative association for OH and HOB, and a positive association with HH. Patient ratio, attitudes towards individual recommendations, awareness of the guidelines, and the guidelines quality score were found to be predictors for both the OH and elevation of HOB recommendations. Time availability and VAP prevention enhancer scores were predictors of self-reported adherence to the elevation of HOB and HH recommendations.

Table 5.16. Summary of the relationship between factors measured in the study and the three recommendations from the VAP prevention CPGs

Significant predictors	Oral hygiene with 0.12% chlorhexidine solution OR (95% *CI) **P value	Elevation of the HOB to 30° to 45° OR (95% *CI) **P value	Hand hygiene OR (95% *CI) **P value
Nursing experience	0.921 (0.883–0.961) < 0.001	0.899 (0.829–0.974) 0.011	1.657(1.357–2.023) < 0.001
ICU experience	-	-	0.817(0.758–0.880) < 0.001
Number of Ventilated Patient per two weeks	0.201 (0.058–0.699) 0.014	2.787 (1.270–6.116) 0.001	-
Educational level	-	-	0.047(0.012–0.188) < 0.001
Nursing speciality certification	-	-	4.706(1.550–14.281) 0.006
Attitude towards individual recommendations	4.563(1.400–14.868) 0.012	2.933 (1.527–5.634) 0.001	-
Guidelines awareness	3.636 (1.621–8.156) 0.002	2.968 (1.451–6.072) 0.003	-
Guidelines quality score	4.246 (2.038–8.846) < 0.001	2.836 (1.610–4.996) < 0.001	-
Time availability	-	3.505 (1.815–6.770) < 0.001	53.320(9.616–295.636) < 0.001
VAP prevention enhancer score	-	2.685 (1.371–5.258) 0.004	8.374(2.558–27.407) < 0.001

*CI = confidence interval

** $p \leq 0.05$

5.2.9 Adherence composite score versus selected variables

The self-reported adherence composite score was measured by summing OH, elevation of HOB and HH adherence. The overall adherence score was tested for significant associations between work-related factors and two guidelines-related factors, the VAP prevention enhancer score and attitude towards VAP prevention guidelines score. Fewer years of ICU experience, a high/low VAP prevention enhancer score and the attitude towards VAP prevention guidelines score were significantly associated with self-reported adherence to the three recommendations from the VAP prevention guidelines (Table 5.18).

Table 5.17. Overall adherence score

Outcome	Predictors	Odds ratio (95% CI**)	Global p value
Overall self-reported adherence	Gender	0.513 (0.250–1.052)	0.069
	ICU experience	0.907 (0.850–0.967)	**0.003**
	Number of Ventilated Patient per two weeks	2.365 (0.903–6.199)	0.080
	Educational level	0.688 (0.342–1.386)	0.295
	VAP prevention enhancer score	3.083 (1.297–7.327)	**0.011**
	Attitude towards VAP guidelines	1.784 (1.239–2.567)	**0.002**

**CI = confidence interval

ICU experience had an OR of 0.907, indicating decreasing adherence odds as ICU experience increased ($p = 0.003$). The attitude toward VAP guidelines had a significant impact, with an OR of 1.784, indicating a 1.8 times higher likelihood of adherence among guideline

supporters (p = 0.002), highlighting the importance of attitude in influencing adherence behaviour. Nurses who cared for fewer than two ventilated patients in the last two weeks had an OR of 2.365, indicating a higher likelihood of adherence (p = 0.080). Compared to University-qualified individuals, educational attainment demonstrated a Diploma-related OR of 0.688, indicating 68.8% adherence odds (p = 0.295).

5.2.10 Comparison of self-reported versus observed adherence to the recommendations in the VAP prevention guidelines

Self-reported and observed adherence were compared by using a chi-squared test. Table 5.19 shows that self-reported adherence was significantly higher than observed adherences for all three recommendations. This was particularly the case for HOB elevation (Table 5.19). There was a statistically significant difference between self-reported and observed adherence for oral hygiene, with 263 nurses (83.2%) indicating self-reported adherence and 237 nurses (74.1%) observing observed adherence, yielding a difference of 9.1% (95% CI: [2.7, 15.4]; the chi-square test, with 1 degree of freedom (df), produced a value of 7.8, resulting in a p-value of 0.0052. The analysis revealed a substantial gap between nurses' self-reported adherence (88.3%) and observed adherence (55.9%) to the HOB recommendation, indicating potential overestimation. This 32.4% difference is statistically significant (chi-square = 82.7, p < 0.0001), prompting the need for further investigation into the factors influencing this gap to enhance guideline compliance in clinical practice. In addition, the analysis revealed a significant disparity between nurses' self-reported hand hygiene compliance (94.6%) and observed compliance (76.1%), indicating potential overestimation. This 21.5% difference is statistically significant (chi-square = 75.2, p < 0.0001), prompting further investigation into the causes and interventions to improve hand hygiene practices in clinical settings.

Table 5.18. Comparison of differences in ICU nurses' self-reported adherence and observed adherence to the three recommendations from the VAP prevention CPGs

Adherence recommendation	Self-reported N (%)	Observed N (%)	Difference in percentages (95% CI*)	Chi-square, DF**, P value
Oral hygiene	263 (83.2)	237 (74.1)	9.1% (2.7, 15.4)	Chi-square = 7.8 df = 1, p = 0.0052
Elevation of HOB	279 (88.3)	179 (55.9)	32.4% (25.7, 38.7)	Chi-square = 82.7, df = 1, p < 0.0001
Hand hygiene	299 (94.6)	1218 (76.1)	21.5% (18.4, 24)	Chi-square = 75.2, df = 1, p < 0.0001

*CI = confidence interval

**Degree of freedom

5.3 Chapter summary

This chapter presented the results of the quantitative study related to the level of ICU nurses' self-reported and observed adherence to three recommendations from the VAP prevention guidelines. Self-reported adherence was significantly higher than observed adherence for each of the three recommendations. While there was no significant variation in observed adherence to OH and elevation of HOB between time of the week or the nursing shift, HH adherence was significantly higher on weekdays and during daytime shifts. Hospital 2 was observed to have higher adherence across all three recommendations. One factor was found to be statistically associated with self-reported adherence to all three recommendations from the VAP prevention guidelines, namely length of nursing experience. The study results point to the need to better

understand factors that influence ICU nurses' adherence to the three recommendations in the guidelines. Accordingly, phase II, the qualitative study, was designed to build on the results of the audit and questionnaire to explore in more depth ICU nurses' experiences of the VAP prevention guidelines.

Chapter 6: Qualitative results

6.1 Introduction

This chapter presents the results of the qualitative study. The direction of the qualitative study was informed by the findings of the quantitative study, which was focused on assessing the level of ICU nurses' adherence to three recommendations from the VAP prevention CPGs. The quantitative study data and statistical results enabled a general understanding of the factors that influence ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia, as outlined in the quantitative results chapter (Chapter 5). Thus, the qualitative data and findings provided deeper explanations of why some factors significantly influenced or did not significantly influence ICU nurses' adherence to the VAP prevention guidelines. These qualitative findings help contextualize the factors that influence ICU nurses' adherence to the VAP prevention guidelines.

In keeping with the research design, the researcher conducted a qualitative study which involved conducting structured interviews with twelve ICU nurses. Due to the concerns raised by the quantitative results, it was important that this study focussed on nurses' experience with each VAP prevention recommendation, OH, elevation of HOB and HH. Data collected from structured interviews was numbered consecutively (anonymised), and inductive content analysis (ICA) was performed to allow the categories to emerge naturally from the combined interview data, as detailed in Section 4.3.8. The study rigour was maintained and ensured throughout a number of principles and strategies, as detailed in Section 4.3.9. As Tashakkori and Teddlie (2021) suggest, the most illustrative contextually rich statements that were related to the identified codes were selected to represent the participants' views. This chapter explores

and describes the findings resulting from the interviews with ICU nurses, followed by an interpretation of the revelations derived from this study.

6.2 Overview of interview participant characteristics

Prior to the presentation of the findings of the qualitative interviews, it would be beneficial to provide some information about the ICU nurses who took part in this study. Providing this information allows the reader to gain a better understanding of both the context in which the interviews with nurses took place as well as the identification of the subsequent themes during the analysis of the data. Table 6.1 presents the characteristics of the ICU nurses who took part in this qualitative study. In total, twelve registered intensive care nurses from general and cardiac focussed units from two hospitals participated in the interviews; their ages ranged from early 20 to mid-40s. The mean time of the interviews was 38 minutes. All interview participants were female, and the majority were non-Saudi (11, 91.7%), which corresponds with the typical reported rate of non-Saudi nationalities in ICUs (Alluhidan et al. 2020). The study participants came from general and cardiac focussed ICUs in the two participant hospitals and were working full-time in their current position; all were active and experienced in the care of ventilated patients.

Table 6.1. Demographic characteristics of participants in the qualitative study (n = 12)

Participant	Intensive care unit	Age group (N = years)	Critical care experience (N = years)	Nursing experience (N = years)
1	C	41 and above	10 and below	11–20
2	A	31–40	10 and below	11–20
3	A	31–40	10 and below	10 and below
4	B	31–40	10 and below	10 and below
5	D	41 and above	11–20	21 and above
6	B	30 and below	10 and below	10 and below
7	H	41 and above	11–20	11–20
8	F	31–40	10 and below	10 and below
9	G	30 and below	10 and below	10 and below
10	H	41 and above	11–20	11–20
11	E	31–40	10 and below	10 and below
12	G	41 and above	11–20	21 and above

6.3 Discovering the refined coding schema steps

An analytical qualitative method, inductive content analysis (ICA), was chosen to analyse the data obtained from interviews since it was considered most appropriate to meet the objectives

of the research. This is because it permitted a broad exploration of the factors that influence nurses in ICUs to adhere to VAP prevention guidelines. As the name suggests, the distinguishing feature of ICA is that the analysis is constructed inductively, based on a thorough reading of the texts and looking for meaning in the transcripts, rather than deductively searching for predetermined elements. ICA produces content categories and subcategories instead of "themes", since themes are outcomes of thematic analysis (Vears & Gillam 2022). Using ICA, data were interpreted and analysed, and a refined coding schema was developed by following the steps set out by Vears and Gillam (Vears & Gillam 2022).

As further explained in Section 4.3.10.1, Vears and Gillam (2022) list structured steps for analysing interviews data using the ICA approach. These steps are: (1) read and familiarize; (2) first-round coding – identify big-picture meaning units; (3) second-round coding – developing subcategories and fine-grained codes; (4) refining the fine-grained subcategories; (5) synthesis and interpretation. The researcher was able to become immersed in the significant amount of analysed data through these steps. This provided a way in which meanings could be derived from the data. The final refined coding schema was agreed by the researcher's supervisory team.

6.3.1 Refined coding schema structure

The process of ICA coding produced content categories and subcategories, which is called a "coding schema" rather than themes and subthemes. Vears and Gillam (2022, p. 115) describe themes as "the term "theme" is sometimes used to refer to broad content categories identified by ICA, but we suggest "theme" is better reserved for use in thematic analyses". In contrast, content analysis considers the descriptive level of the text, which indicates the participants' accounts and is an explicit manifestation of the participants' experiences (Vaismoradi et al. 2016). A category is interpreted by the researcher and may consist of one or more subcategories

that identify its meaning. A theme and a category are distinguished pragmatically by the fact that the latter refers primarily to a descriptive level of content and can thus be considered a manifestation of the manifest content of the text, whereas the former is an expression of the latent content of the text (Graneheim & Lundman 2004). A manifest analysis refers to describing informants' statements using their own words, focusing on their explicit content, whereas a latent analysis is geared towards uncovering the underlying themes and meanings (Bengtsson 2016). It is likely that a theme that is developed via thematic analysis will have more abstract or theoretical characteristics than a category of content. Aside from these differences several similarities exist between ICA and thematic analysis, which is perhaps the most widely recognised form of qualitative analysis, especially when analysing interview data (Braun & Clarke 2006). For example, ICA and thematic analysis share the same process of "coding". In both approaches, the data analysis process is not linear, moving forward-backward and comparing code clusters, but rather should be recursive with frequent reviews (Vaismoradi et al. 2016; Vaismoradi, Turunen & Bondas 2013). In spite of this, ICA is not as well-suited to explicit theoretical interpretation as thematic analysis, which is one of the key differences between the two methodologies. That is, a category is a direct expression of an idea in the text; a theme, on the other hand, is more than just a category. Thus, in this way, the theme serves as a means of eliciting the essence of the participants' experiences (Morse 2008). The goal of ICA is generally to stay closer to the phenomenon under investigation, provide an explanation that is practical and relevant to the research context, and provide an interpretation that is based on the research question/s (Vears & Gillam 2022).

The core refined coding schema identified in this study is presented below in Table 6.2. The titles of all the categories and subcategories are accompanied by a brief statement outlining them. As evidence for the coding schema, quotations (in italics) from participants are tabulated and provided in the text as they relate to the stated category. Following the process of data

analysis that was explained and detailed in Chapter 4, a series of refined coding categories, big-picture category, were identified during the analysis. The refined big-picture category was grouped into content subcategories that were interrelated and interconnected. There were nine subcategories that emerged from the grouped coding categories: (1) *education-related factors*, (2) *Environment-related factors*, (3) *organisational context–related factors*, (4) *individual nurse-related factors*, (5) *patient-centred factors*, (6) *nurse-centred solutions*, (7) *healthcare professionals' solutions*, (8) *organisation-related solutions*, and (9) *nurses' suggestions for VAP practice changes*. These nine subcategories were then grouped into three content categories emerged from the interviews: *nurses' challenges in providing VAP interventions, nurses' solutions for delivery of VAP interventions*, and *nurses' recommended strategies for preventing VAP*. Table 6.2 summarizes the refined coding schema in relation to VAP extracted from the participants' transcripts, presenting the participants' perspectives on factors influencing adherence to the VAP prevention guidelines.

6.3.2 Category 1: Nurses' challenges in providing VAP interventions

This category represents participants' experiences and perceptions of the use of VAP prevention guidelines with ventilated patients. The interview participants provided numerous examples of barriers to adherence that, although not explicitly stated as reasons for non-adherence, may have contributed to their decision to overlook the professional guidelines. This category is concerned with the aspects of the organisational system that impact nurses' behaviours, including adherence to VAP prevention guidelines. It must be noted that study big-picture category are defined by researchers, and they may be grouped into subcategories, which determine the meaning of a category (Constas 1992). That is, the big-picture category itself can be defined and compared to other categories or, if it is broad, grouped into subcategories, and its components identified and described (Morse 2008).

The analysis of the interview data identified factors affecting nurses' adherence to and intended use of the VAP prevention guidelines. Factors that affect nurses' implementation of VAP prevention recommendations may be enablers, barriers or a combination of both, according to the findings. A total of five subcategories of factors that challenge nurses' adherence are described and explored in the following sections. Each section demonstrates how these challenging subcategories impacted and reflected on the participants' experiences of the VAP prevention guidelines, and how these challenging subcategories can be linked to reasons for non-adherence to the guidelines.

Table 6.2. Summary of the refined coding schema in relation to VAP prevention

Coding	Subcategories	Categories
Insufficient education on VAP Insufficient information on VAP	1. Education-related factors	*Nurses' **challenges** in providing VAP interventions*
Failure of healthcare professionals to follow guidelines Teamwork conflicts	2. Environment-related factors	
Inadequate organisational support Issues related to resources availability Issues related to workload Unavailability of VAP prevention guidelines	3. Organisational context–related factors	
Attitude towards ventilation Missed nursing routine practice (poor workforce development)	4. Individual nurse-related factors	
Emergencies that do not allow following procedure Failure of patient visitor or carer to follow hospital guidance Patient aggressiveness and resistance Patient preferences and contraindications	5. Patient-centred factors	
Creating awareness and feedback Education, in-service training and refresher courses are helpful for VAP prevention	1. Nurse-centred solutions	*Nurses' **solutions** for delivery of VAP interventions*

Following VAP bundle		
Collaboration with other health professionals	2. Healthcare professionals' solutions	
Employment of enough staff Focus and priority support Infection control importance and link to nurse role	3. Organisation-related solutions	
Coordinate care for adequate suctioning Minimize ventilator exposure Priority is following VAP bundle of care	1. Nurses' suggestions for VAP practice changes	*Nurses' **recommended** strategies for preventing VAP*

6.3.2.1 Subcategory 1: Education-related factors

This subcategory focuses on the participants' concerns about the lack of education in their settings. The delivery of education, in particular, was a subcategory that participants identified as determining whether VAP prevention guidelines are adhered to. During the interviews, the participants highlighted the importance of educational preparedness for using VAP prevention guidelines within their everyday practice. This subcategory reflects participants' experiences of finding and accessing hospital VAP prevention guidelines, as well as their assessment of their usefulness. A number of education-related factors were identified in this subcategory in relation to the hospital VAP prevention guidelines, including insufficient education and insufficient information about the hospital's VAP prevention guidelines.

Several participants expressed their disappointment with the quality of education and training courses offered to develop and implement VAP prevention guidelines in their practice with ventilated patients. During the discussion, one of the participants pointed out that they had been on similar courses concerning VAP prevention and management for many years and found them boring, providing the following explanation:

> *For many years they are the same and sometimes, like, it's boring. If they [the authorities] update the class and make it more enjoyable like that it will be good for nurses' skills, practices and education (Participant 4).*

Participants highlighted the lack of accessibility of the VAP prevention guidelines and the lack of adequate information for nurses concerning the guidelines. According to a number of participants, the available electronic guidelines did not contain enough information on the required procedures. Also, there were no refresher courses for nurses on emerging trends. This may have resulted in inadequate adherence to guidelines, which can negatively impact the practices of ICU nurses in relation to the VAP prevention guidelines: "*The available VAP*

bundle is more electronically guideline and I feel it is short and there is not much information about it" (Participant 7).

In addition, participants expressed the need for nursing leaders to enact change and adopt different educational strategies to increase adherence to the VAP prevention guidelines:

> *Education for some nurses is not enough nowadays. I mean, like ICU nurse usually receive multiple courses and different classes with new and updated teaching methods. The current educational efforts are still not enough for us. So, the less education, time management and patient condition can lead to low adherence [to VAP prevention guidelines].* (Participant 9)

6.3.2.2 Subcategory 2: Environment-factors

This subcategory focuses on participants' perceptions of cultural environmental issues and how nurses regard the influence of culture on the implementation of the VAP prevention guidelines. A common challenge identified by participants in the interviews was work-related stress that resulted from working with ventilated patients in ICUs. A number of participants expressed concerns regarding the use of guidelines by other healthcare professionals, and shared that teamwork with ventilated patients are not well understood in ICUs. Some participants expressed concerns that other healthcare professionals are not practising the guidelines as recommended. The participants' responses seemed to vary depending on the unit type and the intensive care speciality in which they work:

> *Ah, ah, there is one more thing for doing some procedures. Some doctors they're not practicing it very well. They're not washing their hands before any procedure; they are doing only hand rub. So that's the one thing that we saw.* (Participant 2)

Participants expressed their concerns about the nursing staff ratio and the need for collaboration with other healthcare professionals, which were two of the main challenges in relation to caring for ventilated patients. Some participants noted that there were shortages of

respiratory therapists and nursing staff, and this contributed to excessive workload during the care of ventilated patients. When the researcher sought to discover the feelings and outcomes associated with this, the following statements ensued:

> *The 1 to 1 in the ICU is not enough with those patients. We need some help or so from outside like from other healthcare providers, at least from RTs' [respiratory therapists'] side, it's more helpful for us.* (Participant 10)

> *Challenges actually staff ratio is one matter for our practices with vented patient. I'm always seeking some assistance, but we cannot call another person. Another person also maybe busy with patient.* (Participant 12)

> *Sometimes the availability of the RTs. Sometimes they're really all so busy some sort of us and we need to make time, I mean we need to collaborate with them that they are time with the patient because whenever we do oral care, we need the RTs with us. Because we cannot do the oral care alone.* (Participant 2)

However, some participants did argue that staff shortages were only experienced during the COVID-19 crisis, and that caring for ventilated patients was less challenging before COVID. This is illustrated by the following quotation:

> *There are respiratory therapists, they will take part in this suctioning and also the assessment of ventilators. However, we have to do the suctioning most of time because we have only 1 RTs. Before it was fine for us, but nowadays as we have staff shortage everywhere (due to COVID crisis).* (Participant 4)

A few participants reported that they were confused about VAP management and how to practice the recommendations for VAP prevention. In particular, participants reported that VAP management was led by respiratory therapist (RTs), and this created a conflict when providing direct care to ventilated patients, thus inhibiting their collaboration. This is because ICU nurses may intentionally disrupt with one another's work duties as a result of their overlapping responsibilities. One participant commented that nurses are no longer responsible for ventilation management, which added to the conflict that exists when dealing with

ventilated patients and implementing the VAP prevention guidelines: "*Also, nowadays I think for more than one or two years the ventilator, all management are taking by RTs. It was our nurses' responsibilities before but now RTs are responsible for all ventilator management [managing ventilation settings]*" (Participant 12).

6.3.2.3 Subcategory 3: Organisational context–related factors

This subcategory highlights the importance of organisational culture in facilitating or inhibiting nurses' adherence to and behaviour towards VAP prevention guidelines. Participants shared various issues which were common to all of them related to their context, the place where they work, and its impact on their practice with ventilated patients. The qualitative data revealed that most interview participants felt they lacked organisational support, there were problems of resource availability, their workload was high, and they lacked awareness of the guidelines. Several participants emphasized that nurses' care for ventilated patient might tend to degrade because of the presence of these issues. Considering the assertions made by the participants, the following quotation is illustrative of this:

> *"They [hospital leaders] should provide enough staffing so the staff can stay with the patients and early we can identify the signs and symptoms of this VAP" (Participant 10).*

Participants complained that there was not enough staff to assist nurses in administering care to ventilated patients in their units. There were no other nurses available to assist either, because they were busy or unwilling to do so. The participants pointed out that they experienced significant shortages in their hospitals including ICU staff nurses, assistant staff nurses, and other healthcare professionals during the care for ventilated patients. A number of participants reported that nurses were unable to obtain assistance when they called for assistance, as presented in the following quotation:

Challenges, actually staff ratio is one matter for our practices with vented patient. I'm always seeking some assistance, but we cannot call another person. Another person also maybe busy with patient. Our staff ratio in the unit is 1 to 2 handling mainly, because cardiac surgery sometime always 1 is to 1, but we mainly getting 1 to 2. That is sometimes is very difficult. (Participant 12)

Other participants stressed the problem of availability of resources. A shortage of supplies was identified by participants as another challenge affecting their VAP prevention guidelines adherence. Participants reported they did not have special oral care kits. They noted that chlorhexidine solution for mouth care or some personal protective equipment (PPE) were often unavailable in their units:

Our challenge sometimes is the chlorhexidine. Maybe it's out of stock or not available in the room. (Participant 11)

Some anytime with the unavailability of things. Like some crucial times, we faced some unavailability of things, like that PPE personal protective equipment so it can be affected. (Participant 4)

Staff raised this concern with the head nurse; however, participants reported that not much was done.

