Factors influencing healthcare workers' adherence to infection prevention and control in Saudi Arabia

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Abstract

Background: Infection Prevention and Control (IPC) practices have a unique role in reducing the risk of healthcare-associated infections in healthcare settings. However, adherence to IPC practices, including standard precautions, remains suboptimal among healthcare workers. In Saudi Arabia and across the Middle East, research into IPC is growing, especially following the increased global emphasis on infection control due to the COVID-19 pandemic. However, despite this growing interest, there is still a limited understanding of the factors contributing to IPC adherence among healthcare workers, particularly in intensive care units (ICUs) and medical wards. Therefore, the current study aims to address this gap by conducting a multi-method qualitative study to explore the factors affecting adherence to IPC practices among healthcare workers in ICUs and medical wards in Saudi Arabia.

Methods: The research comprised three phases and the empirical work was conducted in two selected hospitals within Saudi Arabia. A qualitative systematic review was first conducted to explore the factors influencing IPC adherence among healthcare workers in Middle Eastern countries (Phase 1). This was followed by two qualitative studies, designed to capture perspectives on IPC practices and potential factors influencing adherence to IPC practices from different perspectives. The first perspective was that of workers (n = 8) who worked in infection control teams in two hospitals in Saudi Arabia, sought through focus groups (Phase 2). This was followed by Phase 3 in which individual semi-structured interviews were conducted to seek perspectives on IPC practices, and their barriers and facilitators in practice, through the lens of healthcare workers (n = 20) delivering hands-on care and employed within ICU and medical wards of the two hospitals.

Findings:

Phase 1 of the current study identified organisational and individual factors influencing adherence to IPC practices. Individual factors, including moral principles, ethical beliefs, and cultural habits, played a significant role in promoting IPC adherence. Organisational factors, including leadership, training gaps, and environmental challenges were also perceived to affect adherence. Phase 2 further

explored the role of the infection control team in monitoring adherence and providing education and training on IPC practices. The findings from Phase 2 revealed the infection control teams' perceptions of the main challenges associated with IPC adherence. These challenges included perceived differences in adherence among professional groups and across various components of IPC practices; staff stability; and the nature of each department, including its procedures and the acuity of patients. Phase 3 further supported the findings from the second phase. It highlighted poor leadership and managerial support, and the need for more training, and for involving all healthcare workers as well as patients and their relatives in this training, as major challenges that affected adherence to IPC practices. Overall, the study showed a notable increase in awareness of IPC following the emergence of COVID-19. It also highlighted the role of cultural and social factors in IPC adherence, along with persistent hierarchical challenges within the healthcare system.

Conclusion and implications:

This study highlights the importance of organisational support for healthcare workers as well as improving the monitoring strategies in Saudi Arabia. The study recommends enhancing the involvement of family in IPC practices and fostering a supportive working environment through recognition and team-building initiatives. It also emphasises the development of culturally sensitive IPC policies, as well as the establishment of recognition programmes for IPC leaders. Addressing staffing issues and improving the physical work environment are also crucial for maintaining IPC practices. For future research, it is important to explore the impact of culturally sensitive IPC interventions, engaging family members in IPC education, and comparing IPC adherence across various healthcare settings and disciplines to gain a comprehensive understanding of IPC practices and to improve overall adherence.

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Author's Declaration

I hereby declare that explicit reference is made to the contribution of other, that this thesis is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institutions.

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Signature:

Definitions/Abbreviations

CASP Critical Appraisal skills programme

CDC Centers for Disease Control and Prevention

CDI Clostridioides difficile infection

COVID-19 Coronavirus Disease 2019

CAUTI Catheter-associated urinary tract infections

CLABSI Central line-associated bloodstream infections

CRBSI Catheter-related blood stream infections

GCC Gulf Cooperation Council

GDPR General Data Protection Regulation

GDIPC General Directorate of Infection Prevention and Control in Healthcare Facilities

HAP Hospital-acquired pneumonia

HAIs Healthcare-associated infections

HCWs Healthcare workers

MERS Middle East Respiratory syndrome

MDROs Multi-drug-resistant organisms

MoH Ministry of Health

PPE Personal Protective Equipment

SSIs	Surgical site infections
VAP	Ventilator-associated pneumonia
ICUs	Intensive Care Units
IPC	Infection Prevention and Control
WHO	World Health Organisation
UAE	United Arab Emirates
UK	United Kingdom

Chapter 1 Introduction and Background to the thesis

1.1 Introduction

The aim of this chapter is to provide a general introduction to the research. Given the context of the research undertaken within this thesis, the introduction begins with an overview of the healthcare system in Saudi Arabia before moving on to discuss healthcare-associated infections (HAIs). This is followed by a discussion of the significance of adherence with infection prevention and control (IPC) practices, , highlighting the differences in adherence between healthcare settings, such as intensive care units (ICUs) and medical wards in Saudi Arabia. It also presents a justification for the current research study, its aims, research questions and thesis structure.

1.2 The healthcare system in Saudi Arabia

1.2.1 Overview of Saudi Arabia

Saudi Arabia is the largest country in the Arabian Peninsula and covers approximately 2.15 million km^2 with a population of over 32 million people (General