Most of the participants in this study experiences considerable stress as a result of what they described as "excessive" documentation and paperwork related to their care of intubated patients. While some participants agreed that much of the paperwork and documentation is necessary for the assurance of quality nursing care, they believed that this negatively impacts their workload and their ability to provide quality nursing care to ventilated patients:

Another challenge is nowadays we are focusing on the documentation, so maybe sometimes we cannot spend more time to the patient. That is one of the main things that documentation is taking more time from us. Our work will not finish for within 12 hours. That is the main problem. (Participant 10)

The implications of the workload and the availability of the VAP prevention guidelines were also established during the discussion. Some participants expressed that they experienced a high level of stress because of the extra duties and tasks required for ventilated patients in the clinical area. There was a common perception among the nurses in this study that they felt exhausted by their excessive workload, especially during the COVID-19 crisis, which affected their ability to implement guidelines. They reported that they were at an increased risk of getting coronavirus disease; this risk was inescapable, resulting in heightened worry about exposure to infection:

> *I've been working in ICUs for many years now and, overall, the work in ICUs can be stressful sometimes, specially nowadays with the COVID situation.* (Participant 11)

> *The new challenge for us is that we have corona the viral infection. It is really difficult to go each morning to the unit full of corona patients. Nurses nowadays have a very high risk of being infected with such viral infection. We had many nurses' colleagues were clinically infected during work with COVID patients. Personally, I have some fear and uncertain about my practice in the ICUs nowadays.* (Participant 8)

On the other hand, the data showed that ICUs nurses in the two hospitals identified a lack of availability of the VAP prevention guidelines; only a VAP bundle of care was available for their practice and documentation. However, the researcher found that the VAP prevention guidelines were already present within the hospital's guidelines, but were not known by the ICU nurses, which resulted in their ineffective use of the guidelines. Example of their statements are provided below:

> *No, no, we do not have that one [VAP prevention guidelines]. No. No. No, we are mainly following this VAP bundle. The infection control created that VAP bundle and recommended us to use it with all vented patients.* (Participant 12)

Actually, we are highly recommending our hospital to implement the use of clinical guidelines for prevention of VAP. We need that one in our cardiac surgery. There is no guideline in our cardiac surgery. (Participant 12)

In this regard, establishing guidelines on VAP prevention in the hospital does not really serve the purpose of helping to prevent VAPs; rather it has acted as a barrier to implementing VAP prevention in practice, since the guidelines have not been communicated to the nurses in the ICUs.

6.3.2.4 Subcategory 4: Individual nurse-related factors

This subcategory focuses on participants' willingness to provide patient care, including their sense of obligation to ventilated patients, and their missed nursing care, where they do not follow the recommendations in the VAP prevention guidelines. Many participants expressed that the VAP prevention bundle checklist in their unit was very useful for them. Some participants indicated that they would be able to provide this care since they were nurses, even with the challenges they face:

Currently I have 10 years' experience with patients with ventilator and most of the time the care for ventilated patient is difficult. But even though we have maintained the VAP precautions and we are caring for the patient in ICU. (Participant 1)

Although most participants were concerned about the availability of VAP prevention guidelines in their unit, a number of participants indicated that they were in agreement with the bundle of care available for VAP prevention:

The VAP bundle has critical measures that help to save patient from infection. It's surely useful, the VAP bundle is very good. (Participant 10)

Yes, it's very useful. It is like a reminder and like a checklist for you. For you to know that ventilated patients are directly high risk for ventilator-associated pneumonia. (Participant 2)

It must be noted, however, that the participants' experiences indicated that care for ventilated patients was provided in accordance with the usual routine. Thus, novice nurses were exposed to the usual method of care delivery through their experienced colleagues, which was not in line with the guidelines. A practice of this nature resulted in the provision of care outside of the guidelines:

There are some guidelines is telling the use is better for once per shift but according to what have mouth care policy in the hospital for ventilator and non-ventilator patients as mentioned q 8 hourly [Q X hours refers to a practice schedule or frequency]. *That means in between it will come three times per day.* (Participant 12)

Other participants emphasized the discomfort they felt when they were being shadowed or being monitored and judged by peers or by an infection control nurse. Many participants felt that the presence of an observer in their units when working with ventilated patients put them under pressure. The following is an example of their statements:

In our hospitals we have infection control link nurse in each ward. They are observing us, physicians and others. They are watching in like each shift and that will reflect for our evaluation. So, I feel sometimes some pressure when I see them around. (Participant 10)

In contrast, some participants believed that it was beneficial to have observers present during the care of ventilated patients and suggested the addition of more observers to the unit. A later subcategory, nurse-centred solutions, will explain this point further.

6.3.2.5 Subcategory 5: Patient-centred factors

This subcategory was highlighted by participants who viewed non-compliant ventilated patients or patients who displayed aggressive and resistive behaviour as challenges to their practice of providing the VAP bundle. A common view amongst interviewees, the patient-centred factors subcategory described the difficulties they faced in providing nursing care for

ventilated patients. Patient-related aggression was reported by participants who experienced both physical and verbal abuse, especially with agitated ventilated patients who are not deeply sedated. Participants reported that some patients failed to cooperate with nurses during the administration and management of VAP prevention measures and they became more violent and agitated:

> *Depend on patient status. If the patient is too much agitated sometimes, you know, we can't do or perform it [nursing care]. Sometimes I will not do it if like this is the case but usually if the patient sedated and quiet, I have no challenge with this [adhering to VAP prevention guidelines].* (Participant 9)

Other participants reported having difficulty handling patients who were conscious but intubated and refused nursing care. As a result of this refusal, some participants reported they were unable to comply with the VAP prevention recommendations and reported this situation to their doctors:

> *Just recently my patient GCS [Glasgow Coma Scale] of 10. So, he is conscious and he keeps localized pain. He can localize pain. So, every time I suction him, he will fight and bite the Yankauer. So, this is one of the challenges that we face.* (Participant 3)

> *Some patients are conscious even though they are on ventilator and sometimes they will tell us to put the bed down. Sometimes only it's very rare practice. Because of this long [the patient been kept in that position] and when the ventilator-dependent patients are conscious; they are the one telling us to alter the position [by saying], "Sister, I don't like this position, please make it little bit down".* (Participant 11)

A common feeling amongst participants was that it was difficult to follow the recommendations for ventilated patients with pre-existing conditions such a mouth ulcer, /trauma or bariatric patients and those with contraindications to HOB elevation such as pelvic fracture, or suspected or confirmed spinal injury. Participants reported that patients with pre-

existing conditions such as mouth ulcers may be a complication in the administration of tubes through the mouth. Participants added that it was hard for patients to go through that care:

> *The patient's condition. For example, patient is on prone position. It's hard to provide oral care so you have to wait for 16 hours to do oral hygiene after we make him supine like that. Sometimes when your patient BS* [hospital patient code]. *This definition of BC maybe code blue. So at that time, maybe you will not do oral hygiene because you are very busy; your patient coded.* (Participant 3)

> *Sometimes we can't treat patient according to the guideline due to his difficult case with many contraindications.* (Participant 8)

On the other hand, participants highlighted that when they encounter an adverse or critical incident they pay little attention to each aspect of the VAP guideline of care, since the life of a ventilated patient is their primary concern. According to participants, implementing the recommended VAP prevention nursing practices during a life-saving situation can be challenging and in most cases they lacked time.

> *Because the clinical side and the practical side is different. So the practical side is the life-saving situation. So sometimes we have to do everything as fast. So that time we cannot maintain the stability or the safe situation tips on what they are saying in the books or the guidelines. So we have to go that one directly for the lifesaving.* (Participant 5)

6.3.3 Category 2: Nurses solutions for delivery of VAP recommendations

This major category focused on how the participants identified practical experience-based solutions to resolve challenges associated with adherence to the VAP prevention recommendations in their specific context. By incorporating the experiences of ventilated patients' care into their solutions, participants in this major category pointed out practical, experience-based solutions to problems related to adherence to the VAP prevention guidelines.

During the discussion, participants were asked to provide practical solutions focused on achieving change in the healthcare context as well as in their own challenges with following the VAP prevention guidelines. Participants were instructed to consider each potential solution, and then, in subsequent questions, to consider the importance and feasibility of each solution separately. The ICA analysis identified three overarching subcategories regarding solutions to non-adherence by participants as follows.

6.3.3.1 Subcategory 1: Nurse-centred solutions

This subcategory highlights several solutions identified by participants as being crucial for their daily practices with ventilated patients. Most interviewees stated that education for users of VAP prevention guidelines is a very important factor that influences adherence. One of the most prominent solutions presented by participants was to improve the current education and training services in order to improve adherence to the VAP prevention guidelines. Several participants suggested improving the current teaching methods in order to move away from the apprentice style of learning. Although there was no standardized structure for courses, a number of participants reported receiving traditional clinical teaching methods. Participants also suggested tailoring educational topics specifically to educating ICU nurses during bedside care on a monthly basis rather than annually.

> *All infection control courses are online and not only for ventilator but also other topics like central line as well, all of the sort of things about infection control. But these are annually required and it's online. So for us, for me, I will recommend, I think it's better if the infection control can come to the ICU and organize a lecture every month so the nurses will be reminded about their practices.* (Participant 2)

> *Maybe, maybe more if they give simulation courses with dolls are on patient for short time less than 30 mins. But usually it's like PowerPoint short time. Short*

courses especially early morning and within the unit are effective for nurses and patient outcome. (Participant 9)

Some participants suggested that ICU nurses should undergo clinical simulation training and weekly refresher courses on the care of ventilated patients. Participants suggested updating the current learning strategies to align with the evolving trends in the administration and management of patients with VAP. This would enable them to enhance their clinical skills and decision-making abilities by engaging in diverse real-life scenarios. A few participants reported that both theory-based and evidence-based practices should be incorporated into the education and practice of health professionals to bridge the gap between theory and practice: "*For education I mean maybe not only theory classes for every time. It should be like more and more theory and practical courses. We need effective educational classes that are more engagement and practical for us*" (Participant 9).

Considering the critical conditions in which ventilated patients are hospitalized in ICUs, many participants felt that the focus on education alone is not sufficient to change ICU nurses' practice with ventilated patients. There was also discussion regarding the importance of raising staff awareness and knowledge of the VAP prevention guidelines and how to implement them in their daily practice.

> *We are not lacking with any education because on daily basis we have education. So, we are well covered with education, nursing education. Nursing education is very important for everyone, is it's very important, but luckily in our hospital, we are getting the good education. However, nursing education alone is never enough to change our practice or increase staff knowledge.* (Participant 7)

According to the participants, one way of dealing with challenges was by following procedures and guidelines when caring for ventilated patients. They reported that they mentor and remind each other to ensure that the VAP prevention recommendations are followed, which

minimizes the VAP rates in their unit. The participants reported that establishing an atmosphere of awareness and feedback between the ICU nurses will aid in overcoming the challenges associated with adherence to the VAP prevention guidelines. The following is an example statement: "*The support maybe reorienting, encouragement, reintroducing the importance of VAP. We can have this and we can recommend this to our clinical instructors to discuss again the importance of VAP so nurses will be reoriented again*" (Participant 3).

Another participant pointed out that mentoring during the care of ventilated patients may result in a bit of stress for the ICU nurses, but will assist them to ensure ventilated patients avoid the development of VAP:

> *In each unit there is assigned staff from infection control department. So they are monitoring and observing our hand hygiene practice all the time. This can give us some pressure during the practice time but it helps to minimize risk of harms to patient. I think monitoring and observing staff for hand hygiene provides more effective performance not like any other criteria*. (Participant 8)

Many participants expressed the need for nursing leaders to keep pace with the continuous changes in nursing practice and education. Nursing education programs require constant evaluation, improvement, and input from experts in the field. Nursing researchers or educators, who have expertise and experience in evaluating educational programs, can be invaluable resources for this purpose. Having their insights and perspectives can contribute to the development of effective solutions and strategies for enhancing nursing education. The participants emphasized the importance of integrating theoretical and clinical education, as well as discussing the extent to which their theoretical education could be applied in practice. In the discussion, participants agreed that understanding the views and opinions of ICU nurses may be useful in developing educational services in a real clinical setting: "*If we can do some survey like that to explore nurses' views about our current education services like that, this could be another suggestion*" (Participant 4).

6.3.3.2 Subcategory 2: Healthcare professionals' solutions

This subcategory emerged from the participants' emphasis on the importance of establishing professional communication with other healthcare professionals to overcome the challenges associated with adherence to the VAP prevention guidelines. Typically, ventilated patients in intensive care units are not cared for by one healthcare professional; rather, they are treated by a multidisciplinary team of healthcare professionals. Participants stated, however, that this is not yet well established in their context and they must strengthen their professional communication with other healthcare professionals in order to overcome the challenges associated with adherence to the VAP prevention guidelines. Several quotations from the interviews illustrate this:

> *So, my suggestion's we have to increase the close interaction with our physicians and the proper environment to work with that ICUs.* (Participant 10)

> *I think so far, we're covering all and I think the only thing that I can recommend is that the doctors' hand hygiene practices and the collaboration of all the healthcare team with us to help prevent the VAP. That's the only recommendation I can tell.* (Participant 2)

> *Secondly that we need to make a respiratory therapist, I mean more respiratory therapist to be more collaborative as much as possible for us to implement this mouth care because we need them during patient care of giving oral care to patients on ventilator.* (Participant 2)

Participants highlighted the importance of continuing education for all healthcare professionals involved in the care of ventilated patients with respect to the management of VAP and the prevention of VAP. Participants believed that that other healthcare professionals must have knowledge of the complications associated with VAP, as well as the ability to interact effectively with ICU nurses. Consequently, other healthcare staff should receive adequate

training in VAP management and prevention in order to overcome challenges to adherence to the VAP prevention guidelines so that long-term sustainable outcomes can be achieved:

> *We need to give proper education, and everyone should be aware about this VAP and it is complications and how it is affecting the patient's life like that. We need to educate the multidisciplinary team so it can be beneficial for the patient.* (Participant 4)

6.3.3.3 Subcategory 3: Organisation-related solutions

This subcategory arose in response to participants' views of the importance of organisation-level support for ICU nurses in order for them to be able to comply with the VAP prevention guidelines. During the interview, participants highlighted many barriers to adherence to the VAP prevention guidelines, including lack of resources, insufficient organisational support, and the inadequate role of infection control staff, as noted under category one. As a result of the discussion, the participants suggested a few measures that would support the uptake of the VAP prevention guidelines in ICUs at the hospital level, including employment of sufficient staff, and giving priority to the infection control role in VAP prevention measures.

Participants suggested that hospital leaders should be able to establish the necessary conditions for implementing the VAP prevention guidelines, in addition to ensuring ICUs have the logistical capability to facilitate this implementation process. Participants suggested that more senior hospital staff need to commit to promoting the use of the VAP prevention guidelines within ICUs. They mentioned that higher authority needs to be involved in the implementation of VAP prevention guidelines in order to sustain early support for the improved application of the VAP prevention guidelines by ICU nurses. Examples of their statements are provided below:

> *But this is not enough for us. More involvement from higher authority would be great.* (Participant 7)

So, to lowering the risk of VAP and prevent patient from getting pneumonia, higher authority should monitor the work environment like the multidisciplinary team. (Participant 8)

The participants during the interviews mentioned that lack of staffing and workload issues are major barriers to ICU nurses' uptake of the VAP prevention guidelines. Participants suggested that for higher administration to make changes to VAP prevention guidelines in practice and in the care of their ventilated patients, they would need to take into consideration the principal characteristics of the health workforce as well as its present utilization. This is explained further in these statements:

Well the suggestions are that enough, more staff or if we have two side assistant nurses. We can handle this problem and others if we have an assistant nurse at the unit. (Participant 4)

Importantly, we need the manpower. This is not possible for only one nurse. We cannot lift the patient. We need the more staff for that. Nowadays we are getting the help from other staff and we don't have assistant staff nurse. (Participant 10)

Maybe if we have like healthcare assistant to help for like positioning and other minimum tasks this will be amazing. (Participant 9)

Participants pointed out that significant support from senior staff, particularly making the necessary equipment and resources available for the implementation of the VAP prevention guidelines, would have a significant impact on their practices, especially their care of ventilated patients. This would create a situation that ICU nurses get the appropriate resources and equipment for the practice of VAP prevention, as described in the following quotation: "*The lack of equipment, this will be from the hospital side and not from us. The hospital should provide the right equipment and enough kits for patients*" (Participant 9).

Other participants suggested involving dedicated nurses or infection control link nurses in infection prevention and control, since they would be in a position to serve as a link between

their clinical areas and the infection control team. As link nurses, they will inform, motivate and increase awareness in the ICU regarding the use of the VAP prevention guidelines. The following observations were offered by participants who generally believe that VAP link nurses are a worthwhile investment:

> *So, link nurse means, she's more responsible for the review of all vented patient in the unit and assigned nurses. She will come and will assess the vented patients and whether nurses are following all those things relating to VAP bundle. Also, she will observe and review our electronic documentation of VAP bundle.* (Participant 7)

> *The VAP team is monitoring this checklist and we are keeping file record because quarterly we have to give report, like every three months to unit managers and nursing departments. Our nursing care aims to zero VAP always.* (Participant 9)

> *We have also a signed VAP measure nurse who's responsible for connection between educators, staff and patients. So without this nurse we cannot do anything.* (Participant 10)

6.3.4 Category 3: Nurses' recommended strategies for preventing VAP

This major category focused on the practical recommendations highlighted by the participants to assist ICU specialists to prioritize and implement strategies to prevent VAP. ICU nurses play a vital role in infection prevention; therefore, participants were asked to share their perspectives on the most effective VAP prevention strategies as well as practical interventions that can be used to prevent VAP. Through incorporating the experiences of ventilated patients into their VAP prevention strategies, participants proposed some practical strategies aimed to prevent VAP. After considering each potential recommended VAP prevention strategy, participants were asked to examine the importance and feasibility of each strategy separately in subsequent questions. It was decided that the discussion would be centred on the most effective non-

pharmacological prevention measures since nurses are at the forefront of the infection control process. Based on the ICA analysis, the following subcategories were identified regarding nurses' recommendations for VAP prevention strategies.

6.3.4.1 Subcategory 1: Nurses' suggestions for VAP practice changes

This subcategory summarizes the recommended VAP prevention strategies that were highlighted by participants. Study participants identified three infection prevention strategies that they thought would help to prevent ventilated patients from getting VAP: (1) minimize ventilator exposure; (2) coordinate care for adequate suctioning; (3) prioritize oral hygiene care, head of bed positioning and hand hygiene Five Moments practices.

Among all participants, the most recommended VAP prevention strategy was early extubation, which reduces the possibility of patients developing VAP. Participants suggested that the implementation of a daily assessment protocol (known as spontaneous awaking trial or sedation vacation) of patient readiness to wean can reduce the likelihood of patients developing VAP by interrupting the sedation daily and maintaining spontaneous breathing. Thus, implementing a daily screening protocol of ventilated patients to identify those able to breathe spontaneously is possibly the most effective strategy to prevent patients from getting VAP. The following explanation was offered by participants who believe that, whenever possible, mechanical ventilation should be avoided or limited in order to prevent VAP:

> *[I]t's much better that to prevent the VAP is the earliest time possible to assess the patient to wean off from the ventilator. That is the best possible thing I can recommend.* (Participant 2)

> *This sedation vacation, I'm mentioning is the sedation vacation. Because mechanically ventilated patients are all or mostly sedated. So if they are so we're not able to find out if the patient can wean off from the ventilator so what we are doing is removing step by step those sedations and then assessing the abilities of the patient or the ability of the patient to breath on himself and if*

there are different extubation parameters and if the patient pass that extubation parameters then the earlier, the earlier they will pass the earlier the machine will be removed from the patient. (Participant 6)

[W]e are asking for the weaning plan and earliest extubating is better than the prevention of this one. (Participant 5)

The second recommended VAP prevention strategy is based on the fact that endotracheal intubation interferes with normal mucociliary function, which in turn results in production of more airway secretions and a decreased ability to remove them. Among the participants' recommendations for preventing excess or abnormal secretions is sufficient endotracheal suctioning in order to remove secretions and to maintain airway patency. Therefore, to help ventilated patients avoid VAP complications and potential risks, healthcare professionals including ICU nurses should maintain endotracheal suctioning in accordance with VAP prevention guidelines:

These things are there [VAP prevention guidelines] but we should keep the adequate suctioning. The adequate suction should be there because there is chance the mucus plugs will be plugged inside and that also will cause infection. So the patency, adequate suctioning, the position of the endotracheal, these also our nursing practice. (Participant 7)

Endotracheal suctioning is a very important because if the patient not suctioned frequently, it can accumulate secretions in the lung and chest to grow more and it can lead to infection. (Participant 1)

The third recommended VAP prevention strategy was to follow the three recommendations that were discussed during the interviews, namely oral hygiene with 0.12% chlorhexidine solution, elevation of HOB between 30° and 45°, and hand hygiene Five Moments.

I do consider these three are very important tools which we should follow in order to prevent the VAP because if we are not following the patient can really

go to VAP situation. All the three recommendations are very important and these three require high priority in the ICU. (Participant 1)

It is very essential because if we are not practising any of these recommendations, we are introducing the infection to the patients from our nursing side. However, these all with a high priority for us and for patient life. (Participant 7)

6.4 Chapter summary

This chapter presented the results of the qualitative study. Three major categories emerged from the interviews with ICU nurses: nurses' challenges in providing VAP interventions, nurses' solutions for delivery of VAP interventions, and nurses' recommended strategies for preventing VAP. The study revealed a number of challenges ICU nurses face in regard to adhering to hospital guidelines concerning the prevention of VAP. Hence, study participants mentioned a combination of educational, environmental, organisational, individual and patient-related barriers to adherence. However, participants pointed out several practical solutions to promote adherence to the VAP prevention guidelines in their unit, including nurse-centred solutions, healthcare professionals' solutions, and organisation-related solutions. The study participants also highlighted prevention strategies that may help to prevent VAP in the future. Identifying the factors that influence ICU nurses' adherence to the VAP prevention guidelines increases the depth of understanding of the best ways to implement the guidelines that are appropriate and applicable in Saudi Arabia. The following integration chapter presents information obtained from both the quantitative and qualitative data to provide a more comprehensive understanding of both sets of findings.

Chapter 7: Data integration

7.1 Introduction

This study used a sequential explanatory mixed-methods design, as discussed in Section 3.9. The aim of this study was to gain an understanding of the factors that influence the uptake by nurses working in ICUs of VAP prevention guidelines with a focus on OH, the elevation of HOB and HH. The study commenced with a quantitative study and was followed by a qualitative study. The two sets of data were collected and analysed separately, followed by a process of integration to enable an in-depth understanding of the study phenomenon. This chapter presents the findings that have been integrated to more effectively understand nurses' use of VAP prevention guidelines. Specifically, this chapter discusses how data analysis, interpretation and representation of the mixed-methods study findings for the current study were integrated. Finally, the integrated data is presented to describe the influences on ICU nurses' adherence to the VAP prevention guidelines.

7.2 Integration of the study's main findings

The outcome of "mixing" in mixed-methods research can be dramatically enhanced when quantitative and qualitative data are integrated (Schoonenboom & Johnson 2017). Integrating mixed-methods data can offer rich insights into study phenomena that may not be fully understood by using either method alone. Integration has been identified as a fundamental principle of mixed-methods research by several authors (Clark & Ivankova 2015; Fetters, Curry & Creswell 2013; Guetterman, Fetters & Creswell 2015). Integration in mixed-methods research is defined by Clark and Ivankova (2015, p. 9) as "an explicit interrelating of the quantitative and qualitative components within a study". Fetters, Curry and Creswell (2013)

point out that integration within mixed-methods research may be accomplished at different stages depending on the study, such as at the design, methodological and interpretation/reporting levels. In spite of the growing recognition of integration as a vital component of mixed-methods studies (Creswell & Clark 2018), researchers have difficulty performing mixed-methods integration because "existing studies do not discuss in-depth replicable techniques for integrating different types of data" (Johnson, Grove & Clarke 2017, p. 303). Techniques of data integration derived from mixed-methods design continue to receive little attention (Creswell & Clark 2018; Fetters, Curry & Creswell 2013; Schoonenboom & Johnson 2017).

This process for the conduct of the study is described in a series of stages (as shown in Figure 7.1). The emphasis placed on the integration of the findings in mixed-methods studies, like this PhD, differentiates them from other methodologies (Creswell & Clark 2018; Guetterman, Fetters & Creswell 2015; Schoonenboom & Johnson 2017). Methodological integration in this study, as described by Fetters, Curry and Creswell (2013), was achieved by linking the methods of data collection and analysis through building and merging approaches. Building involved using the findings of the qualitative phase to develop a deeper understanding of the results of the quantitative phase. Merging involved combining both data sets for analysis. A narrative report was then developed based on the integrated results, ensuring a coherent and comprehensive presentation. This chapter presents the overall study findings, and a more detailed interpretation of these findings will be provided in the following chapter.

7.3 Integration of study findings techniques

Various techniques can be employed to integrate quantitative and qualitative data at the interpretation and reporting levels in order to enhance the knowledge derived from this approach (Fetters, Curry & Creswell 2013; O'Cathain, Murphy & Nicholl 2010). Several

techniques have been proposed to formalize and standardize the process of data integration, such as the *Triangulation Protocol* (Farmer et al. 2006) and the *Following a Thread* method (Moran-Ellis et al. 2006). Moreover, the *Joint displays* (Guetterman, Fetters & Creswell 2015) and the *Pillar Integration Process* (Johnson, Grove & Clarke 2017) have emerged as additional techniques to integrating mixed methods research, providing insights by visualizing the integration of data. However, concerns have been raised about the time consumption, complexity, and applicability of these techniques to all types of research (Dawadi, Shrestha & Giri 2021; Gauly, Ulahannan & Grove 2022; Timans, Wouters & Heilbron 2019). Integration of data during data analysis in this study was accomplished through two different techniques: integration through *following a thread* and *joint displays* (Guetterman, Fetters & Creswell 2015; Moran-Ellis et al. 2006) (Figure 7.1).
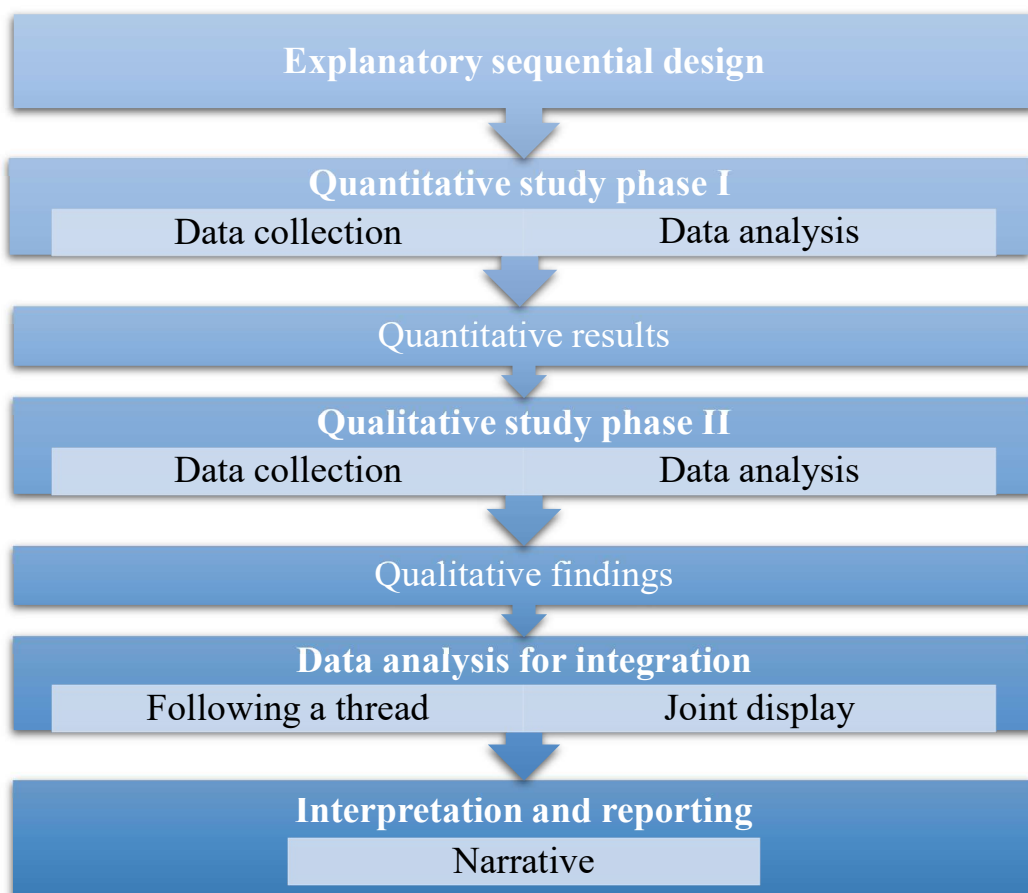
Figure 7.1 An illustration of the study techniques for data analysis and data integration

Following a thread is an analytical technique for integrating data proposed by Moran-Ellis et al. (2006). Using this technique facilitates the development, critique and improvement of researchers' approaches to integration. A major benefit of this approach is that it can assist researchers in gaining a deeper understanding of their study. This technique has the potential for integrating different data sets, enabling simultaneous analysis and comparison of the data (Moran-Ellis et al. 2006; O'Cathain, Murphy & Nicholl 2010). This technique allows researchers to keep the paradigmatic nature of different methodologies while interweaving them to gain a more comprehensive understanding (Dupin & Borglin 2020). Thus, a multifaceted picture of the phenomenon is created by integrating qualitative and quantitative data. As part of the technique, four key steps are followed: analysis of each dataset separately, identification of promising emergent findings, linking threads across datasets to identify patterns, and synthesizing findings from various threads (Moran-Ellis et al. 2006). Using this technique, datasets were first analysed with respect to their respective paradigms, and then emerging themes or analytical questions were investigated across multiple datasets in order to integrate the findings (Moran-Ellis et al., 2006). The integration process ensured that the credibility of the analysis was enhanced, avoiding the mere mixing and matching of methods (Dupin & Borglin, 2020).

Joint display is an analytical approach that enables visualization and analysis of mixed data in a manner that enhances interpretation and generates fresh insights (Fetters, Curry & Creswell 2013; Haynes-Brown & Fetters 2021). Guetterman, Fetters and Creswell (2015) point out three types of joint displays that could occur in a sequential explanatory design, namely side-by-side displays, theoretical lenses and innovative path diagrams illustrated with clinical examples. In this study, a joint display analysis is used and involves comparing the results of the two types of data side by side to determine their "fit". However, the outcome of data integration varies depending on whether the findings are confirmed (i.e. findings from the two

types of data confirm each other), expanded (i.e. findings from the two data sets differ and expand), or discordant (i.e. findings from the two data sets disagree with each other) (Haynes-Brown & Fetters 2021). During the process of joint display analysis, researchers usually undergo several rounds of revisions and refinements of the developed constructs. Through the application of such a process researchers can ensure the effectiveness of their integration of their analysis (Guetterman, Fetters & Creswell 2015).

7.4 Process of data integration analysis

The data integration process is outline in Figure 7.2. This study integrated the quantitative and the qualitative data using two analytical techniques, integration through following a thread and joint display (Guetterman, Fetters & Creswell 2015; Moran-Ellis et al. 2006). Following a thread technique was utilized first, which entailed conducting an initial analysis of the quantitative study to identify important key results and questions that needed further exploration by the following qualitative study. By tracing these key themes and questions across the qualitative findings, patterns and connections between them were revealed. The association between the quantitative results and the qualitative findings was established, based on the statistically significant correlations observed in the quantitative data (Moran-Ellis et al. 2006). As a result, these themes were cross-referenced and integrated in order to develop constructs that attempted to interlink the emerging findings based on the similarity of their analysis. Then, a joint display technique was used to ensure validity in the design process by aligning findings from each study according to their degree of fit. A visual representation through a side-by-side joint display was developed to generate new insights that go beyond the information derived from the separate quantitative and qualitative analyses (Guetterman, Fetters & Creswell 2015). A final process of the integration analysis involved the development of the two major constructs that incorporated findings from both qualitative and quantitative

studies to gain a deeper understanding of the factors that influence ICU nurses' adherence to VAP prevention guidelines. The integration of both types of data, through a joint display as well as a thread analysis method, has the advantage of provoking the researcher to think simultaneously about both sets of data (Dupin & Borglin, 2020). These two major constructs were then used to inform the discussion of the findings and draw conclusions from the data.
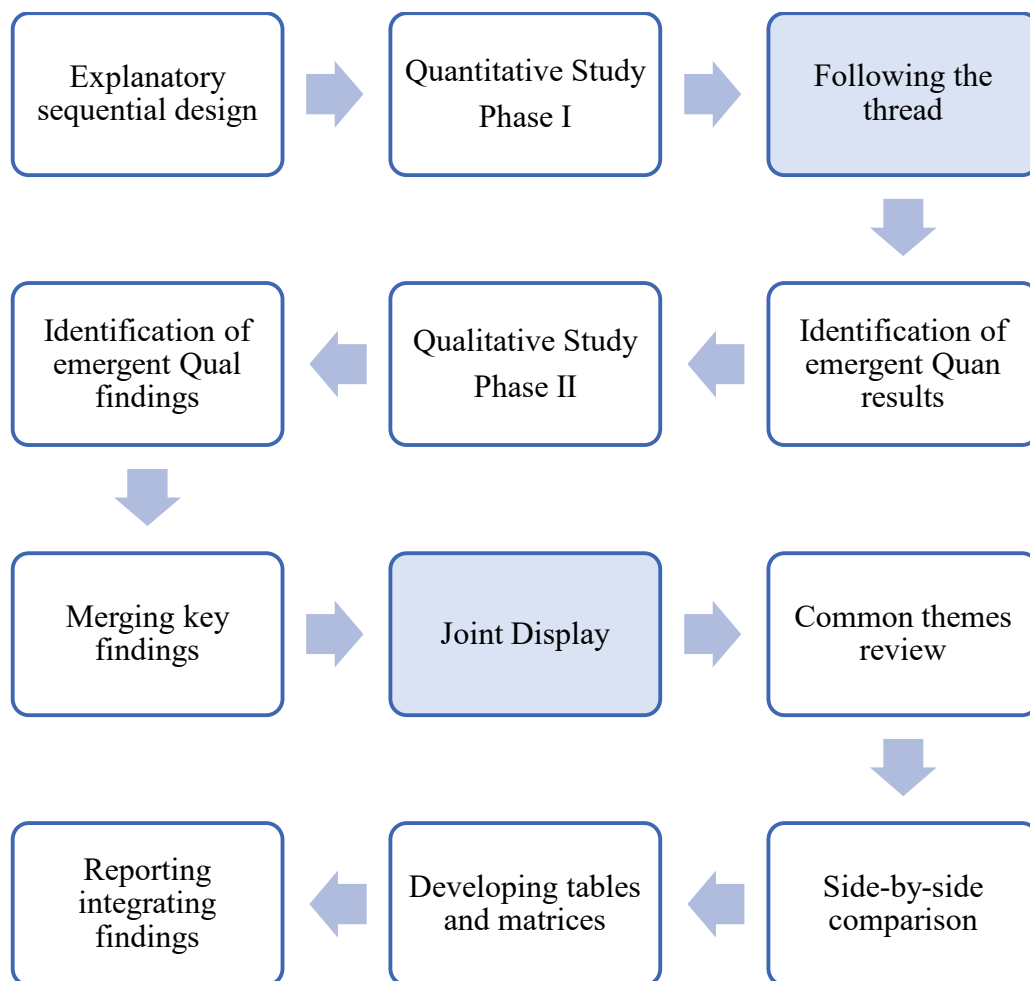
Figure 7.2 Process of data integration techniques

7.5 Integrated main results

The following section describes the results of the integrated data, with examples of multiple answers that were merged from the responses of ICU nurses to both the questionnaire and interviews. The combination of quantitative data with qualitative findings was achieved by

analysing the results of the audit of current practices and the questionnaire, as well as reviewing the responses of ICU nurses during interviews. The major constructs were analysed by aggregating the subconstructs into two main constructs categorized as: a) intrinsic factors influencing ICU nurses' adherence to VAP prevention guidelines, and b) extrinsic factors influencing ICU nurses' adherence to VAP prevention guidelines.

According to Haynes-Brown and Fetters (2021) the outcomes of data integration are classified into three subcategories: confirmation, expansion and divergence. When the results of the quantitative phase of the study are affirmed by the findings from the qualitative phase, then the outcome of data integration is classified as "confirmation". If the findings from the qualitative phase partially affirm the quantitative results this partially opens the potential for further discussions and explorations, and the outcome is termed "expansion". Finally, the term "divergence" is used to depict the outcomes of data integration wherein the results of the qualitative and quantitative phases do not complement each other (or in other words, when they diverge). The two main constructs with their subconstructs are presented in Table 7.1 and 7.2.

7.5.1 Intrinsic factors that influence ICU nurses' adherence to VAP prevention guidelines

This major construct is centred on the insights derived from the integrated analysis of the audit of current practices, questionnaire responses, and interview findings. The comprehensive analysis identified subconstructs related to factors impacting nurses' implementation of VAP prevention recommendations, encompassing both enablers and barriers. These subconstructs were linked to the reasons for non-adherence to the guidelines, shedding light on ICU nurses' adherence to VAP prevention guidelines. The integration analysis revealed four overarching subconstructs concerning intrinsic factors influencing adherence, which will be further explored in the following sections (Table 7.1).

Table 7.1. Joint display of the integrated results for intense factors that influence nurses'
adherence to VAP prevention guidelines

Joint display of the integrated quantitative and qualitative data	Outcome
Attitudes towards the VAP prevention guidelines: The majority (N=316; >72.5) of the participants self-reported a positive attitude towards 3 recommendations from the VAP prevention guidelines in the ICU, but 53.8% of the nurses have a positive attitude towards the VAP prevention guidelines on the sub-dimension measures. *"Nursing education is very important for everyone, is it's very important but luckily in our hospital, we are getting the good education. However, nursing education alone is never enough to change our practice or increase staff knowledge ..."* (Participant 7).	Confirmation/ expansion
Knowledge and awareness of VAP prevention guidelines: The majority of the ICU nurses stated that they have read the VAP prevention guidelines at least once. However, 13.4% of the nursing staff were unaware of the content as well as the availability of the VAP prevention guidelines. Participants' comments indicated a state of confusion regarding the availability and content of the VAP prevention guidelines. "*No, no, we do not have that one* [VAP prevention guidelines]. *No. No. No, we are mainly following this VAP bundle. The infection control created that VAP bundle and recommended us to use it with all vented patients. Actually, we are highly recommending our hospital to implement the use of clinical guidelines for prevention of VAP. We need that one in our cardiac surgery. There is no guideline in our cardiac surgery ..." (Participant 12).*	Confirmation/ expansion
Quality of the guidelines: After regression analysis on the sub-dimension scales, around 40% of the participants believed that the OH and HOB sections of the guidelines have adequate quality. *"The available VAP bundle is more electronically guideline and I feel it is short and there is not much information about it ..."* (Participant 7).	Confirmation
Role of experience in influencing the ICU nurses' adherence to VAP prevention guidelines: Only 24.05% of the participants have > 10 years of experience in ICU settings, which is especially reflected in the practice of OH, elevation of HOB and HH. *"Currently I have 10 years' experience with patients with ventilator and most of the time the care for ventilated patient is difficult. But even then, we have maintained the VAP precautions and we are caring for the patient in ICU ..."* (Participant 1).	Expansion

7.5.1.1 Attitudes towards VAP prevention guidelines

Quantitative: The majority (N=316; >72.5) of the participants reported a positive attitude towards VAP prevention guidelines in the ICU. To measure attitudes towards the three individual recommendations in the VAP prevention guidelines, the composite score of three variables was used for regression analysis, resulting in a single score of > 70%. This indicates that the nursing staff of the ICU have an overall positive attitude towards the VAP prevention guidelines. However, after accounting for subdimension measures for attitude, 53.8% of the nurses have a positive attitude towards the VAP prevention guidelines overall. Furthermore, around 38% of the ICU nurses stated that the guidelines may interfere with their professional autonomy to make clinical decisions outside of the guidelines.

Qualitative: The qualitative study affirmed the results of the quantitative study, wherein some participants were positive towards the VAP prevention guidelines. However, no evidence was found to support the quantitative study's findings on attitude subdimensions in relation to ICU nurses' concerns about the VAP prevention guidelines and professional autonomy. Further, the researcher was unable to find qualitative evidence supporting negative attitudes towards the VAP prevention guidelines among ICU nurses at the subdimension scales, as was indicated in the quantitative phase. Therefore, the integration of the qualitative and quantitative studies regarding the ICU nurses' attitude towards the VAP prevention guidelines *expands* the possibilities of further research because the qualitative results do not completely *confirm* the quantitative findings. The statements of ICU nurses which confirm the overall positive attitudes of the ICU nurses are given below:

> *The VAP bundle has critical measures that help to save patient from infection.*
> *It's surely useful, the VAP bundle is very good.* (Participant 10)

Yes, it's very useful. It is like a reminder and like a checklist for you. For you to know that ventilated patients are directly high risk for ventilator-associated pneumonia. (Participant 2)

Integration outcomes: Both the qualitative and quantitative studies suggest that nursing staff have an overall positive attitude towards the VAP prevention guidelines. As per the self-reported adherence among the ICU nurses, the positive attitudes towards different criteria of VAP recommendations ranged from 78.8 to 94.3%. However, around half of the nurses (46.2%) have some negative attitudes towards the guidelines at the subdimension level. For instance, the variations observed between the day and night shifts in some of the nurses suggests there is variation in adherence to VAP prevention guidelines. The variation in adherence to VAP prevention guidelines between day and night shifts could be attributed to workload differences or other intrinsic factors.

7.5.1.2 Knowledge and awareness of VAP prevention guidelines

This subconstruct revealed that several factors, such as insufficient knowledge and accountability, along with a lack of awareness regarding the availability and implementation of VAP prevention guidelines, can significantly impact the ICU nurses' adherence to these guidelines. Further details on these factors are provided in the subsequent section.

7.5.1.2.1 Factors related to a lack of accountability and lack of knowledge of the VAP prevention guidelines

Quantitative: The quantitative data showed that most ICU nurses believed that they have accountability for the delivery of care as per the guidelines' recommendations. However, in response to the colleagues' sense of responsibility question, 28% to 50% of the participants (for elevation of HOB and OH) believed that their colleagues have an adequate response to the VAP recommendations. Regarding knowledge of the VAP prevention guidelines, around half of the respondents stated that there are no conflicts in the VAP prevention guidelines for OH

and HOB recommendations. Furthermore, around half of the participants stated that the practice of OH and HOB are nurses' practice responsibility, whereas others believed that this practice is shared with other healthcare professionals.

Qualitative: Lack of adequate opportunities for education was identified as one main reason for nurses' lack of adherence to the VAP prevention guidelines. While discussing the factors that hinder ICU nurses' adherence to the VAP prevention guidelines, many nurses described how the lack of access to refresher courses and insufficient information on the existing guidelines negatively affected their adherence to VAP prevention recommendations in the ICU, as described by interview Participant 9 below:

> *Education for some nurses is not enough nowadays. I mean, like ICU nurse usually receive multiple courses and different classes with new and updated teaching methods. The current educational efforts are still not enough for us. So, the less education, [issues of] time management and patient condition can lead to low adherence [to the VAP prevention guidelines].* (Participant 9)

Integration outcomes: The quantitative analysis indicated that approximately half of the participants lacked adequate knowledge of the VAP prevention guidelines. In the qualitative analysis, many participants complained regarding the lack of opportunity to learn about the VAP prevention guidelines. Based on the results of this study, it appears that a substantial number of the study participants were unfamiliar with the guidelines and were unable to apply them in practice. Furthermore, the qualitative analysis revealed that many of the participants were unclear about the rationale and reasoning behind the guidelines. The lack of opportunity to learn may be one of the major reasons for lack of knowledge among the ICU nurses regarding the VAP prevention guidelines. Therefore, the qualitative results expand the findings of quantitative phase of this study. Further, the lack of accountability among the ICU nurses, which is related to the HOB and OH recommendations of VAP prevention guidelines, were

indicated in the quantitative phase. However, this study could not confirm or expand this finding through the qualitative analysis.

7.5.1.2.2 Quality of the VAP prevention guidelines and institutional support

Quantitative: Issues related to the quality of the VAP prevention guidelines provided to the ICU nurses were identified in the quantitative phase. Amon the survey participants, 70% of the respondents stated that the VAP prevention guidelines are easy to understand, indicating potential areas for improvement in guideline clarity and comprehensibility. After regression analysis on the subdimension scales, 40% of participants believed that the OH and HOB sections of the guidelines have adequate quality. This means the majority of the respondents believe that there is a lack of quality in the OH and HOB sections of the VAP prevention guidelines. The regression analysis showed that the majority of participants felt the guidelines were of adequate quality, but there were still issues in specific sections that need to be addressed. For example, the OH and HOB sections were not seen to have adequate quality by 40% of respondents.

Qualitative: The qualitative data confirmed the findings of quantitative data analysis regarding the ICU nurses' positive attitude towards the content of the VAP prevention guidelines. However, participants in some of the ICUs were affected by the lack of support from the authorities in arranging refresher courses and in providing updated VAP prevention guidelines. Participants complained that the same content is provided over and over by the authorities and there are no "updates" which can improve the knowledge of the ICU nurse with regards to the VAP prevention guidelines. This is demonstrated by the following quotation: "*For many years they are the same and sometimes, like, it's boring. If they [the authorities] update the class and make it more enjoyable like that it will be good for nurses' skills, practices and education*". (Participant 4)

A positive statement on the VAP prevention guidelines is provided below: "*Actually, we are highly recommending our hospital to implement the use of clinical guidelines for prevention of VAP. We need that one in our cardiac surgery. There is no guideline in our cardiac surgery*". (Participant 12)

Integration outcomes: The quantitative data identified that the VAP prevention guidelines provided to the participations were lacking in quality. For instance, 40% of the participants complained that the OH and HOB sections of the VAP prevention guidelines do not have adequate quality. Further, around 30% of the participants believed that the guidelines are not easy to understand. The results of the quantitative phase regarding the quality of the VAP prevention guidelines were affirmed through the qualitative phase, wherein some of the participants complained that the VAP prevention guidelines provided to them do not have adequate quality because of a lack of updating. The contents of the guidelines are the same for the past several years and the authorities are not putting sufficient effort to incorporate the latest information into the guidelines. Therefore, the qualitative phase of the study confirms the results of the quantitative phase of this study.

7.5.1.2.3 Lack of awareness among ICU nurses

Quantitative: The majority of the ICU nurses reported that they have read the VAP prevention guidelines at least once. However, 13.4% of the nursing staff were unaware of the content as well as the availability of the VAP prevention guidelines in their unit. In relation to the nursing staff's attitudes towards the guidelines' recommendations, over 85% of the participants expressed agreement with the individual recommendations provided in the guidelines. However, when it comes to the practical adoption of the VAP guidelines, only 78.5% of the ICU nursing staff have indicated their intention to implement these recommendations. These findings were further clarified in the qualitative study, providing valuable insights.

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Qualitative: Though the nurses expressed a positive attitude towards their roles, the lack of knowledge on the availability of VAP prevention guidelines in the ICU, issues with the cooperation of co-workers (while working with RTs to achieve optimum OH) and lack of experience were the main individual-related factors identified during the qualitative study. A negative attitude towards the use of VAP prevention measures was not identified. One of the participants explained factors affecting OH:

> *Sometimes the availability of the RTs. Sometimes they're really all so busy some sort of us and we need to make time, I mean we need to collaborate with them that they are time with the patient because whenever we do oral care, we need the RTs with us. Because we cannot do the oral care alone.* (Participant 2)

Some of the participants were not aware of the availability of VAP prevention guidelines at their unit. A state of confusion was observed in some cases. For instance, Participant 12 stated:

> *No, no, we do not have that one [VAP prevention guidelines]. No. No. No, we are mainly following this VAP bundle. The infection control created that VAP bundle and recommended us to use it with all vented patients.* (Participant 12)

Integration outcomes: The quantitative data revealed a knowledge gap among ICU nurses pertaining to the recommendations in the VAP prevention guidelines. Qualitative data analysis affirmed the finding that there is a lack of knowledge among the nurses on the internationally accepted recommendations for the prevention of VAP. Further, several participants in this study expressed their concern regarding the lack of meaningful courses and updates on the prevention of VAP. Because of this concern, 78.5% of participants plan to implement the guidelines in their future practice with ventilated patients. The remaining 21.5% had difficulties in implementing the guidelines due to a lack of resources and inadequate support from their superiors. Most of the participants reported that they need more information and support to effectively act on the guidelines. The lack of access to necessary resources has also been a

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contributing factor to the current situation. Finally, the conflict between individual beliefs regarding personal accountability and colleagues' shared responsibility in delivering patient care can potentially hinder nurses' adherence to and the successful implementation of VAP prevention guidelines in ICU settings.

7.5.1.3 Role of experience in influencing ICU nurses' adherence to the VAP prevention guidelines

Quantitative: The quantitative analysis indicated that 24% of the respondents have significant experience (more than 10 years) in the ICU settings. This indicates that nearly three quarters of participants had relatively limited experience in the ICU environment, making it important to provide guidance and training for these staff members. It was observed that less than 10 years of experience in the ICU setting is associated with lack of proper hand hygiene practice as described in the HH Five Moments guidelines (as shown in Table 5.17). Furthermore, there was a direct association between a respondent's total professional experience as a nurse and their self-reported adherence to all three recommendations in the VAP prevention guidelines including the practices of OH, elevation of HOB and HH.

Qualitative: The qualitative analysis found that management of non-compliant ventilated patients requires experience. A patient's physical conditions that require them to be nursed in a prone position also affect adherence to the VAP prevention guidelines. This is highlighted by this remark from a novice nurse:

> *Some patients are conscious even though they are on ventilator and sometimes they will tell us to put the bed down. Sometimes only it's very rare practice. ... when the ventilator dependent patients are conscious [Patient being conscious during endotracheal intubation]; they are the one telling us to alter the position [by saying], "Sister, I don't like this position, [please make it] little bit down".* (Participant 11)

Similarly, Participant 9 explained how the patient's condition affects the adherence to VAP prevention guidelines:

Depend on patient status, if the patient is too much agitated sometimes, you know, we can't do or perform it [nursing care]. Sometimes I will not do it if like this is the case but usually if the patient sedated and quiet, I have no challenge with this [adhering to VAP prevention guidelines]. (Participant 9)

Integration outcomes: The association between adequate experience in the ICU and acceptance and use of the VAP prevention recommendations revealed in the quantitative data was further substantiated by the qualitative data analysis. Even though the ICU nurses with < 10 years of experience have good self-reported adherence to OH, HOB and HH practices, the observed adherence to OH, HOB and HH was lower than the self-reported rate among these ICU nurses. The chi-square tests affirm this notion (as shown in Table 5.19). Even though HH is a common practice in all areas of health care, it is still affected by lack of experience in ICU settings. Therefore, there is a need for additional training and education programs to ensure that those who care for ICU patients are adequately trained and experienced with VAP prevention guidelines. Hospital administrators might consider allocating at least one nurse with over 10 years of ICU experience in every ICU. Also, encouraging interaction between novice ICU nursing staff and experienced nurses may improve the adherence of novice nursing staff to guidelines.

7.5.2 Extrinsic factors that influence ICU nurses' adherence to VAP prevention guidelines

This major construct is built upon insights gained from the integration of audits of current practices, questionnaire responses, and interview findings. This section explores the extrinsic factors, which influence ICU nurses' adherence to VAP prevention guidelines in

Saudi Arabia. Table 7.2 presents a brief overview of the results of the integrated analysis relating to the extrinsic influential factors.

Table 7.2. Joint display of the integrated results for extrinsic factors that influence nurses' adherence to VAP prevention guidelines

Joint display of the integrated quantitative and qualitative data	Outcome
Lack of uniformity in VAP prevention guidelines across ICUs The ICU nurses' adherence to the VAP prevention guidelines was found to vary significantly across the ICUs, which was related to the lack of uniformity in VAP prevention guidelines across different ICUs. "*There are some guidelines is telling the use is better for once per shift but according to what have mouth care policy in the hospital for ventilator and non-ventilator patients as mentioned q 8 hourly …*" (Participant 12).	Expansion
Lack of administrative support Lack of availability of resources negatively affects adherence to OH in 25% of the cases. "*Our challenge sometimes is the chlorhexidine. Maybe it's out of stock or not available in the room ...*" (Participant 11).	Confirmation
Lack of adequate staff and equipment The number of ventilated patients per two weeks (more than 3) was found to be an independent predictor for adherence to the OH practice in the VAP prevention guidelines (p = 0.014). "*They [hospital leaders] should provide enough staffing so the staff can stay with the patients and early we can identify the signs and symptoms of this VAP ...*" (Participant 10).	Confirmation
Shortage of time influences adherence Shortage of time was found to influence the nurses' adherence to the VAP prevention guidelines "*Another challenge is nowadays we are focusing on the documentation, so maybe sometimes we cannot spend more time to the patient. That is one of the main things that documentation is taking more time from us …*"(Participant 10).	Confirmation

7.5.2.1 Differences in VAP recommendations and practices across ICUs

Quantitative: It was found that the ICU nurses' adherence to the VAP prevention guidelines varied widely across the ICUs. It was noticed that the overall percentage of OH across 8 ICUs in the two hospitals varied from 69.4% to 100%. Similarly, elevation of HOB varied from 79.2% to 100%. The practice of HH was least varied (87.9% to 100%).

Qualitative: The qualitative data also suggested that some ICUs have poor adherence to the VAP prevention guidelines. Most of the nursing staff were concerned about the VAP prevention guidelines in one way or another. A participant from one of these ICUs explained:

> *There are some [discussions about the variation in the VAP prevention guidelines for oral hygiene] guidelines is telling the use is better for once per shift but according to what have mouth care policy in the hospital for ventilator and non-ventilator patients as mentioned q 8 hourly. That means in between it will come three times per day.* (Participant 12)

Integration outcomes: The quantitative data identified that there is a considerable difference in adherence to the three recommended practices among nurses across different ICUs. The qualitative data analysis revealed that there is considerable variation in the recommendations for VAP prevention among nurses across different ICUs because of the variation between the VAP prevention guidelines. In this study, participants stressed the importance of having clear and standardized guidelines that are adapted to the local context and culture of Saudi Arabia. The findings suggest that developing culturally appropriate strategies and interventions to deal with these variations could improve the quality of care provided to Saudi Arabian patients on mechanical ventilation and reduce the incidence of ventilator-associated pneumonia.

7.5.2.2 Lack of administrative support

Quantitative: In the quantitative study, 25% of respondents reported that the lack of supply of 0.12% chlorhexidine for OH practice because of administrative failures, negatively affects adherence to the VAP prevention guidelines. Further, a lack of time negatively affects both the OH and HOB practices in around 30% of the cases. The HH practice was largely unaffected in most of the cases.

Qualitative: Many participants complained about the excess workload due to the lack of staff, which in turn reflects a lack of administrative support [in arranging adequate human resources].

In addition, some participants were concerned about the lack of teamwork, which also reflects the failure of administration in ICU staff allocation and in precisely defining the role of each staff in the ICU duty. The failure of supervisors/hospital administration to encourage teamwork was further substantiated by the fact that most of the complaining participants belonged to particular ICU units. One participant explained: "*Challenges, actually staff ratio is one matter for our practices with vented patient. I'm always seeking some assistance but we cannot call another person. Another person also maybe busy with patient*" (Participant 12).

Integration outcomes: The qualitative data showed the association between lack of coordination between staff and nurses' failure to adhere to guidelines in the ICU. This lack of proper duty allocation resulted in conflicts among staff, leading to a lack of collaboration. Due to this lack of coordination, nurses were unable to follow the proper VAP guidelines recommendations due to confusion about their roles and responsibilities. There is a risk of decline in the quality of patient care in the ICU as a result of this.

7.5.2.3 Inadequate staff and equipment

Quantitative: The quantitative study identified that the number of ventilated patients cared for in the past two weeks, specifically those caring for two or fewer patients, serves as an independent predictor for adherence to Oral Hygiene (OH) practices outlined in the VAP prevention guidelines ($p = 0.014$). This finding implies that individuals in this group are 4.6 times more likely to follow OH guideline recommendations compared to those caring for three or more patients, with an Odds Ratio of 4.604 (95% CI: [1.368, 15.5]).

  Qualitative: The qualitative analysis affirmed the findings of qualitative study. Many participants reported that their ICU unit has insufficient staff, supply of PPE kits and 0.12% chlorhexidine for oral care to prevent VAP, as described by participants 10, 11 and 4:

They [hospital leaders] should provide enough staffing so the staff can stay with the patients and early we can identify the signs and symptoms of this VAP. (Participant 10)

Our challenge sometimes is the chlorhexidine. Maybe it's out of stock or not available in the room. (Participant 11)

Some anytime with the unavailability of things. Like some crucial times, we faced some unavailability of things, like that PPE personal protective equipment so it can be affected. (Participant 4)

Outcomes: The results of the qualitative and quantitative studies implied that in the absence of adequate staff, and supportive equipment, nurses may not be able to adhere to the VAP prevention guidelines, even when they want to follow them.

7.5.2.4 Random factors that are not under the control of the nursing staff

Quantitative: Shortage of time and the quality of the guidelines significantly affected the adherence of ICU nurses to the practices recommended in the VAP prevention guidelines.

Qualitative: Factors such as non-compliant and aggressive patients, and excess workload due to COVID-19 were identified during the qualitative analysis, as demonstrated by the following quotation:

Just recently my patient GCS [Glasgow Coma Scale] of 10. So, he is conscious and he keeps localized pain he can able to localize pain. So, every time I suction him, he will fight and bite the Yankauer. So, this is one of the challenges that we face. (Participant 3)

Integration outcomes: The aforementioned factors may act as stressors for inexperienced ICU nursing staff and can cause non-adherence to the VAP prevention guidelines. The presence of an experienced nurse may help in handling a difficult patient.

7.6 Data not used in the integration of the findings

Since mixed-methods research stems from two quite different research paradigms, quantitative and qualitative, it would be surprising to find that all the outcomes are well suited for integration. Based on the findings of this study, it was determined that:

- From the quantitative study results – There was a low level of observed adherence to the three recommendations in the VAP prevention guidelines during the audit of the current practices. These results appeared as strong findings within the quantitative study but received little attention in the interviews despite the focus on the factors that influence study participants' adherence to the use of VAP prevention guidelines.

- From the qualitative study findings – The process of ICA coding highlighted "nurses' recommended strategies for preventing VAP" as a core category in the qualitative findings. These findings did not relate to any of the questions in the quantitative study results, but they demonstrate the extent to which qualitative methods are capable of identifying extended detail.

Since the integrated analysis of the most pertinent information to answer the research questions was the primary objective of this mixed-methods evaluation, and since the above-mentioned themes lack novelty, these 'peripheral' findings were excluded from the integrated analysis. Therefore, a considerable amount of emphasis has been placed on discussing the most relevant information that had a significant impact on the subject/results under examination.

7.7 Summary

The integration of the quantitative and qualitative results showed that there are many extrinsic and intrinsic factors that influence ICU nurses' adherence to the VAP prevention guidelines. Among these, some of the problems were solvable (for example, the availability of resources

for the OH and HH practices and appointing adequate staff), whereas some others were not under the control of the ICU nurse or the hospital administration (like a non-compliant patient or the patient's health condition). There were some crucial concerns to address, which include the need to update the content of the VAP prevention guidelines to ensure their quality, providing ICU nurses with refresher courses, and attempts to improve ICU nurses' awareness of and attitude towards the VAP prevention guidelines.

Chapter 8: Discussion

8.1 Introduction

This discussion chapter has been informed by the results of this study. The present study identified many intrinsic and extrinsic factors influencing ICU nurses' adherence to the VAP prevention guidelines. As mentioned in the previous chapter, many of the findings from the quantitative phase were affirmed through the qualitative phase. Some of the findings made in the quantitative phase are open to further research and discussion. However, none of the findings from the quantitative and qualitative phases were contradictory. This chapter attempts to discuss the overall study findings using the recent and relevant literature, with an aim to suggest best possible ways to overcome the barriers. By doing so, this discussion chapter aims to form suggestions, which may be useful in implementing EBP in Saudi Arabian ICUs.

Since implementation of the VAP prevention guidelines by overcoming a range of personal and institutional barriers was the primary aim, the discussion is framed against the Integrated Promoting Action on Research Implementation in Health Services (i-PARIHS) framework (Harvey & Kitson, 2015). According to the i-PARIHS framework, successful implementation (SI) is conceptualised as involving facilitation (Fac^n), addressing the innovation in practice (I), the recipients (R), and the context (inner and outer) (C) (Harvey & Kitson, 2015). This well-known framework offers a way to examine implementation-related elements such as innovation, context, recipients and facilitation (Bergström et al. 2020; Duan et al. 2022; Harvey & Kitson, 2015). This framework was instrumental in structuring the integrated study findings and formulating the study recommendations.

The usage of the i-PARIHS framework in this study enabled the classification of the factors affecting ICU nurses' adherence to VAP prevention guidelines in a systematic manner.

Bergström et al. (2020) and Duan et al. (2022) conducted a citation review of the PARIHS and i-PARIHS frameworks and found that the application and usage of the framework is context-dependent and efficient. Several researchers have utilized the i-PARIHS framework in various ways within the research process. This included using the framework to guide and design implementation strategies, as well as for data collection, data analysis, and evaluation of study results. Bergström et al. (2020) and Duan et al. (2022) describe that the i-PARIHS framework is multi-dimensional with regards to the interpretation and evaluation of research findings.

Another important reason for selecting i-PARIHS framework to guide the discussion part of the present study's findings, because it identifies crucial elements for successful implementation of evidence-based practice in healthcare (Figure 8.1), including innovation, context, recipients and facilitation (Harvey & Kitson 2015). The initial development of the i-PARIHS framework was prompted by the recognition that the successful implementation of healthcare practices is contingent upon three elements (evidence, context and facilitation), which were tested through empirical case analyses (Nilsen 2020). A significant amount of research and development has been conducted since then and the framework has been widely adopted (Bergström et al. 2020; Duan et al. 2022). Each element of the framework, as described below, offers a way to consider the findings of this study and should provide a template for Saudi authorities to make changes to improve the prevention of VAP. This helped the researcher to determine the factors that influence the uptake of nurses working in intensive care of VAP prevention guidelines.

By applying the i-PARIHS framework, the study findings can be systematically categorized, thereby aiding in the implementation of evidence-based practice (Harvey & Kitson, 2016). The present study revealed certain disparities between the claims made by ICU nurses and the reality of their practice. Therefore, utilizing i-PARIHS as a framework to discuss these disconnects and the contributing factors could prove beneficial in systematically

classifying them. Once the findings are systematically classified, researchers can use them as a guideline for designing future research studies, while healthcare authorities can ensure the effective implementation of VAP prevention guidelines in Saudi Arabia.

Facilitator focus and activity
What the facilitator looks at
What the facilitator does

Outer context
Inner context: Organization
Inner context: Local
Recipients
Innovation

Outer context
Policy drivers & priorities
Incentives & mandates
Regulatory frameworks
Environmental (in)stability
Inter-organisational networks
& relationships

Political awareness & influence
Communication
Marketing
Networking
Boundary spanning
Sustainability & spread

Characteristics of the innovation
Underlying knowledge sources
Clarity
Degree of fit (compatibility or contestability)
Degree of novelty
Likely boundaries
Trialability
Relative advantage

Problem identification
Acquiring/appraising evidence
Baseline context & boundary assessment
Stakeholder mapping

Recipients
Motivation
Values & beliefs
Clinical consensus
Local opinion leaders
Existing data sources
Skills and knowledge
Time and resources
Learning environment
Collaboration and teamwork
Power & authority
Professional boundaries & networks

Goal setting
Consensus building
Audit & feedback
Improvement methods
Project management
Change management
Team building
Conflict management & resolution
Barriers/boundary assessment
Boundary spanning

Inner context: local level
Formal & informal leadership support
Culture
Past experience of change
Mechanisms for embedding change
Evaluation & feedback processes

Local context assessment
Communication & feedback
Networking
Boundary assessment & spanning
Negotiating & influencing
Policies & procedures
Structuring learning

Inner context: organisational level
Organisational priorities
Structure
Leadership & senior management support
Systems & processes
Culture
History of innovation & change
Absorptive capacity

Stakeholder engagement
Communication & feedback
Marketing & presentation
Networking
Boundary spanning
Negotiating & influencing
Policies & procedures

Figure 8.1 Framework elements: facilitators' focus and activity (Harvey & Kitson 2015, p. 50).

This chapter discusses the significant findings identified from the integrated results of the quantitative and qualitative studies presented in Chapter 7 and considers their practical and policy implications. The limitations of the study are acknowledged, and suggestions for future research are presented.

8.2 Summary of study findings

The present study identified the factors that influence ICU nurses' adherence to VAP prevention guidelines and fits neatly into the key elements of the i-PARIHS framework, including the level and nature of the innovation, the recipients, the context in which the research was applied, and the method by which the study process was facilitated. The study findings suggest that ICU nurses' adherence to VAP prevention guidelines can be improved considerably, if the factors presented in Chapter 7 are systematically addressed. Several intrinsic and extrinsic factors were identified during the integration of the quantitative and qualitative results. These factors were classified according to the i-PARIHS framework, as the context, innovation, and recipient elements (Table 8.1).

In the innovation element of the i-PARIHS framework, the researcher identified an association between self-reported adherence to the VAP prevention guidelines and the length of participants' experience in the ICU environment as well as their total experience as a nurse. Further, the ICU nurses' knowledge, and their attitude towards the VAP prevention guidelines and towards practising them were also identified as important influential factors. Among these, nurses' total experience in the nursing profession and the length of their experience as an ICU nurse were found have a statistically significant association with self-reported adherence to HH, OH and HOB ($p < 0.05$). Table 8.1 provides a brief summary of the findings in relation to the i-PARIHS framework; it shows that the contextual elements play a vital role in influencing the ICU nurses' adherence to the VAP prevention guidelines. Thereafter, these factors are discussed in detail, with comparisons to the results from similar studies, in the following section. A detailed description of how the key findings of the current study falls under important aspects of the i-PARIHS framework is presented in the following section.

8.3 Discussion of study findings using the structure of the i-PARIHS framework

The revised i-PARIHS framework can be distinguished from the original PARIHS framework in two significant ways (Duan et al. 2022; Harvey & Kitson 2016). Firstly, the framework acknowledges the innovation element, which recognises that healthcare professionals may select certain evidence, such as the clinical guidelines, to better suit their particular context and purpose. In doing so, healthcare professionals apply their experience and knowledge to adapt the evidence to their needs. Secondly, the recipient element of the framework recognises the individuals involved in the implementation of the evidence. The framework considers how the implementation process can be tailored to the needs and preferences of the individuals involved, and how their feedback can be integrated to enhance the implementation process (Bergström et al. 2020).

In this chapter the major findings of the study are discussed, explained and compared to other research studies in order to enhance comprehension of the research and develop practical suggestions while also drawing broad conclusions from the research. With these elements in place, a more comprehensive and informed understanding of the study's results can be achieved, leading to valuable recommendations. Therefore, a detailed description of how the key findings of the current study fall under important aspects of the i-PARIHS framework is presented below.

The study revealed that there are many intrinsic and extrinsic factors that can influence ICU nurses' adherence to VAP prevention guidelines in Saudi Arabia. These findings align with the core elements of the i-PARIHS framework, because these factors show a dynamic interaction between the evidence presented (innovation), the ICU environment/institutional milieu (context) and the recipients (ICU staff nurses). The major influential factors identified in this study and their link to the i-PARIHS framework are summarized in Table 8.1. The key findings of the current study are presented using the i-PARIHS framework below.

Table 8.1. Major factors identified by this study which influence ICU nurses' adherence to the VAP prevention guidelines

No	Factors identified	Stakeholder source	Connection with i-PARIHS framework
1	Lack of supply and equipment (e.g. lack of OH essentials like 0.12% chlorhexidine)	Hospital management	Context
2	ICU nurses' lack of knowledge regarding the VAP prevention guidelines	ICU nurses	Innovation /recipients
3	Lack of accountability influencing ICU nurses' adherence to the VAP prevention guidelines	ICU nurses	Recipients
4	ICU nurses' attitudes	ICU nurses	Recipients
5	Quality of VAP prevention guidelines	Hospital management	Context
6	Individual ICU nurse-related factors	ICU nurses	Context
7	Role of experience	ICU nurses and hospital management	Innovation / Recipients
8	Differences in VAP recommendations & practices	Hospital management	Context
9	Lack of adequate staff	Hospital management	Context
10	Excess workload and shortage of time	Hospital management	Context
11	Non-compliant vented patients	ICU nurses	Context
12	Patients' conditions	ICU nurses	Context

8.3.1 Context

According to Kitson, Harvey and McCormack (1998, p. 150) context is defined as the "environment or setting in which the proposed change is to be implemented". The context element is viewed from a holistic perspective, focusing both on the immediate local setting (inner context) and the broader health system (outer context). Inner context refers to the immediate local setting and the organisation in which it is embedded, whereas outer context refers to the health system as a whole (Harvey & Kitson 2015). Understanding the distinction between the inner and outer context is critical for comprehending how they can either support or hinder the implementation process and ultimately lead to successful implementation (Nilsen 2020).

Contextual factors with the potential to influence ICU nurses' adherence to VAP prevention guidelines in the ICU include administrative factors, individual nurse-related factors and the culture of the ICU. To achieve the goals of this study, all the possible aspects of context and ICU environment were explored via the interviews. Cultural, professional and organisation structure-related factors were assessed and explored. ICU nurses' beliefs and values, as well as their experience within the organisation and their professional and personal relationships with other nurses, were also analysed qualitatively. Environmental elements like organisational structure, administrative support, supervisors, teamwork and availability of equipment and guidelines were also investigated through the qualitative interviews as well as through the quantitative study. After integrating the quantitative and qualitative findings, this study has identified some "context" related factors which can influence ICU nurses' adherence to VAP prevention guidelines. The significant context related factors are discussed below.

8.3.1.1 Lack of administrative support

Lack of administrative support is regarded as an influential factor coming under "inner context" in the i-PARIHS framework (organisational-level). Since this factor is primarily a governance/management associated issue, it can be corrected and/or improved adequate resourcing. The present study identified more than one barrier related to administration perceived by ICU nurses. Excess workload was identified as one major issue in some ICUs. Not employing adequate staff is the primary reason for this, along with an increase in the number of patients with difficult conditions like COVID-19 pandemic. According to Yaseen and Salameh (2015), 74.5% of their participants perceived "shortage of staff" as a major barrier to their adherence to VAP prevention guidelines. This study is relevant to this research because it was conducted in Saudi Arabia. Further, excess workload and inadequate staffing in the ICUs and their relationship with the ICU nurses' lack of adherence to VAP prevention guidelines was reported by previous studies (Hamishehkar et al. 2014; Toulabi et al. 2020). Though the quantitative study did not explore this finding, many participants in this qualitative study expressed their concern over the shortage of staff.

A recent study by Aloush and Al-Rawajfa (2020) reported very low self-reported adherence to the VAP prevention guidelines among ICU nurses. Less than 30% of the participants reported that their adherence to VAP prevention guidelines was satisfactory. Some of the barriers to adherence perceived by ICU nurses, as reported by Aloush and Al-Rawajfa (2020), are similar to the current study's findings. The study reported there were insufficient staff and resources to implement the VAP prevention guidelines, making it difficult for nurses to tackle their own adherence. The present study found that lack of resources for OH practice constitutes a major barrier in around 25% of the cases, which affirms the findings of Aloush and Al-Rawajfa (2020). Furthermore, the current study found that inadequacy of time negatively affects both OH and HOB practices in around 30% of the cases. In contrast to this

study, Jam et al. (2018) reported a lack of association between workload and ICU nurses' adherence to the VAP prevention guidelines. However, the work of Aloush and Al-Rawajfa (2020); Jansson, Kääriäinen and Kyngäs (2013); and Yaseen and Salameh (2015) are in agreement with the current study's findings, as these articles reported a significant association between the shortage of staff, heavy workloads and adherence to the VAP prevention guidelines. Notably, the current study found that the practice of HH was largely unaffected in most of the cases. The reason could be that the study period spanned the COVID-19 peak times. During COVID-19 pandemic, there was an abundant supply of resources for OH and HH practices and nurses were more aware of the importance of good HH practice for preventing COVID-19 infections. Furthermore, other barriers were the lack of teamwork, lack of a sense of responsibility and excess workload in some ICUs. As these issues primarily pertain to internal contextual factors within the ICU environment, their resolution can be facilitated through proactive efforts and collaboration between hospital administration and ICU supervisors, thereby promoting effective problem-solving.

8.3.1.2 Differences in VAP recommendations and practices across ICUs

The barriers discussed in this section may be regarded as context-dependent elements of the i-PARIHS framework. This study found that ICU nurses' adherence to the three recommended practices for OH, elevation of HOB and HH varied between the 8 ICUs from 69.4% to 100%. This indicates the involvement of hospital administration related factors, such as lack of supply of 0.12% chlorhexidine solution, as reported by around 25% of participants in this study. Previous studies support this idea that lack of supply acts as a barrier to ICU nurses' adherence to VAP prevention guidelines (Jansson, Kääriäinen & Kyngäs 2013). Similarly, studies by Park, Cho & Kwak (2014) and Toulabi et al. (2020) also have suggested that adequate supply as an important step in ensuring VAP control in the ICUs. Most notably, the current study found a difference in ICU nurses' adherence and perceived barriers (lack of resources, lack of

awareness of the VAP prevention guidelines and attitude issues) between two ICUs of the same hospital. This indicates that individual ICU supervisors influence adherence, rather than the senior management of the hospital. It may be also due to a supervisor's lack of competence in ensuring the availability of essentials like 0.12% chlorhexidine solution, displaying a printout of the VAP prevention guidelines, proper monitoring of the ICU nurses to ensure their adherence to the guidelines, and appropriate allocation of duties. In the study of Yaseen and Salameh (2015), 47.3% of the participants complained that there was no written protocol in their ICU for the prevention of VAP.

The current study also found a state of uncertainty or confusion among the ICU nurses regarding the availability of VAP prevention guidelines within the unit. A sample statement is:

No, no, we do not have that one [VAP prevention guidelines]. No. No. No, we are mainly following this VAP bundle. The infection control created that VAP bundle and recommended us to use it with all vented patients. Actually, we are highly recommending our hospital to implement the use of clinical guidelines for prevention of VAP. We need that one in our cardiac surgery. There is no guideline in our cardiac surgery. (Participant 12)

This statement suggests more than one possibility: the first and most probable reason for the ICU nurse's statement is the lack of a written protocol in their ICU, because the nurse clearly mentioned that the cardiac ICU lacks written VAP prevention guidelines. This could be primarily due to the lack of support from the ICU nursing supervisors or hospital authorities. Several studies have previously highlighted the positive association between the quality of VAP prevention guidelines provided to the ICU nurses and the ICU nurses' adherence to VAP prevention guidelines (Burja et al. 2018; Eom et al. 2014; Lim et al. 2015; Wip and Napolitano 2009). According to Al-Sayaghi (2021), situations like this arise when hospital authorities want to cut expenses by reducing the supply of essentials. The second possibility is lack of awareness by the ICU nurse regarding the availability of the VAP prevention guidelines. Even if this is

the case, the supervisors and hospital authorities should make ICU nurses aware of important guidelines and protocols.

The findings of the present study are in-line with the afore-mentioned studies, wherein the participants complained regarding the lack of quality in the guidelines provided to them. Some of the participants pointed out that the VAP prevention guideline available at their ICU is outdated and it is merely an electronic component for the sake of accreditation. Further, differences in the VAP recommendation and practices (lack uniformity) were identified through the present study. Such differences can cause issues to the nurse's adherence to VAP prevention guidelines, when their duty is shifted from one ICU to the other (Eom et al. 2014; Jam et al. 2012; Lim et al. 2015).

8.3.1.3 Random factors that are not under the control of the nursing staff

All the random factors identified in the present study, including the condition of the patient, non-compliant patients and conditions like COVID-19, come under the context element of the i-PARIHS framework. Reasons reported by ICU nurses for non-adherence to the VAP prevention guidelines included the condition of the patient (contraindicating head elevation), a non-compliant patient (a patient who resists ventilation or is poorly sedated may bite the Yankauer suction tip), and in some cases the realization that the patient is in discomfort. These study findings are similar to those in a study from Iran (Dehghan et al. 2022). In Dehghan et al.'s (2022) study, more than 60% of the participating ICU nurses reported non-compliance with the VAP prevention guidelines due to concerns related to potentially harming the patient, the possibility of side-effects, and worries about the patient's discomfort or deterioration of their condition. These barriers to adherence were previously reported by Al-Tamimi, Refaat & Issa (2022), indicating that novice ICU nurses are mostly affected, leading to a negative impact on their adherence to VAP prevention guidelines. Al-Tamimi, Refaat & Issa (2022), suggest

that novice nurses can overcome this issue by either discussing it with experienced ICU nurses or gaining more working experience over time.

In this PhD study, many ICU nurses named the lack of adequate staff, excess workload and excess documentation as reasons for their non-adherence to the VAP prevention guidelines. In support of these findings, Al-Sayaghi (2021) reported that a shortage of nurses, forgetting to perform guidelines recommendation, and the cost control policies are barriers for the ICU nurse in Saudi Arabia who wishes to comply with the VAP prevention guidelines. This study found that hospital authorities want to cut expenses; however, by doing so they are risking patients' lives. The study of Aloush (2017) also reported that higher workload, higher number of ventilated patients, high patient to nurse ratio and ICUs with more than 15 beds have a significant association with increased incidence of VAP. Contrary to these findings, Jam et al. (2018) present a different perspective, asserting that they did not identify a significant connection between excess workload and the non-pharmacological measures for VAP prevention. Jam et al. (2018) claim that there is no connection between workload and compliance, their study shows that extent of compliance hand washing before suctioning secretions among the participated nurses (n = 97) is very low (only 11.9%). Which means, around 88% of the nurses do not perform sterile hand washing technique before a procedure HH moment. This scenario itself is self-explanatory that the nurses are not adhering to the VAP prevention guidelines, even though the authors claim otherwise.

These findings strongly suggest that an awareness program is necessary to educate ICU nurses in the Saudi environment about the critical importance of adhering to VAP prevention guidelines. The findings of this section come under the context element of the i-PARIHS framework. Though they are context dependent, an experienced nurse with adequate knowledge may handle these situations more professionally and may adhere to the VAP

prevention guidelines. Therefore, many of the context-related issues discussed in this section are also connected to the recipients and innovation elements.

8.3.2 Innovation

The i-PARIHS framework developers re-labelled and extended the concept of evidence in the original form of the framework to the broader notion of innovation, which includes both explicit and tacit knowledge, generated and mobilized through various means (Harvey & Kitson 2015, 2016). The i-PARIHS framework proposes innovation as a central element in which the focus is on sourcing and applying research evidence to inform innovation (Harvey & Kitson 2016). As an example, within this study, the innovation under consideration was the VAP prevention guidelines. According to Harvey and Kitson (2015) innovation encompasses a number of key features, including the generation, mobilization and exchange of knowledge, as well as the characteristics of knowledge that enhance or inhibit its dissemination. The present study measured the nurses' adherence not only through assessing the "self-reported values", but also collected "observed values" via auditing nurses' practices towards the three recommendations. This enabled the researcher to compare self-reported adherence scores with observed adherence scores, thereby allowing the researcher to gain a clear understanding of the actual care given to ventilated patients and the uptake of the VAP prevention guidelines.

This study was the first to examine ICU nurses influencing factors of adherence about professional accountability regarding the VAP prevention guidelines in the Saudi environment. After considering the environment/context-related factors, the researcher used this wide-ranging body of evidence to draw conclusions and make recommendations to policy makers and users of the VAP prevention guidelines in Saudi ICU settings.

8.3.2.1 Role of experience

One of the significant themes that emerged from the study is the positive relationship between ICU nurses' level of experience and their adherence to the three specific recommendations from the VAP prevention guidelines. This theme can be regarded as an example of the use of innovation/guidelines under the i-PARIHS framework. Both the qualitative and quantitative analyses showed the importance of experience in ICU nurses' adherence to the VAP prevention guidelines, especially during difficult situations like the management of non-compliant patients and patients with severe health conditions. For example, experienced ICU nurses also showed better knowledge scores related to the VAP prevention, as compared to less-experienced ICU nurses ($p<0.05$). Further, a direct association between the participants' total professional experience and their self-reported adherence was observed. This finding is important for other i-PARIHS element of this study as ICU nurses' self-reported adherence to all three recommendations in the VAP prevention guidelines, the practice of OH, elevation of HOB and HH, were directly linked to their total professional experience.

Studies exploring the relationship between ICU nurses' experience and their adherence to VAP prevention guidelines are limited. One such study that explored the relationship was by Zenas et al. (2022). However, they did not find a significant association between the ICU nurses' experience levels and their adherence to VAP prevention guidelines. A work in the Jordanian context conducted by Alkhazali, Bayraktar and Al-Mugheed (2021) explored the relationship between various factors impeding ICU nurses' adherence to VAP prevention guidelines. These factors included experience, knowledge, education and professional training. Alkhazali, Bayraktar and Al-Mugheed (2021) found a significant association between the experience of the ICU nurses and their level of knowledge. Though the authors suggested that lack of experience may be acting as a barrier to the ICU nurses' adherence to VAP prevention guidelines, they found that the correlation was not statistically significant. Al-Sayaghi (2021)

is the only study in the Saudi Arabian context which has compared and discussed the relationship between ICU nurses' years of professional experience and their adherence to VAP prevention guidelines. Like Al-Sayaghi (2021) and Zenas et al. (2022), previous studies have not found a statistically significant relationship between these two variables. A previous study by Korhan et al. (2014) reported a possible relationship between duration of professional experience, level of education and level of knowledge of VAP prevention guidelines. The authors also reported that, as the ICU nurses' years of experience increased, their potential for playing more than one role in the ICU increased (Korhan et al. 2014). However, these experienced ICU nurses tend to participate in training programs less frequently.

A previous study by Aloush et al. (2018) explored the association between ICU nurses' years of professional experience, previous education on VAP prevention and academic degree, with compliance with the VAP prevention guidelines. This study was conducted among 476 ICU nurses from 16 medical centres in Jordan, Egypt and Saudi Arabia. Interestingly, they found a significant association between the length of professional experience and ICU nurses' compliance with VAP prevention guidelines. The more professional experience the ICU nurses had, the higher the compliance shown with VAP prevention guidelines. The findings of the present study are in line with Aloush et al. (2018) study findings, wherein a statistically significant relationship between ICU nurses' level of experience and their adherence to the VAP prevention guidelines is reported in the Saudi context. In contrast, a recent study by Yeganeh et al. (2019) did not find a significant relationship (p = 0.327) between the years of ICU experience and the knowledge levels of ICU nurses (n = 171), with regards to VAP prevention guidelines. Yeganeh et al. (2019) study was conducted in the Iranian context, whereas the current study was conducted in the Saudi Arabian context. Country-wise differences in the healthcare systems and differences in institutional policies could be the reason for this contrast in results. However, both Yeganeh et al. (2019) study and the current

study identifies lack of knowledge among the ICU nurses as a potential barrier to adherence to VAP prevention guidelines.

A study conducted by Al-Mugheed and Bayraktar (2020) examined the relationship between the length of experience and patient safety attitudes among doctors and nurses in Northern Cyprus. The study revealed that respondents had negative perceptions regarding patient safety domains. Notably, a statistically significant relationship was found between the length of nurses' experience and their adherence to patient safety guidelines. While Al-Mugheed and Bayraktar (2020) did not specifically discuss nurses' adherence to VAP prevention guidelines, their findings can be related to the present study as both studies highlight the positive correlation between the length of nurses' experience and their adherence to patient safety guidelines. The positive relationship between the length of nurses' experience and the nurses' adherence to patient safety guidelines prompts the question of how to utilize experience as a crucial tool for improving adherence to VAP prevention guidelines among ICU nurses, given that appointing numerous vastly experienced nurses in every ICU is not a practical option. The most feasible way is to transfer the knowledge gained over the years from an experienced nurse to a novice nurse is through promoting fruitful discussions and interactions between them. Secondly, encouraging teamwork between the experienced and the less experienced nurses in ICU settings can be extremely useful in disseminating important technical knowledge. In this regard, nurses' experience in ICUs can play a critical role in increasing novice nurses' adherence with VAP prevention guidelines. Accordingly, the factors discussed in this section overlap with one or more elements of the i-PARIHS framework and this discussion shows how interconnected all these factors are.

8.3.3 Recipients

The term "recipients" refers to the individuals or teams who are involved in the implementation process (Harvey & Kitson 2015). The framework developers stress the importance of considering the impact of both individuals and teams involved in the implementation process, as research suggests that both can have a significant role in either facilitating or hindering change (Harvey & Kitson 2016). The recipient element is a crucial part of the i-PARIHS framework as it is essential for the success of the innovation and facilitation elements (Harvey & Kitson 2016). Without the recipient element, the other i-PARIHS components would be rendered ineffective, and the results of implementation would be unattainable (Harvey & Kitson 2015). Thus, the inclusion of the "recipients" factor is imperative for the proper functioning and achievement of the i-PARIHS framework (Harvey & Kitson 2016). The "recipients" element therefore represents those people who are affected by and may influence the implementation both at the individual and team level (Harvey & Kitson 2016).

The ICU nurses represent the "recipient" element of i-PARIHS in the current study. Since the importance of the recipient element is underscored by the i-PARIHS framework, the present study evaluated the factors that may be associated with the recipient's element with utmost care. The parameters used to analyse ICU nurses' adherence to the VAP prevention guidelines and the factors influencing this adherence included both the individual level (knowledge, education level, attitudes, professional experience and individual workload) and the extrinsic level (institutional culture, extent of teamwork/collaboration, refresher courses, availability of essential equipment, and support from the institution). Through the design of the quantitative and qualitative methods, this study was able to assess the effects of each factor on the recipient element and collect valuable information to support the study's goal and objectives. The integration of the quantitative and qualitative data provided a deeper understanding of the hindering as well as facilitating factors related to the implementation of

VAP prevention guidelines in the Saudi Arabian context. This information could be helpful in improving the ICU nurses' adherence to VAP prevention guidelines in the Saudi context. The main factors identified under the "recipients" element of the i-PARIHS framework are ICU nurses' attitudes, lack of accountability and knowledge levels of ICU nurses.

8.3.3.1 ICU nurses' attitudes towards the VAP prevention guidelines

The present study identified that there are considerable issues with regard to ICU nurses' attitude towards the uptake of VAP prevention guidelines. For instance, the majority of the participants (92.1%) agreed that the contents of the guidelines regarding the elevation of HOB are useful for preventing VAP, with 78.5% of the participants stating that they plan to use the guidelines. The specific factors that contribute to approximately 22% of ICU nurses holding a negative attitude towards the implementation of the HOB recommendation remain unclear. One possible explanation for the attitude-related issues towards the OH guidelines among Saudi ICU nurses is provided by Alotaibi et al. (2016, p. 210). They found that around 48% of ICU nurses have the attitude that the "oral cavity is the most difficult anatomical part of the body to clean" and, furthermore, 17.3% of participants have the attitude that cleaning the oral cavity is an "unpleasant task". These perceptions may be acting as a determinant of the nurses' attitudes in the present study as well. Another important take away from the aforementioned study is that 33.8% of the participating ICU nurses stated that there are more important things to do than oral care for ventilated patients. This statement not only suggests the nurses' negative attitude to the OH recommendations, but also reflects the lack of knowledge on the importance of OH in preventing VAP. Jahansefat et al. (2016) reported significantly lower levels of knowledge, less-positive attitude towards application of EBP for VAP prevention, and lower levels of adherence to VAP prevention guidelines among healthcare workers. Notably, they also found that a negative attitude towards VAP prevention guidelines is a key factor in ICU nurses' adherence. The present study found that only around 88% of the participants plan to

use the OH and HH recommendations. After the regression analysis on a subdimension scale, the overall scores for attitude towards the VAP prevention guidelines were found to vary from 72% to 77%.

A possible explanation for negative attitudes towards the VAP prevention guidelines among ICU nurses is provided by Jordan et al. (2014). They found that the presence of a written VAP prevention guideline in the ICU, lack of awareness and experience are the key decisive factors for negative attitudes among ICU nurses. Al-Mugheed et al. (2022) and Al-Mugheed and Bayraktar (2020) identified various factors that shape nurses' negative attitude towards patient safety. These factors include lack of awareness, working environment, level of job satisfaction and stress. They suggested that in-service education, availability of updated versions of guidelines, having proper institutional regulations and adequate management support may be possible solutions.

An earlier study by Kaynar et al. (2007) showed that lack of translation of evidence to bedside practice and lack of awareness among ICU nurses are the two main reasons for non-compliance with the VAP prevention guidelines. They suggested team-based efforts, scientific data collection and reporting, and preparation of tailored VAP prevention guidelines that are suited for the institution as well as its nursing staff are important to improve adherence to VAP prevention guidelines. Though the present study did not explore the reasons for the negativity among the ICU nurses regarding the VAP prevention guidelines, it is possible that institutional and experience-related factors played a crucial role in shaping the attitudes of the ICU nurses who participated in the present study.

8.3.3.2 ICU nurses' knowledge and level of adherence to VAP prevention guidelines

The relationship between ICU nurses' knowledge level and their adherence to the three recommendations from the VAP prevention guidelines was an important theme identified in the present study. Notably, the statistical analysis suggested that ICU nurses' awareness of

VAP prevention guidelines can be used as an effective tool for predicting their adherence to the guidelines.

The present study found that 13.4% of the nursing staff were unaware of the availability of the VAP prevention guidelines. A study by Aloush and Al-Rawajfa (2020) reported that ICU nurses' education on the VAP prevention guidelines is an influential factor in their compliance with the VAP prevention guidelines. A nurse's lack of awareness of the availability of VAP prevention guidelines at their ICU suggests an inadequacy of VAP awareness programs and refresher courses. A study by Bankanie et al. (2021) reported that lack of knowledge, lack of skills and lack of staff are the three major barriers to implementing VAP prevention guidelines in Tanzania. They reported lack of knowledge from the ICU nurses in 79.3% of the cases. Though the knowledge levels of the ICU nursing staff in the current study were much better, the findings of this study are in agreement with previous research, where the knowledge level of the ICU nurse is regarded as a key parameter for compliance (Bankanie et al. 2021; Getahun et al. 2022).

Several previous studies drew a direct connection between ICU nurses' level of knowledge of the VAP prevention guidelines and their adherence to the hygienic principles of VAP prevention. For instance, an earlier study by Biancofiore et al. (2007) demonstrated lack of knowledge among ICU nurses as a major barrier to effectively applying VAP prevention guidelines. This study showed that more than half (54.8%) of the participants were poorly informed about the VAP prevention guidelines. This study is comparatively old (published in 2007) and, since then, ICU nurses' knowledge of and compliance with the VAP prevention guidelines has improved considerably. For example, a relatively recent study by Darawad, Sa'aleek and Shawashi (2018) reported ICU nurses' knowledge scores and percentage of adherence to VAP prevention guidelines as above 80%. Similar to this study, the self-reported

adherence to the OH, elevation of HOB and HH recommendations in the VAP prevention guidelines among the participants in the current study was above 80%.

The results of the study by Bokhary et al. (2022) are particularly relevant to the current study because of regional similarity, and because both studies explored ICU nurses' adherence with VAP prevention guidelines. Most importantly, Bokhary et al. (2022) reported that only 24% of the participants have satisfactory knowledge (> 75% score) of the evidence-based practices for the successful prevention of VAP. Further, 41% of the participants scored less than 60%, which is regarded as an unsatisfactory level of knowledge by Bokhary et al. (2022). Though the current study did not directly test the knowledge levels of participants, the self-reported awareness of the OH, elevation of HOB and HH recommendations were better in the current study (> 85%). The results of Bokhary's study are in line with an earlier study in the Saudi context (Yaseen & Salameh 2015), wherein the authors found a significant relationship between the level of education and VAP prevention guidelines knowledge scores. Further, the level of knowledge described in the earlier study (Yaseen & Salameh 2015) is similar to the scores described in Bokhary et al. (2022), indicating a lack of effort by the authorities to improve the situation. A recent study by Bankanie et al. (2021) reported that there is a significant relationship between higher levels of education in nursing and adherence to VAP prevention guidelines and knowledge scores (p = 0.004; n= 116). Furthermore, the authors identified a lack of education as a significant barrier in the practice of the VAP prevention guidelines in 79.3% of cases. In agreement with the study of Bankanie et al. (2021), the current study found a significant correlation between HH practice and higher levels of education in nursing (p < 0.001). However, it did not find a statistically significant relationship between the education levels of participants and the OH and HOB practices. Along with other studies (Al-Mugheed et al. 2022; Bankanie et al. 2021; Jahansefat et al. 2016), this PhD study identified a direct connection between the level of education and knowledge levels of the ICU nurses. Lack

of knowledge in turn acts as a barrier to nurses' adherence to all three recommendations from the VAP prevention guidelines. The higher the level of education, the higher the ICU nurses' knowledge scores/awareness of the three recommendations from VAP prevention guidelines, and hence their adherence to VAP prevention guidelines. Therefore, educating ICU nurses regarding the significance and practical application of VAP prevention guidelines is a key strategy for improvement of patient care.

8.3.4 Facilitation

In this study the role of facilitation was assessed by exploring the role of hospital management and the level of knowledge/education among ICU nurses, their experience and their attitudes towards the VAP prevention guidelines. The researcher decided to follow this route based on the evidence from previous research studies, which reported that education can function as an effective facilitator of evidence-based practice, improving the skill sets and competencies of nurses in clinical practice (Kim et al. 2019; Sapri et al. 2022). Further, the attitudes of ICU nurses towards the implementation of the VAP prevention guidelines were also assessed because attitude can be an important facilitator (Kim et al. 2019). Whenever an overlap between the i-PARIHS elements was found, the researcher used logic to discuss the possible interactions because overlap between elements is consistent with the i-PARIHS model (Duan et al. 2022). For example, the role of ICU nurses' knowledge as a decisive factor in their adherence to the VAP prevention guidelines comes under the "innovation" element of the i-PARIHS framework. However, ICU nurses' willingness to learn and attitude towards VAP prevention guidelines can influence their knowledge scores. This comes under the "recipient" element of the i-PARIHS framework. This means two elements act as decisive factors and overlap on the same topic – ICU nurses' knowledge scores. In this case, the researcher's own experience as a healthcare professional helped in identifying the areas of overlap. Therefore,

this research recommends the i-PARIHS framework as an essential tool to be used for identifying, comprehending and solving the issues in evidence-based practice in clinical settings, including ICU nursing practice in the Saudi Arabian context. Thus, the researcher hopes that the influential factors and facilitators identified during this study will be useful for implementing evidence-based nursing practices in the ICU settings of Saudi Arabia to tackle VAP more effectively.

The revised i-PARIHS framework gives more weight to the "process of facilitation" than the "facilitators". By doing so, the revised framework can demarcate the sub-elements, thereby enabling better implementation (Harvey & Kitson 2016). In other words, the application of elements like innovation and context becomes more straightforward through the inclusion of the element recipients. ICU nurses are the recipients of the present study. Therefore, facilitators like knowledge and education can be related to various contexts, including individual ICU nurses' attitudes towards the VAP prevention guidelines and contexts involving the ICU supervisors and hospital management.

Since knowledge can function as a "facilitator" of the adherence to and successful implementation of VAP prevention guidelines, refresher courses, continuing nursing education courses, seminars and workshops may be useful in improving the knowledge/awareness of ICU nurses of the VAP prevention guidelines and their adherence to them. A widely recommended method to increase ICU nurses' knowledge of and adherence to VAP prevention guidelines is arranging appropriate educational programs within the recipients' specific contexts. For instance, a systematic review by Jansson, Kääriäinen & Kyngäs (2013) provided substantial evidence in this regard. This study analysed data from eight original studies and found that, by increasing ICU nurse education, significant improvement in knowledge scores and adherence to VAP prevention guidelines can be achieved. Consequently, decreased incidence of VAP, better clinical outcomes and less VAP-associated mortality was observed. The results derived

from Mogyoródi et al. (2022) study also indicate that educational interventions may serve as the optimal solution for addressing knowledge-related challenges.

Research conducted in Pakistan by Meherali et al. (2011) also suggests that educational interventions are the best method to improve ICU nurses' knowledge levels on VAP prevention guidelines. They reported that, after a 5-hour teaching module on VAP prevention guidelines, there was a significant improvement in the nurses' knowledge of evidence-based guidelines for preventing VAP. Notably, Romero et al. (2019) showed that education programs can significantly improve adherence to HH practices in the ICU. However, Romero et al. (2019) study did not find a significant improvement in VAP incidence and mortality. The reason for this could be that Romero et al. (2019) did not try to improve other VAP prevention practices including the HOB and OH guidelines. Consequently, extensive education on HH practice alone could not ensure adherence to other essential elements of the VAP prevention guidelines, which is reflected by the lack of reduction in VAP and mortality. The results of a randomized controlled trial conducted on 80 patients support the above viewpoint (Atashi et al. 2018). This study used an improved oral care program to prevent VAP in Iran. However, improvement in oral care (OH) alone was insufficient to significantly reduce the incidence of VAP in critically ill patients.

Another facilitator identified in the present study is the role of experience in ensuring ICU nurses' adherence to the VAP prevention guidelines. However, it is unlikely to have all nurses in the ICU with 10 years of experience in ICU settings. Novice nurses also need to get ICU experience. One suggestion is to make certain that every shift in the ICU has at least one nurse who possesses a minimum of 10 years of experience in this specific medical setting. This may help to ensure that patients receive the highest level of care possible. The less experienced ICU nurses can learn from these senior nurses regarding key aspects of VAP prevention and hygienic practices. Also, the ICU supervisors may assign these "experienced nurses" to "teach"

or "help" the novice or less experienced nurses on how to handle difficult ventilated patients as well as difficult situations.

However, the present study also identified a lack of support from hospital authorities in arranging such courses and providing the essentials for practising VAP prevention. These factors can act as a barrier to gaining adequate knowledge and adhering to the guidelines under difficult situations. Therefore, the ICU nurse is not the only person responsible for the lack of knowledge; there are external factors influencing it. Further, it is understood that knowledge alone is not adequate for ensuring ICU nurses' adherence to VAP prevention guidelines. For instance, a study by Kalyan et al. (2020) showed that, though more than 90% of the participants had above-average knowledge scores, the adherence to VAP prevention guidelines was not satisfactory. Similarly, Aloush (2017) reported that an education program alone is not enough to improve the compliance of ICU nurses with VAP prevention guidelines. The confounding factor identified in this study was "excess workload", which prevented the ICU nurses from practicing the guidelines, even when they were aware of them. In agreement with the notion that knowledge alone is inadequate to ensure ICU nurses' adherence to VAP prevention guidelines, the current study identified more than one factor that can influence adherence.

8.4 Contribution of the study

This study applied the i-PARIHS framework to the discussion of factors influencing ICU nurses' adherence to VAP prevention guidelines in the Saudi Arabian context. Systematic scientific studies exploring the factors related to ICU nurses' adherence to hygienic principles in the Saudi context are uncommon. In this regard, the present study is of great value because this study successfully identified and discussed the factors which influence ICU nurses' compliance with the VAP prevention guidelines. Further, this study discussed the potential facilitators in detail and suggested valuable solutions for the issues identified. The usage of the

i-PARIHS framework in this study enabled the classification of these factors in a systematic manner, which in turn can be useful for promoting and implementing evidence-based practice in the future. Finally, an understanding of the patterns evident from this study can be used by researchers as a guideline for designing future research studies.

8.5 Implications of the study

This study was the first to critically examine ICU nurses influencing factors of adherence regarding the VAP prevention guidelines in the Saudi environment.

8.5.1 Implications for practice

As discussed in previous chapters, the performance of ICU nurses is influenced by various internal and external factors. These factors should be considered while implementing VAP prevention guidelines in Saudi Arabian hospitals. This implies that, the process of facilitation should happen through the action of both internal and external facilitators to achieve optimum implementation of the VAP prevention guideline in the Saudi Arabian hospitals. For instance, education on better ICU practices and interaction with experienced ICU nurses can act as an efficient internal facilitator. The lower knowledge scores and lack of awareness regarding the VAP prevention guidelines among the Saudi Arabian ICU nurses may be a result of their level of education. It was observed that 43.7% of the participating ICU nurses were with the basic education requirement for the service (Diploma) whereas only 3.4% of the ICU nurses in this study had a master's degree or higher. This scenario supports the argument that higher education and imparting knowledge can function as a "facilitator" of the adherence to VAP prevention guidelines among the ICU nurses and successful implementation of VAP prevention guidelines in Saudi Arabia. Knowledge imparting programs for the ICU nurses such as refresher courses, continuing nursing education courses, seminars, and workshops may be useful in this regard. In addition, the hospital authorities may encourage those ICU nurses who

want to pursue their higher degrees on a part-time or full-time basis. If higher authorities can encourage nursing staff that pursuit of higher degrees will not result in the loss of their current job, then higher number of nurses may become willing to develop their qualifications. Notably, a systematic review by Jansson, Kääriäinen & Kyngäs (2013) supports the notion that arranging educational programs within the recipients' specific contexts can be instrumental for improving the ICU nurses' knowledge scores. According to this study, by increasing ICU nurse education, significant improvement in knowledge scores and adherence to VAP prevention guidelines can be achieved. As a result, decreased incidence of VAP, better clinical outcomes and less VAP-associated mortality was attained. It is noteworthy to mention that, educating ICU nurses alone may not be adequate in improving their adherence because the external factors or context-related elements such as hospital authorities, supervisors and healthcare policy makers also play a pivotal role here. Therefore, educating all these stakeholders is essential to achieve optimum implementation of the VAP prevention guidelines in the ICUs of Saudi Arabia. In addition to educating, optimisation of healthcare policies is required to ensure the active involvement of stakeholders other than the ICU nurses.

8.5.2 Implications for policy

The qualitative phase of this study identified accountability-related and attitude related issues. Lack of accountability and negative attitudes often lead to less compliance with the guidelines. Healthcare policy changes related to the management of ICUs can act as an external facilitator in ensuring the ICU nurses adherence to VAP prevention guidelines. The policy makers may clearly establish the accountability of each stakeholder involved in the implementation of the VAP prevention guidelines in Saudi Arabia. Further, policy changes, which ensures regular monitoring/inspection from the higher authorities in Saudi Arabian healthcare system may ensure that hospital authorities are complying with the minimum requirements for

accreditation, such as adequate nursing staff and availability of supplies and equipment for preventing VAP.

8.5.3 Implications for future research

The present study has successfully identified and classified the factors that influence the ICU nurses' adherence to VAP prevention guidelines. However, the factors influencing the decision-making of other stakeholders such as ICU supervisors, hospital management, district and national level healthcare officials, are not explored. Therefore, future research works in this regard is essential to understand the issue completely, which in turn will help to overcome the hurdles during the implementation of VAP prevention policies and practices and more broadly evidence-based practice. For instance, the present study identified the shortage of supplies. Therefore, the reasons why the hospital management/ICU supervisors fail to supply the essentials shall be explored in future research works. Similarly, the hurdles faced by the ICU supervisors, hospital management, and the policy makers in establishing optimum functioning of ICUs may be explored in future. Such studies will help to identify the local and loco-regional issues and to form appropriate policies to tackle the issues. Furthermore, this study includes 8 ICUs from two hospitals. A multi-centric study involving many hospitals/ICUs across different parts of Saudi Arabia can provide a deeper understanding on the factors related to the implementation of VAP prevention guidelines in Saudi Arabian hospitals. A longitudinal study, rather than a cross-sectional study may be more appropriate in this regard.

8.6 Recommendations for improvement

The present study has formed four main recommendations aimed at improving Saudi Arabian ICU nurses' adherence to VAP prevention guidelines. These recommendations include: A) implementing education-based interventions to enhance the knowledge of the recipients, B)

promoting future research efforts enhancing nurses' adoption of VAP prevention guidelines, all with the ultimate goal of improving ICU nurses' adherence to VAP prevention guidelines. Prior to implementing the recommendations, it is crucial to commence a collaborative effort that engages healthcare policymakers from both external contexts, like the ministry of health, and internal context within the hospital. This effort should also involve representatives of ICU nurse managers and ICU staff nurses. The overarching purpose of this collaborative initiative is to effectively address and formulate strategies to enhance adherence to VAP prevention guidelines among ICU nurses. Furthermore, establishing a multidisciplinary team within the hospital, comprising nurses, physicians, administrators, and policymakers, is of utmost importance. This team would play a crucial role in assessing staff knowledge, workload-related issues, proposing evidence-based solutions, and closely monitoring their implementation. Through the establishment of such collaborative efforts and the inclusion of frontline ICU nurses in the policy development process, this approach will effectively pinpoint critical areas for improvement in the healthcare system. Further details on study's recommendations are provided in the following sections:

8.6.1 Implementing education-based interventions to enhance the knowledge of the recipients

Education-based interventions is well-known method to improve the knowledge scores of ICU nurses regarding the VAP prevention guidelines. Previous studies have reported significant improvement in knowledge scores and improved adherence among the ICU nurses, to the VAP prevention guidelines (Jansson, Kääriäinen & Kyngäs 2013; Mogyoródi et al. 2022). In addition, Subramanian et al. (2013) has reported a noticeable drop in the incidence of VAP, from 39 per 1000 ventilator days in the pre- education intervention period to 15 per 1000 ventilator days in the post-education intervention period. As a result of the established

effectiveness of education-based interventions to improve ICU nurses' knowledge of VAP prevention guidelines, two critical recommendations are necessary for maximizing implementation. Firstly, educational modules should be customized to address the specific needs and challenges of each ICU. Assessments should be conducted in each unit to identify areas for improvement and knowledge gaps. This ensures that ICU nurses receive relevant information for their daily practice with ventilated patients. It is important to incorporate interactive teaching methods, such as case-based scenarios and simulation exercises, in order to enhance the retention of knowledge and its practical application. Second, ICU nurse educators or managers should establish a structured plan for continuous professional development within their units, including regular updates and refresher courses, to ensure the staff remain informed about the latest developments and evidence-based practices in the prevention of VAPs. Furthermore, nurses should be actively encouraged to participate in the development activities of the educational courses to identify potential areas for enhancing adherence to VAP prevention measures. Integrating these recommendations into existing education-based interventions may have a significant impact on ICU nurses' knowledge levels and contribute to the ongoing mitigation of VAP incidence.

8.6.2 Promoting future research efforts enhancing nurses' adoption of VAP prevention guidelines

According to Kamath & Guyatt (2016), advocating for research is one of the most valuable strategies for identifying practical solutions and evidence-based practices within healthcare. This is especially pertinent when considering nurses' compliance with VAP prevention guidelines. The current literature pertaining to the implementation of EBP and ICU nurses' adherence to VAP prevention guidelines in the Saudi Arabian context has several limitations (discussed in the review of literature chapter). Especially, the direct involvement of nurses in

Saudi Arabia in research is negligible (Musumadi et al. 2023). Therefore, promoting the research involvement of ICU nurses and the ICU nurse-lead research activities based on the VAP prevention will be of great use for improving the adherence to VAP prevention guidelines in future.

8.7 Limitations of the study

Despite the study's crucial role in delineating the influential factors influencing ICU nurses' adherence to VAP prevention guidelines in the Saudi context, the study has potential limitations. Firstly, this study relied exclusively on the i-PARIHS framework to classify and analyse the integrated findings from the sample population. The framework was not utilized to guide data collection, or to inform data analysis. The absence of a framework-driven approach during these crucial stages could have potentially restricted this PhD study's ability to fully capitalize on the framework's advantages, including the framework's emphasis on conducting a diagnostic evaluation of the practice context prior to drafting and implementing an intervention (Harvey & Kitson, 2015). Indeed, engaging more than one framework would ensure the comprehensiveness of the information generated. Therefore, future researchers should verify the results of this study using different frameworks.

Secondly, this study population had a majority (n = 300, 94.9%) of non-Saudi nationals. This implies that the basic knowledge or basic education gained by the ICU nurses may be from another country. Consequently, the individual nurses' knowledge levels mentioned in this study may not completely represent the Saudi context. This suggests the question: is there a connection between the attitude/knowledge level of the ICU nurses and the country in which they obtained their basic nursing degree? An analysis in this regard was not possible in the present study due to very low number of Saudi ICU nurses in the sample population (~ 5% only). A purposive sampling technique could be used in future research studies to improve the

percentage of Saudi ICU nurses in the study sample and thereby the casual relationships discussed above could be assessed.

The third limitation of this study is that the sample of the study included ICU nurses from just two hospitals in Saudi Arabia. A multi-facility study could provide a broader picture on the educational, knowledge-related and cultural factors within the ICU units, thereby generating more comprehensive data. Therefore, future research could extend the results of this research to other hospitals in Saudi Arabia. Lastly, though most of the ICU nurses expressed positive attitudes about the VAP prevention guidelines, they did not explain their positive perceptions in fine detail. In simple words, a detailed analysis of the positive attitudes was not possible. More planned and structured interviews based on the patterns derived from this study could be useful in this regard.

Lastly, the impact of the COVID-19 pandemic has introduced significant limitations to the conduct of the phase II and the intended utilization of the i-PARIHS framework within this PhD study, which aimed to use the i-PARIHS framework for qualitative data analysis and data integration. Initially, the data collection plan for phase II study entailed face-to-face interviews with nurses in the participating hospitals to gain deeper insights into their experiences and perspectives. However, the implementation of lockdown measures and restrictions on physical access to the ICU facilities necessitated a modification of the study's approach. As a result, the research plan was adjusted to conduct interviews with nurses via Zoom video conferencing technology. While this adaptation allowed for data collection to continue, it introduced potential limitations related to the quality of data gathered in a virtual setting. Factors like technological constraints, potential distractions, and the absence of face-to-face interaction could impact the depth and richness of the qualitative data collected.

8.8 Chapter summary

This chapter aimed to classify and discuss the factors/barriers identified in the previous chapter using the i-PARIHS framework. By using the i-PARIHS framework, the researcher classified these factors under four major elements – innovation, context, recipients and facilitation. Research that classifies the factors influencing ICU nurses' compliance with the VAP prevention guidelines is lacking in the Saudi Arabian context. The lack of proper identification and classification of these factors hinders proper implementation of VAP prevention guidelines in Saudi Arabian ICUs. Therefore, the present study aimed to classify the factors associated with ICU nurses' adherence using the i-PARIHS framework. The usage of the i-PARIHS framework not only ensured the identification and classification of the factors, but also helped to generate possible solutions for successful implementation of the VAP prevention guidelines in the Saudi Arabian context.

As discussed previously, several intrinsic and extrinsic factors were identified during the integration of the quantitative and qualitative results. The context-related factors include lack of administrative support, quality of the VAP prevention guidelines, lack of adequate staff and equipment, lack of teamwork/coordination, excess workload, and some minor factors like the non-compliance of patients and the patients' health conditions. Factors examined under the innovation construct included ICU nurses' experience in the ICU environment as well as their total experience as a nurse. Further, ICU nurses' knowledge, and their attitudes towards the VAP prevention guidelines and towards practising them were also identified as key factors, which come under the recipient construct. Notably, ICU nurses' experience and knowledge are the key facilitators identified in this study. The findings of this study suggest that ICU nurses' adherence to VAP prevention guidelines can be improved significantly if the influential factors are tackled scientifically. Consequently, the researcher's suggestions to improve the present situation have been listed in this chapter. To conclude, this study has identified crucial areas

for future research in the context of the implementation of VAP prevention guidelines in Saudi

hospitals.

Audit of Current Practice
Oral Hygiene Medical Record Review

Day/Time: **ICU Ward/Unit**
Hospital Name: **Nursing Shift:**

OH AUDIT	OH 0.12% ORAL CHLORHEXIDINE		OH AUDIT	OH 0.12% ORAL CHLORHEXIDINE	
Patient File No	Performed	Note	Patient File No	Performed	Note
Total					

Total number of File Audited: _____

Fill in Y or N as appropriate:

Y= Adhered to the VAP prevention guidelines recommendation.

N= Not Adhered to VAP prevention guidelines recommendation.

Appendix 2:   **Study tool for auditing elevation of HOB practices**

Audit of Current Practice

Elevation of the Head of Bed between 30° to 45° Observation

Day/Time: **ICU Ward/Unit**
    Hospital Name: **Nursing Shift:**

BED NUMBER	PERFORMED	NOTE	BED NUMBER	PERFORMED	NOTE
TOTAL					

Total number of Bed Observed: _____
Fill in Y or N as appropriate:
    Y= Adhered to VAP prevention guidelines recommendation.
    N= Not Adhered to VAP prevention guidelines recommendation.

Appendix 3: **HHA's Five Moments observation form for hand hygiene**

Hand Hygiene observation - Data collection form.

Organisation: _____

Depart/Ward: _____

Date: _____ / _____ / _____

Auditor: _____   Session No.: _____

Start Time: _____   Finish Time: _____

Duration of Session: _____ mins

FIVE MOMENTS FOR HAND HYGIENE
1. Before touching a patient
2. Before a procedure
3. After a procedure or body fluid exposure risk
4. After touching a patient
5. After touching a patient's surroundings

Notes

Hcw	Moment	Action	Glove	Hcw	Moment	Action	Glove	Hcw	Moment	Action	Glove
	1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.
	1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.
	1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.
	1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.
	1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.
	1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.
	1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.
	1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.
	1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.		1 2 3 4 5	☐ 1. Rub ☐ 2. Wash ☐ 3. Missed	○ 1. On ☐ 2. Off ☐ 3. Cont.

Total Correct Moments: _____   **Total Moments:** _____

Instructions:
The followings questions ask about mechanically ventilated patients' oral hygiene, semi-recumbent patient positioning, and hand hygiene practices. For each item please select the answer choice(s) that best matches your opinion.

	Please tell us about yourself	
1.	What is your Age?	_____ Years
2.	What is your Gender?	☐ Male ☐ Female
3.	What is your Nationality?	☐ Saudi ☐ Non-Saudi: _____
4.	How long have you worked as a registered nurse?	_____ Years
5.	How long have you been worked in <u>this ICU</u>?	_____ Years
6.	How many mechanically ventilated patients have you taken care of in the last 2 weeks?	Check one: ☐None ☐ 1-2 patients ☐ 3-5 patients ☐ ≥6 patients
7.	What is your highest qualification in nursing?	Check one: ☐ Diploma ☐ Bachelor ☐Master ☐Doctoral degree
8.	What is your current nursing specialty certification status?	Check one: ☐ None ☐ Critical Care Registered Nurse ☐ Other …

1-A. Oral Hygiene for Mechanically Ventilated Patients

9.	How do <u>you</u> rate the priority level of oral hygiene for mechanically ventilated patients?	Check one: ☐ Low priority ☐ high priority ☐ Moderate priority highest priority
10.	How do <u>other nurses rate the priority level</u> of oral hygiene for mechanically ventilated patients?	Check one: ☐ Low priority ☐ high priority ☐ Moderate priority highest priority
11.	Who is responsible for making sure that patients receive appropriate oral hygiene?	Check one: ☐ Shared responsibility between ☐ Nurses' responsibility respiratory therapists and nurses ☐ Don't know
12.	I am accountable for providing appropriate oral hygiene for patients.	Check one: ☐ Yes ☐ No ☐ Don't know
13.	How often is oral hygiene practice affected by the patient's <u>condition</u> or patient's (or their family's) <u>preference</u>?	Check one: ☐ Always Some of the time ☐ Most of the time ☐ Never ☐ Don't know
14.	Do you use a standardized oral assessment tool to the oral cavity?	Check one: ☐ Yes (specify:). ☐ No
15.	The following supplies are readily available (i.e., at bedside):	Check ALL that apply: ☐ Tooth swab ☐ Flashlight ☐ Tooth brush ☐ Tooth paste

16. In general, how often do you provide oral hygiene care for mechanically ventilated patients? For each intervention, please check <u>only ONE</u> frequency.

Frequency / Oral Hygiene Intervention	Q2 hours	Q4 hours	Q6 hours	Q8 hours	Q12 hours	Less than once a shift
Oral assessment	☐	☐	☐	☐	☐	☐
Foam swabs/foam toothettes	☐	☐	☐	☐	☐	☐
Toothbrush	☐	☐	☐	☐	☐	☐
Toothpaste	☐	☐	☐	☐	☐	☐
Oral rinses (eg, Peridex/Chlorhexidine)	☐	☐	☐	☐	☐	☐
Oral paste/gel (eg, antimicrobial paste)	☐	☐	☐	☐	☐	☐

1-B Oral Hygiene Policy/Guideline for Mechanically Ventilated Patients	
17. How much have you read the hygiene policy/guideline for your unit?	Check one: ☐ Not at all.　　　　☐ All section at least once. ☐ Some sections.　　　☐ All sections multiple times.
18. What is the recommended frequency of <u>tooth brushing</u>?	Every _____ hours　　☐ Don't know

How true are these statements for you?

Check one	True	Mostly True	Sometimes True	Not True	Don't Know
19. I agree with the oral hygiene policy/guideline.	☐	☐	☐	☐	○
20. The oral hygiene policy/guideline is practical to use.	☐	☐	☐	☐	○
21. The oral hygiene policy/guideline is difficult to understand.	☐	☐	☐	☐	○
22. Using the oral hygiene guideline/policy will reduce VAP.	☐	☐	☐	☐	○
23. I plan to use the oral hygiene guideline/policy whenever 1 can.	☐	☐	☐	☐	○
24. I am confident that I can perform oral hygiene as recommended policy/guideline.	☐	☐	☐	☐	○
25. Sometimes I don't have time to provide oral hygiene as recommended in the policy/guideline.	☐	☐	☐	☐	○
26. There are other policies that conflict with the oral hygiene policy/guideline.	☐	☐	☐	☐	○
27. I had a hard time practicing oral hygiene per policy/guideline with the last 4 ventilated patients I cared for.	☐	☐	☐	☐	○

How often do these statements apply to you?

Check one	Always	Most of the Time	Some of the Time	Never	N/A
28. I practiced oral hygiene per policy/guideline with <u>last 4 ventilated patients</u> that I cared for.	☐	☐	☐	☐	○
29. In general, <u>my nurse colleagues</u> practice oral hygiene per policy/guideline.	☐	☐	☐	☐	○

2-A Elevation of Head of Bed

For Mechanically Ventilated Patients

30.	How do <u>you</u> rate the priority level of placing mechanically ventilated patients in semi-recumbent position?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
31.	How do the <u>other nurses</u> rate the priority level of placing mechanically ventilated patients in semi-recumbent position?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
32.	Who is responsible for making sure that patients are in semi-recumbent position when medically appropriate?	Check one: ☐ Shared responsibility between respiratory therapists and nurses. ☒ Nurses' responsibility.
33.	I am accountable for placing patients in semi-recumbent position.	Check one: ☐ Yes ☐ No ☐ Don't know
34.	How often is your semi-recumbent patient position practice affected by the patient's <u>condition</u> or patient's (or their family's) <u>preference</u>?	Check one: ☐ Always ☐ Some of the time ☐ Most of the time ☐ Never Don't know

2-B Elevation of Head of Bed Position Policy/Guideline for Mechanically Ventilated Patients	
35. How much have you read the ventilated patient positioning policy/guideline for your unit?	Check one: ☐ Not at all. All sections at least once. ☐ ☐ All sections multiple times. Some sections.
36. Patients on mechanical ventilation should be placed at ___degrees	_____ degrees ☐Don't know

How true are these statements for you?

Check one	True	Mostly True	Sometimes True	Not True	Don't Know
37. I agree with the semi-recumbent patient positioning policy/guideline.	☐	☐	☐	☐	O
38. The semi-recumbent patient position policy/guideline is practical to use.	☐	☐	☐	☐	O
39. The semi-recumbent patient positioning policy/guideline is difficult to understand.	☐	☐	☐	☐	O
40. Using the semi-recumbent patient positioning policy/guideline will reduce VAP.	☐	☐	☐	☐	O
41. I play in use the semi-recumbent patient positioning policy/guideline whenever I can.	☐	☐	☐	☐	O
42. I am confident that I can position patients as recommended in the policy/guideline.	☐	☐	☐	☐	O
43. Sometimes I do not have time to place patients in a semirecumbent position as recommended in the guideline.	☐	☐	☐	☐	O

	Check one					
44.	There are other police /guidelines that conflict with the semi-recumbent patient positioning guideline (e.g. pressure ulcer prevention policy)	☐	☐	☐	☐	O
45.	I had a hard time positioning patients per semi-recumbent policy/guideline with the <u>last 4 ventilated patients</u> that I cared for.	☐	☐	☐	☐	O

How often do these statements apply to you?

Check one	Always	Most of the Time	Some of the Time	Never	N/A
46. I positioned patients in semi-recumbent per policy/guideline with the <u>last 4 ventilated patients</u> that is cared for.	☐	☐	☐	☐	O
47. In general, <u>my nurse colleagues</u> position patients in semi-recumbent position per policy/guideline	☐	☐	☐	☐	O

3-A Hand Hygiene

48.	How do <u>you</u> rate the priority level of hand hygiene?	Check one: ☐ Low priority ☐ High priority ☐ ☐ Moderate priority Highest priority
49.	How do the <u>other nurses</u> rate priority level of hand hygiene?	Check one: ☐ Low priority ☐ High ☐ ☐ priority Moderate priority Highest priority

50.	I am accountable for practicing appropriate hand hygiene.	Check one: ☐ Yes ☐ No ☐ Don't know
51.	The following supplies are readily available (i.e., at bedside)	Check All that apply: ☐ Sink ☐ Soap ☐ Alcohol gel

3-B Hand Hygiene Policy/Guideline	
52.	How much have you read about the hand hygiene policy/guideline of your unit/hospital?	Check one : ☐ Not at all. ☐ All sections at least once ☐ Some Sections. ☐ All sections multiple time
53.	After going into the room of a patient who is known have C Diff, how would you clean your hands?	Check one : ☐ Nothing ☐ Water and soap ☐ Alcohol gel ☐ Alcohol gel or water & soap

How true are these statements for you?

	Check one	True	Mostly True	Sometimes True	Not True	Don't Know
54.	I agree with the hand hygiene policy/guideline.	☐	☐	☐	☐	◯
55.	The hand hygiene policy/guideline is practical to use.	☐	☐	☐	☐	◯
56.	The hand hygiene policy/guideline is difficult to understand.	☐	☐	☐	☐	◯
57.	The hand hygiene policy/guideline will reduce VAP.	☐	☐	☐	☐	◯

			Most of the Time	Some of the Time		
58.	If I follow the hand hygiene policy/guideline, it is likely that my hand will be in worse shape (e.g., drier skin).	☐	☐	☐	☐	○
59.	I plan to use the hand hygiene policy/guideline whenever I can.	☐	☐	☐	☐	○
60.	I am confident that I can perform hand hygiene as recommended in the policy/guideline.	☐	☐	☐	☐	○
61.	Sometimes I don't have time for hand hygiene as recommended in the policy/guideline.	☐	☐	☐	☐	○
62.	I had a hard time following the hand hygiene policy/guideline. In the last 2 weeks.	☐	☐	☐	☐	○

How often do these statements apply to you?

Check one	Always	Most of the Time	Some of the Time	Never	N/A
63. I practiced hand hygiene per policy/guideline in the last 2 weeks.	☐	☐	☐	☐	○
64. In general, my nurse colleagues practice hand hygiene per policy/guideline.	☐	☐	☐	☐	○

4. Your experience with VAP prevention					
Check one	True	Mostly True	Sometimes True	Not True	Don't Know
65. I know that VAP prevention is a priority in my hospital.	☐	☐	☐	☐	○

66.	I think the role of the Infection Control Department has been important in VAP prevention.	☐	☐	☐	☐	O
67.	I have hand adequate education on VAP prevention.	☐	☐	☐	☐	O
68.	I know who to ask when I have questions about VAP prevention practices.	☐	☐	☐	☐	O
69.	Preprinted order sets help me do VAP prevention in the right way.	☐	☐	☐	☐	O
70.	A designated place to document VAP prevention measures (e.g., oral hygiene, patient position) makes me more conscious of VAP prevention.	☐	☐	☐	☐	O
71.	Knowing that I may be audited (through chart review or observation) make me do VAP prevention practices as recommended in the policy/guideline.	☐	☐	☐	☐	O

72.	The most recent VAP rate of my unit was _____ (per 1.000 ventilator days).	Check one: ☐ ≤1 incidences ☐ 3≤5 incidences ☐1≤ 3 incidences ☐> 5 incidences ☐ I don't know

<table>
<tr><td colspan="3" style="background-color:red;color:white;text-align:center">5. "VAP Prevention Policy/Guideline " of your hospital (e.g., VAP Bundle, Policy & Procedure, Manual, Standard of Card)</td></tr>
<tr><td>73.</td><td>How much have you read this "VAP Prevention Guideline"?</td><td>Check one:

☐ Not at all.   ☐ All sections at least once
☐ Some sections.   ☐ All sections multiple times</td></tr>
</table>

74.	The "VAP Prevention Policy/Guideline" is helpful in my practice.	Check one: ☐ True ☐ Somewhat true ☐ Slightly true ☐ Not true
75.	This guideline will decrease inappropriate variation of care.	Check one: ☐ True ☐ Somewhat true ☐ Slightly true ☐ Not true
76.	The "VAP Prevention Policy/Guideline" interferes with my professional autonomy.	Check one: ☐ True ☐ Somewhat true ☐ Slightly true ☐ Not true

The End of the Questions

If you are distressed, contact your employee Clinical.

PARTICIPANT INFORMATION SHEET

PROJECT TITLE: Nursing Care of Mechanically Ventilated Patients in Intensive Care in Saudi Arabia
HUMAN RESEARCH ETHICS COMMITTEE APPROVAL NUMBER: 33692 H-2019/ H-2019-100/KSU-IRB E-19-4063
PRINCIPAL INVESTIGATOR: Professor Gillian Harvey
STUDENT RESEARCHER: Mr. Nader Eqaab D Alotaibi
STUDENT'S DEGREE: Higher Degree by Research

Dear Participant,

You are invited you to participate in the research project described below.

What is the project about?
This research project is seeking to assess the level of nursing adherence to Prevention of Ventilator Associated Pneumonia Clinical Practice Guidelines in intensive care units in Saudi Arabian hospitals. Findings from this study may inform the future planning of strategies that could support the delivery of improved care to this group of patients.

Who is undertaking the project?
This project is being conducted by Nader Eqaab D Alotaibi. This research will form the basis for the degree of Doctor of Philosophy (PhD) at the University of Adelaide under the supervision of Prof. Gillian Harvey and Dr. Elizabeth Ann Lynch.

Why am I being invited to participate?
You are being invited as you are a nurse who works in the intensive care unit at [Hospital Name].

What am I being invited to do?
If you agree to participate, you will undertake your clinical practice as usual on the ward. During this time, the researcher, Alotaibi, Nader, will undertake an audit of the care of mechanically ventilated patients. This will involve collecting data through observing the elevation of head of bed and hand hygiene opportunities, and reviewing medical records for the oral hygiene care. In addition, you will be invited to complete an anonymous questionnaire, which will ask about your views and experience of caring for mechanically ventilated patients. Once completed, you can return the questionnaire to a secure collection box on the ward.

How much time will my involvement in the project take?
The only time commitment would be to complete the questionnaire. This will take up to 30 minutes to complete.

Are there any risks associated with participating in this project?
There are no identified risks associated with participating in this project. If you feel uncomfortable being observed by the researcher during the audit period, you can opt out of the research and the researcher will not observe your practice. As the sample size is relatively small, complete anonymity cannot be guaranteed. However, the utmost care will be taken to ensure that no personal identifying details are revealed. The confidentiality and privacy of all participants will be upheld and their views and opinions will not be publicly accessible in a personally identifiable manner.

What are the potential benefits of the research project?
While there may be no immediate benefit to you from participating in the research, it may lead to a better understanding of the factors that influence how nurses deliver care to mechanically ventilated patients. In turn, this may help to inform future strategies to improve the care of this patient group.

Can I withdraw from the project?
Participation in this project is completely voluntary. If you agree to participate in the audit of current practice, you do not have to sign a consent form. If you DO NOT want to take part, you need to **'opt out'** of the research, by contacting a member of the research team.
By not opting out of the research, you are indicating that you:
- Understand what you have read.
- Consent to take part in the research project as described.

In addition, if you choose to complete the questionnaire and return it, we accept that you have consented to participate in the study. Because the questionnaire is anonymous, your data will not be able to be withdrawn after you have returned a completed questionnaire.

What will happen to my information?
Confidentiality and privacy: To ensure your privacy and confidentiality, all of the data collected will be anonymous. No identifying information will be recorded in the audit and you will not be asked to include your name or any other information that may directly identify you on the questionnaire. Locked boxes will be located at the nursing station in the ICU in which you work for the return of completed questionnaires. The researcher and his supervisors will be the only people who have access to the data.

Storage: The hard copies of audit forms and questionnaires will be locked in a personal secure cupboard in the researcher's office at King Saud University during the data collection. After the data are entered onto the computer, the hard copies will be transported by secure post to the University of Adelaide for secure storage. Electronic data will be stored in a password-protected computer file. All data will be stored for five years *(as per University of Adelaide Regulation)* after the completion of the PhD, after which time hard copies will be shredded and computer files will be destroyed confidentially.

Publishing: The study findings will be published as a PhD thesis and in related journal papers and conference presentations. Individual organisations and intensive care units will not be identified in any presentation or publication.

Who do I contact if I have questions about the project?
If you would like further information regarding any aspect of this project, you are encouraged to contact the researcher's principal supervisor or the researcher via the phone number or email addresses listed below.

Principal Investigator: Prof. Gillian Harvey Email: gillian.harvey@adelaide.edu.au	HDR Researcher Alotaibi, Nader Phone: +966505253542 Email: nader.alotaibi@adelaide.edu.au

What if I have a complaint or any concerns?
The study has been approved by the Human Research Ethics Committee at the University of Adelaide (33692 H-2019). This research project will be conducted according to the NHMRC National Statement on Ethical Conduct in Human Research 2007 (Updated 2018). If you have questions or problems associated with the practical aspects of your participation in the project or wish to raise a concern or complaint about the project, then you should consult the Principal Investigator. If you wish to speak with an independent person regarding concerns or a complaint, the University's policy on research involving human participants, or your rights as a participant, please contact the Human Research Ethics Committee's Secretariat on:
Phone: +61 8 8313 6028   Email: hrec@adelaide.edu.au
Post: Level 4, Rundle Mall Plaza, 50 Rundle Mall, Adelaide, SA 5000

          The overseas local ethics committee contact is:
          Dr. Hisham Mohamed Aziz, General Director for Research and Studies, Ministry of Health – Saudi Arabia.
          Phone: +966114735039 Ext: 104   **Email**: Haziz@moh.gov.sa
Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

If I want to participate, what do I do?
If you agree to participate in the audit, you do not have to do anything other than go about your usual activities on the ward. If you agree to complete the questionnaire, you are asked to complete the questionnaire and return it in the secure box available at the nursing station.

Yours sincerely,
Alotaibi, Nader
HDR Student | Adelaide Nursing School | Faculty of Health and Medical Sciences
E-mail: Nader.alotaibi@Adelaide.edu,au
Phone: +966505253542

CALL FOR PARTICIPANTS

Study Title: Nursing Care of Mechanically Ventilated Patients in Intensive Care in Saudi Arabia

This research project is examining the nursing care of mechanically ventilated patients in intensive care units in Saudi Arabian hospitals. Findings from this study will help to inform the future planning of strategies that could support the delivery of improved care to this group of patients.

All ICU nurses are invited to participate in this study

Requirements:

Participation are voluntary.

Questionnaire survey are available at the nursing station desk.

Completing questionnaire survey will take approximately 30 mins.

No identification will be recorded. Completed questionnaire to be returned to the secured box at your nursing station.

Thank You for your participation

Any inquires contact researcher:
Alotaibi, Nader HDR student
 University of Adelaide
nader.alotaibi@adelaide.edu.au
+966505253542

THE UNIVERSITY of ADELAIDE

Appendix 7:   Preliminary study ethics approvals

Kingdom of Saudi Arabia
Ministry of Health
General Directorate for Research and Studies
(GDRS)

**Preliminary Approval Letter**   _Date: 23/04/2019_

To whom it may concern

University of Adelaide
College of Nursing
Australia

Subject: To facilitate the mission of Mr. Nader Eqaab D Alotaibi
Academic ████████

Dear Sir/Madam,

This is to inform you that, this is a preliminary approval letter to _**Mr. Nader Eqaab D Alotaibi**_ who submitted an application to The General Directorate for Researches and Studies, Ministry of Health, Kingdom of Saudi Arabia (_**GDRS-MoH**_) to collect data for his research project titled "_**Factors Influencing Intensive Care Nurses' Adherence to Prevention of 'Ventilator Associated Pneumonia' Clinical Practice Guidelines in Saudi Arabia: A Mixed Method Study**_" as a part of his Ph.D degree thesis at ████████████ KSA to be started from **(15/06/2019)** till **(15/08/2019)**.

Please note that according to our rules and regulations, the proposal needs to get acceptance by MoH scientific and ethical reviewing committees prior conducting the study at MoH facilities.

Yours Faithfully

Genera

e-mail: research@moh.gov.sa

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Appendix 8: **The University of Adelaide ethics approval letter for phase I study**

Our reference 33692

RESEARCH SERVICES
OFFICE OF RESEARCH ETHICS, COMPLIANCE AND INTEGRITY
THE UNIVERSITY OF ADELAIDE

LEVEL 4, RUNDLE MALL PLAZA
50 RUNDLE MALL
ADELAIDE SA 5000 AUSTRALIA

TELEPHONE +61 8 8313 5137
FACSIMILE +61 8 8313 3700
EMAIL hrec@adelaide.edu.au
CRICOS Provider Number 00123M

14 June 2019

Professor Gillian Harvey
Nursing

Dear Professor Harvey

ETHICS APPROVAL No:	H-2019-100
PROJECT TITLE:	Factors influencing Intensive Care Nurses' Adherence to 'Prevention of Ventilator-Associated Pneumonia' Clinical Practice Guidelines in Saudi Arabia: A mixed method study

The ethics application for the above project has been reviewed by the Low Risk Human Research Ethics Review Group (Faculty of Health and Medical Sciences) and is deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research 2007 (Updated 2018)* involving no more than low risk for research participants.

You are authorised to commence your research on: 14/06/2019
The ethics expiry date for this project is: 30/06/2022

NAMED INVESTIGATORS:

Chief Investigator:	Professor Gillian Harvey
Student - Postgraduate Doctorate by Research (PhD):	Mr Nader Eqaab D Alotaibi
Associate Investigator:	Dr Elizabeth Ann Lynch

CONDITIONS OF APPROVAL: Thank you for your responses to the matters raised. The revised ethics application provided on the 14th of June, 2019 has been approved.

Ethics approval is granted for three years and is subject to satisfactory annual reporting. The form titled Annual Report on Project Status is to be used when reporting annual progress and project completion and can be downloaded at http://www.adelaide.edu.au/research-services/oreci/human/reporting/. Prior to expiry, ethics approval may be extended for a further period.

Participants in the study are to be given a copy of the information sheet and the signed consent form to retain. It is also a condition of approval that you immediately report anything which might warrant review of ethical approval including:

- serious or unexpected adverse effects on participants,
- previously unforeseen events which might affect continued ethical acceptability of the project,
- proposed changes to the protocol or project investigators; and
- the project is discontinued before the expected date of completion.

Yours sincerely,

Miss Sarah Harman

Secretary

The University of Adelaide

Appendix 9: **The University of Adelaide ethics approval letter for phase II study**

THE UNIVERSITY
of ADELAIDE

RESEARCH SERVICES
OFFICE OF RESEARCH ETHICS, COMPLIANCE
AND INTEGRITY
THE UNIVERSITY OF ADELAIDE

LEVEL 4, RUNDLE MALL PLAZA
50 RUNDLE MALL
ADELAIDE SA 5000 AUSTRALIA

TELEPHONE +61 8 8313 5137
FACSIMILE +61 8 8313 3700
EMAIL   hrec@adelaide.edu.au

CRICOS Provider Number 00123M

Our reference 33692

20 October 2020

Professor Gillian Harvey
Nursing

Dear Professor Harvey

ETHICS APPROVAL No:	H-2019-100
PROJECT TITLE:	Factors influencing Intensive Care Nurses' Adherence to 'Prevention of Ventilator-Associated Pneumonia' Clinical Practice Guidelines in Saudi Arabia: A mixed method study

Thank you for providing the amended application dated the 14th of October 2020. The request to include interviews and focus groups to the protocol has been approved.

The ethics amendment for the above project has been reviewed by the Low Risk Human Research Ethics Review Group (Faculty of Health and Medical Sciences) and is deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research 2007 (Updated 2018)* involving no more than low risk for research participants.

You are authorised to commence your research on: 14/06/2019
The ethics expiry date for this project is: 30/06/2022

NAMED INVESTIGATORS:

Chief Investigator:	Professor Gillian Harvey
Student – Postgraduate Doctorate by Research (PhD):	Mr Nader Eqaab D Alotaibi
Associate Investigator:	Dr Elizabeth Ann Lynch

CONDITIONS OF APPROVAL: Thank you for your responses to the matters raised. The revised ethics application provided on the 14th of June, 2019 has been approved.

Ethics approval is granted for three years and is subject to satisfactory annual reporting. The form titled Annual Report on Project Status is to be used when reporting annual progress and project completion and can be downloaded at http://www.adelaide.edu.au/research-services/oreci/human/reporting/. Prior to expiry, ethics approval may be extended for a further period.

Participants in the study are to be given a copy of the information sheet and the signed consent form to retain. It is also a condition of approval that you immediately report anything which might warrant review of ethical approval including:

- serious or unexpected adverse effects on participants,
- previously unforeseen events which might affect continued ethical acceptability of the project,
- proposed changes to the protocol or project investigators; and
- the project is discontinued before the expected date of completion.

Yours sincerely,

Ms Yvette Kim Clarissa Wijnandts
Secretary

The University of Adelaide

Appendix 10:   IRB approval for phase I from participating hospital 1

Kingdom of Saudi Arabia
Ministry of Health

IRB Registration Number with KACST, KSA:
IRB Registration Number with OHRP/NIH, USA:
Approval Number Federal Wide Assurance NIH, USA:

May 16, 2019
IRB Log Number: 19-268E
Department: External - The University of Adelaide
Category of Approval: EXEMPT

Dear Nader Alotaibi, Prof. Gillian Harvey and Dr. Elizabeth Ann Lynch,

I am pleased to inform you that your submission dated May 12, 2019 for the study titled **'Factors Influencing Intensive Care Nurses' Adherence to 'Prevention of Ventilator-Associated Pneumonia' Clinical Practice Guidelines in Saudi Arabia: A Mixed Methods Study'** was reviewed and was approved according to Good Clinical Practice guidelines. Please note that this approval is from the research ethics perspective only. You will still need to get permission from the head of department or unit in KFMC or an external institution to commence data collection.

We wish you well as you proceed with the study and request you to keep the IRB informed of the progress on a regular basis, using the IRB log number shown above.

Please be advised that regulations require that you submit a progress report on your research every 6 months. You are also required to submit any manuscript resulting from this research for approval by IRB before submission to journals for publication.

As a researcher you are required to have current and valid certification on protection human research subjects that can be obtained by taking a short online course at the US NIH site or the Saudi NCBE site followed by a multiple choice test. Please submit your current and valid certificate for our records. Failure to submit this certificate shall a reason for suspension of your research project.

If you have any further questions feel free to contact me.

Sincerely yours,

Appendix 11:   IRB approval for phase I from participating hospital 2

03.07.2019 (30.10.1440)
Ref. No. 19/0791/IRB

To: **Mr. Nader Eqaab D Alotaibi**
Ph.D. student
Adelaide Nursing School, University of Adelaide
Email: A⬛⬛⬛⬛⬛⬛⬛⬛
Principal Investigator

CC: Prof. Gillian Harvey, Dr. Elizabeth Lynch
Co-Investigators

Subject: **Approval of Research Project No. E-19-4063**

Study Title: "Factors influencing Intensive Care Nurses' Adherence to 'Prevention of Ventilator-Associated Pneumonia' Clinical Practice Guidelines in Saudi Arabia: A Mixed Methods Study"

Type of Review: Expedite
Date of Approval: 03 July 2019
Date of Expiry: 03 July 2020

Dear Mr. Nader Eqaab D Alotaibi,

I am pleased to inform you that your above-mentioned research project submitted to the IRB was reviewed and approved on 03 July 2019 (30 Shawwal 1440). You are now granted permission to conduct this study given that your study does not disclose participant's identity and poses no risk to the patients.

As principal investigator, you are required to abide by the rules and regulations of the Kingdom of Saudi Arabia and the research policies and procedures of the KSU I⬛⬛⬛⬛⬛ make any changes to the protocol during the period of this approval, you must submit a revised protocol to the IRB for approval prior to implementing the changes. Please quote the project number shown above in any future correspondence or follow-ups related to this study.

This approval is for a period of one (1) year commencing from the date of this letter. If you wish to have your protocol approved for continuation, please submit a completed request for reapproval of an approved protocol form (⬛⬛⬛⬛⬛⬛ least 30 days before the expiry date. Failure to receive approval for continuation before the expiration date will result in automatic suspension of the approval of this protocol on the expiration date. Information collected following suspension is unapproved research and can never be reported or published as research data.

We wish you success in your research and request you to keep the IRB informed about the progress and final outcome of the study in a regular basis. If you have any question, please feel free to contact me.

Thank you!

Sincerely yours,

⬛⬛⬛⬛⬛⬛⬛⬛ ects

Appendix 12:   Interview questions guide for phase II study

Nurses Interview Guide

Title:	Factors influencing Intensive Care Nurses' Adherence to 'Prevention of Ventilator-Associated Pneumonia' Clinical Practice Guidelines in Saudi Arabia: A Mixed Methods Study
Ethics Approval Number:	H-2019-100
Principal Investigator:	Professor Gillian Harvey
Student Researcher:	Mr. Nader Eqaab D Alotaibi
Student's Degree:	Higher Degree by Research

Dear Sir/Madam

Thank you for agreeing to participate in this research which is part of my Ph.D. studies at the University of Adelaide and supervised by **Prof. Gillian Harvey** and **Dr. Elizabeth Lynch.** During the interview, you will be asked about your nursing experience with Mechanically Ventilated Patients in the ICUs.

Have you had an opportunity to read the PIS?

Do you have any questions?

Are you willing for this interview to be recorded?

[Before the start of the interview, the researcher will confirm verbally with the participant the signed **Consent Form** for their agreement of participation in the interview session and the use of their responses in the study].

Interview questions

General questions about caring for mechanically ventilated patients

- I would like to start by asking about your experience of caring for mechanically ventilated patients in the intensive care setting:
    - Is this a regular aspect of your nursing practice?
    - What you do on your unit to prevent patients getting ventilator associated pneumonia?

- Are you aware of any clinical practice guidelines relating to the prevention of ventilator associated pneumonia?
    - If yes, can you describe how the guidelines are used on your unit?
    - If no, do you think they would be useful?

Specific questions about ventilator-associated pneumonia prevention clinical practice guideline recommendations caring for mechanically ventilated patients

In my research, I am interested in the implementation of Clinical Practice Guideline recommendations for the prevention of Ventilator-Associated Pneumonia that are most relevant to nursing practice, namely: Oral Hygiene with 0.12% Chlorohexidine Solution, Elevation of Head of Bed between 30° to 45°, and Hand Hygiene 5 moments.

Oral Hygiene with 0.12% Chlorohexidine Solution
- The guidelines recommend that chlorhexidine solution (0.12%) should be used once per shift for oral hygiene in ventilated patients admitted in ICU.
    - Would you say the practice on your unit is in line with this recommendation?
    - If not, what are the particular challenges or barriers you face?
    - Do you have any suggestions about ways to address these barriers?
    - If yes, what do you think supports people to do this?

Elevation of Head of Bed between 30° to 45°
- The guidelines recommend that mechanically ventilated patients should be nursed in the semi-recumbent position (elevation of the head of the bed to 30-45°), unless contraindicated.
    - Would you say the practice on your unit is in line with this recommendation?
    - If not, what are the particular challenges or barriers you face?
    - Do you have any suggestions about ways to address these barriers?
    - If yes, what do you think supports people to do this?

Hand Hygiene 5 moments
- The guidelines recommend that Hand Hygiene, in accordance with international hand hygiene guidelines Hand Hygiene 5 moments, should be part of the routine clinical care of mechanically ventilated patients.
    - Would you say the practice on your unit is in line with this recommendation?
    - If not, what are the particular challenges or barriers you face?
    - Do you have any suggestions about ways to address these barriers?
    - If yes, what do you think supports people to do this?

Overall views and experience of the VAP prevention guideline
- When you think about the three recommendations we have discussed (Oral Hygiene, Elevation of HOB and Hand Hygiene), do you consider these as essential to the prevention of VAP?
  a. How high a priority do you give these recommendations to prevent patient from getting VAP?
  b. Are there other things that you do as a nurse that you think are important to prevent VAP?
- The research evidence shows that it is very hard to get 100% adherence to clinical practice guidelines. Does that reflect your experience and why do think this is?
- Is there anything more you would like to add about the prevention of VAP in the intensive care setting or the prevention of VAP CPGs?

Questions To keep flowing of the interview discussion:
- *Can you please tell me more about this/that?*
- *What do you mean by this/that?*
- *What else?*

Thank you

Nader Alotaibi

Interview Participant Information Sheet

Project Title: Nursing Care of Mechanically Ventilated Patients in Intensive Care in Saudi Arabia
Human Research Ethics Committee Approval Number: H-2019-100
Principal Investigator: Professor Gillian Harvey
Student Researcher*:* Mr. Nader Eqaab D Alotaibi
Student's Degree: Higher Degree by Research

Dear Participant,

You are invited to participate in the research project described below.

What is the project about? This research project is seeking to explore the factors influencing nurses' adherence to the Prevention of Ventilator-Associated Pneumonia (VAP) Clinical Practice Guidelines (CPGs) in intensive care units in Saudi Arabian hospitals. Findings from this study may inform the future planning of strategies that could support the delivery of improved care to this group of patients.

Who is undertaking the project? This project is being conducted by Mr. Nader Alotaibi. This research will form the basis for the degree of Doctor of Philosophy (Ph.D.) at the University of Adelaide under the supervision of Prof. Gillian Harvey and Dr. Elizabeth Ann Lynch.

Why am I being invited to participate?
You are being invited as you are:
- Registered Nurse.
- Working in an ICU unit at [Hospital Name].
- Working in [Hospital Name] during the data collection time.
- Aged 18 years and above.

What am I being invited to do? You are invited to participate in an interview guided by Mr. Nader Alotaibi about your understanding and experience of implementing VAP Prevention CPGs. The interview will be conducted via a Zoom meeting at a time and place that is convenient for you.

How much time will my involvement in the project take?
The interview will last approximately 30 – 45 minutes.

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Are there any risks associated with participating in this project?
There are no foreseeable risks associated with participating in this research. As the sample size for the study is relatively small, complete anonymity cannot be guaranteed. However, the utmost care will be taken to ensure that no personal identifying details are revealed. The anticipated burden on you by participating in this study is the time you will spend in the interview. To mitigate this burden, the meeting will be scheduled at a time that suits you. The researcher will discuss the appropriate time with you.

What are the potential benefits of the research project?
There is no direct benefit to you from participating in the research. The information collected may increase understanding about nurses' experience with VAP Prevention Clinical Practice Guidelines (CPG) and the implementation of evidence-based practice. This could help to inform future strategies to facilitate the uptake of VAP prevention CPGs in Saudi Arabia.

Can I withdraw from the project?
Participation in the study is completely voluntary. If you agree to participate and decide not to continue, you are free to withdraw from the study at any time. Whether or not you decide to participate, your decision will not disadvantage or negatively affect your work.

What will happen to my information?
Confidentiality and privacy: To ensure your privacy and confidentiality, no identifying information will be recorded in the interview and you will not be asked about your name or any other information that may directly identify you. The researcher and his supervisors will be the only people who have access to the data. During data analysis, you will be given a code, and only the code will be used in any reporting of the results.
Storage: The audio-recorded interview data, without any participant identifiers, will be saved on a password-protected computer file in a confidential staff server at the University of Adelaide. All data will be stored for five years (as per the University of Adelaide Regulation) after the completion of the Ph.D., after which time hard copies will be shredded and computer files will be destroyed confidentially.
Publishing: The study findings will be published as a Ph.D. thesis and in related journal papers and conference presentations. Individual organisations and intensive care units will not be identified in any presentation or publication.
Your information will only be used as described in this participant information sheet and it will only be disclosed according to the consent provided, except as required by law.

Who do I contact if I have questions about the project?
If you would like further information regarding any aspect of this project, you are encouraged to contact the researcher's Principal Supervisor, Prof Gillian Harvey, or the researcher via the phone numbers or email addresses listed below.

Principal Investigator: Prof. Gillian Harvey
Email: gillian.harvey@adelaide.edu.au   Tel: +61 8 8313 0267
HDR Researcher: Nader Alotaibi
Email: nader.alotaibi@adelaide.edu.au   Tel: +966505253542

What if I have a complaint or any concerns?

The study has been approved by the Human Research Ethics Committee at the University of Adelaide (H-2019-100). This research project will be conducted according to the NHMRC National Statement on Ethical Conduct in Human Research 2007 (Updated 2018). If you have questions or problems associated with the practical aspects of your participation in the project or wish to raise a concern or complaint about the project, then you should consult the Principal Investigator. If you wish to speak with an independent person regarding concerns or a complaint, the University's policy on research involving human participants, or your rights as a participant, please contact the Human Research Ethics Committee's Secretariat on Phone: +61 8 8313 6028 Email: hrec@adelaide.edu.au Post: Level 4, Rundle Mall Plaza, 50 Rundle Mall, Adelaide, SÁ 5000 The overseas local ethics committee contact is: Dr. Hisham Mohamed Aziz, General Director for Research and Studies, Ministry of Health –Saudi Arabia. Phone: +966114735039 Ext: 104Email: Haziz@moh.gov.sa Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

If I want to participate, what do I do?

If you decide to participate, please email the researcher Nader Alotaibi, alternatively you may call him on the telephone number listed below. In addition, please sign the consent form attached to this email and return it to the researcher's email. The researcher will organize a convenient time with you to conduct the Zoom meeting.

> **Yours sincerely,**
> **Alotaibi, Nader**
> HDR Student | Adelaide Nursing School | Faculty of Health and Medical Sciences
> E-mail: Nader.alotaibi@Adelaide.edu,au
> Phone: +966505253542

Appendix 14: **Phase II study data collection flyer**

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Appendix 15:   Invitation letter for phase II study

Invitation letter to ICU educators

ICU nurses' interview

Dear ICU Managers/Educators

Greetings,

My name is Nader Alotaibi, and I am a doctoral candidate in Adelaide Nursing School, at The University of Adelaide, Australia. I am kindly requesting your assistance to invite your adult **ICU nurses** to participate in a doctoral research study that I am conducting titled: Factors influencing Intensive Care Nurses' Adherence to 'Prevention of Ventilator-Associated Pneumonia' Clinical Practice Guidelines in Saudi Arabia: A mixed method study.

The study involves participating in an interview about their understanding and experience of implementing Ventilator-Associated Pneumonia Prevention Clinical Practice Guidelines. The interview will be conducted via a Zoom meeting at a time that is convenient for them. With their consent, the interview session will be digitally recorded and transcribed. The interview will last approximately 30–45 minutes.

If the **ICU nurses** would like to participate in the study, they only need to read the attached **Participant Information Sheet** and **Interview Invitation Flyer** that outlines the aim and the purpose of the study. If they are interested in taking part of the study, they need to sign the **Consent Form** attached to this email and email it back to me to arrange a time.

If you require any further information, feel free to contact me

Sincerely,
Nader Alotaibi BSN, MSN, RN, PhD Candidate Adelaide Nursing School

THE UNIVERSITY
of ADELAIDE

Interview Consent Form

1. I have read the attached Information Sheet and agree to take part in the following research project:

Title: Nursing Care of Mechanically Ventilated Patients in Intensive Care in Saudi Arabia

Ethics Approval Number: H-2019-100

2. I have had the project, so far as it affects me, and the potential risks and burdens fully explained to my satisfaction by the research worker. I have had the opportunity to ask any questions I may have about the project and my participation. My consent is given freely.

3. Although I understand the purpose of the research project is to improve the quality of health/medical care, it has also been explained that my involvement may not be of any benefit to me.

4. I have been informed that, while information gained during the study may be published in a journal article, Ph.D. thesis, and conference presentation, I will not be identified, and my personal results will not be divulged.

5. I understand that I am free to withdraw from the project at any time without any negative consequences.

6. I agree to the interview being audio and video recorded via Zoom.   Yes 0   No 0

7. If no to Q6, I agree to the interview being audio recorded only.   Yes 0   No 0

8. I have been informed that the information gained in the project may be published in a book/journal article/thesis/news article/conference presentations/website/report etc.

9. I am aware that I should keep a copy of this Consent Form, when completed, and the attached Participation Information Sheet.

10.   I understand my information will only be disclosed according to the consent provided, except where disclosure is required by law.

11.   As the sample size for this study is relatively small, complete anonymity cannot be guaranteed. However, the utmost care will be taken to ensure that no personal identifying details are revealed. The confidentiality and privacy of all participants will be upheld, and their views and opinions will not be publicly accessible in a personally identifiable manner.

Participant to complete:

Name: **Signature:**   **Date:**

Appendix 17:   Permission to use the VAP questionnaire

RE: Alotaibi, Nader Questionnaire request

Hiroko Kiyoshi-Teo <kiyoshi@ohsu.edu>

Thu 7/02/2019 4:14 AM

To: Nader Eqaab D Alotaibi <nader.alotaibi@adelaide.edu.au>;Abigail Khan <khaab@ohsu.edu>

Hi Alotaibi (I hope I am addressing you correctly).

Thank you for resending your email. I may have missed it. I'm delighted to know that you are interested in using the P-VAP questionnaire. I think it's a good idea to change SBT. You may want to adjust the terminology related to VAP as things have shifted since it was published. Feel free to use and to modify the tool as needed.

Great question about not using hand hygiene in the analysis. We excluded HH in the analysis because it lacked enough variation in responses for statistical analysis. If you are interested in studying hand hygiene it might be a good idea to explore how you ask the hand hygiene question (since you will be using the survey) so that you get variability in your responses. Hand hygiene is crucially important but I think it's more complicated to study. So many opportunity to do HH exist in a day. People often don't remember doing one or not.

Good luck with your project! Let me know if you have other questions.

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Appendix 18: IRB approval for phase II from participating hospital 1

IRB Registration Number with KACST, KSA:
IRB Registration Number with OHRP/NIH, USA:
Approval Number Federal Wide Assurance NIH, USA

Date: November 19, 2020
IRB Log Number: 19-268E
Category of Approval: EXEMPT

Dear Dr. Nader Eqaab D Alotaibi,

We have received, reviewed and approved the amendment submitted on October 20, 2020 for the study titled
**'Factors influencing Intensive Care Nurses' Adherence to 'Prevention of Ventilator-Associated Pneumonia'
Clinical Practice Guidelines in Saudi Arabia: A Mixed Methods Study'** as per details below:

1. A qualitative study will be undertaken to explore and gain a deeper understanding of the key findings
   from the Phase one study (Quantitative study), in particular what influences whether and how nurses
   working in ICU can implement the Ventilator-Associated Pneumonia (VAP) prevention guidelines in
   practice. In phase two, we will conduct semi-structured interviews via an online Zoom meeting to
   collect data from a sample of nurses working in the ICU units involved in the phase one study. In
   addition, the researcher will present the results of phase one and two to nursing leaders through
   group discussion. The Interpretive group discussion via an online Zoom meeting will be facilitated to
   generate recommendations and strategies to address the issues identified regarding ICU nurses'
   adherence to VAP prevention guidelines.
2. Audio-recordings of the interviews and group discussions will be transcribed in full by the researcher.
   Analysis will be conducted according to Braun and Clarke's (2006) six steps of thematic analysis:
   familiarization with the data, generating initial codes, searching for themes, reviewing themes,
   defining and naming themes, and producing the report.
3. For the semi-structured interviews, we added a new Participant Information Sheets, Flyer, consent
   form and Interview guide.

Recommendation:

To continue with the research is approved.

The request to include interviews and focus groups to the protocol has been approved.
The ethics amendment for the above project has been reviewed by the Low Risk Human Research Ethics
Review Group, as exempt.

Conditions of approval:

Ethics approval is granted for one year and is subject to satisfactory annual reporting.
Participants in the study should be given a copy of the signed informed consent form and the original copy to be retained.

To report immediately anything which might warrant review of ethical approval such as serious or unexpected adverse effects on participants, previously unforeseen events which might affect continued ethical acceptability of the project, proposed changes to the protocol or project investigators; and if the project is discontinued before the expected date of completion.

Sincerely yours,

Institutional Review Board (IRB)

Appendix 19:   IRB approval for phase II from participating hospital 2

13.10.2020 (26.02.1442)
Ref. No. 20/0725/IRB

To: Mr. Nader Eqaab D Alotaibi
                    PhD Student
                    King Saud University College of Nursing
                    The University of Adelaide – College of Nursing
                    Email:
                    Principal Investigator

Cc: Prof. Gillian Harvey, Dr. Elizabeth Lynch
                    Co-investigators

Subject: Approval of Amendment of Research Project No. E-19-4063
Study Title: "Factors influencing Intensive Care Nurses' Adherence to 'Prevention of
                    Ventilator-Associated Pneumonia' Clinical Practice Guidelines in Saudi Arabia: A
                    mixed method study"
Type of Review: Expedite

Dear Mr. Nader Eqaab D Alotaibi,

Reference to your request for the approval of the amendment done on the above-mentioned research
project which was initially reviewed and approved on 03 July 2019 (30 Shawwal 1440), please be
informed that the IRB has no objection towards your request to the following modifications:

1. To add a qualitative part in the study by conducting a semi-structured interviews to collect
    data from a sample of nurses working in the intensive care units involved in the phase one
    study by using zoom interview, and a Zoom group discussion with the ICU nurses'
    leaders/managers
2. Audio-recordings of the interviews and group discussions which will be transcribed in full by
    the researcher.
3. Use of Flyers and Participant Information Sheets that will be posted on each ICU nursing
    station board participants and sending an invitation email to staff from the 8 ICUs to invite and
    recruit potential participants.

You may continue with the conduct of this study with the above-mentioned approved modifications.
Please be informed that in conducting this study, you as the principal investigator, are required to
abide by the rules and regulations of the Government of Saudi Arabia, the   IRB policies and
procedures and the ICH-GCP Guidelines. The IRB mandates regular submission of study progress report
every six months by the primary investigator. Otherwise, project approval will be suspended.

We wish you success in your research.

Thank you!

Sincerely yours,

2 NOV 2020

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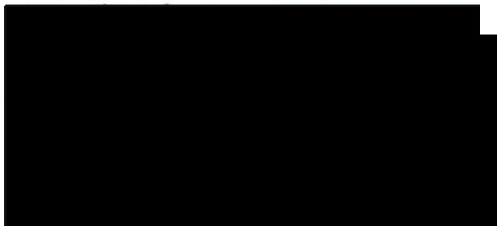
Appendix 20:   **Overall auditing results of the ICU nurses' adherence**

Adherence category	Adherence unit level	Adherence OH N = 320		Adherence HOB N = 320		HH compliance N = 1600	
		Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)
Hospital	Hospital 1	109 (68.1)	51 (31.9)	81 (50.6)	79 (49.4)	565 (70.6)	235 (29.4)
	Hospital 2	128 (80.0)	32 (20.0)	98 (61.3)	62 (38.8)	653 (81.6)	147 (18.4)
	Overall adherence	237 (74.1)	83 (25.9)	179 (55.9)	141 (44.1)	1218 (76.1)	382 (23.9)
Time	Weekday	117 (73.1)	43 (26.9)	91 (56.9)	69 (43.1)	647 (80.9)	153 (19.1)
	Weekend	120 (75.0)	40 (25.0)	88 (55.0)	72 (45.0)	571 (71.4)	229 (28.6)
Nursing shift	Day shift	116 (72.5)	44 (27.5)	100 (62.5)	60 (37.5)	630 (78.8)	170 (21.3)
	Night shift	121 (75.6)	39 (24.4)	79 (49.4)	81 (50.6)	588 (73.5)	212 (26.5)
Hospital 1	Unit A	27 (67.5)	13 (32.5)	13 (32.5)	27 (67.5)	133 (66.5)	67 (33.5)
	Unit B	28 (70.0)	12 (30.0)	24 (60.0)	16 (40.0)	149 (74.5)	51 (25.5)
	Unit C	30 (75.0)	10 (25.0)	28 (70.0)	12 (30.0)	139 (69.5)	61 (30.5)
	Unit D	24 (60.0)	16 (40.0)	16 (40.0)	24 (60.0)	144 (72.0)	56 (28.0)
Hospital 2	Unit E	29 (72.5)	11 (27.5)	23 (57.5)	17 (42.5)	155 (77.5)	45 (22.5)
	Unit F	30 (75.0)	10 (25.0)	27 (67.5)	13 (32.5)	159 (79.5)	41 (20.5)
	Unit G	34 (85.0)	6 (15.0)	25 (62.5)	15 (37.5)	175 (87.5)	25 (12.5)
	Unit H	35 (87.5)	5 (12.5)	23 (57.5)	17 (42.5)	164 (82.0)	36 (18.0)

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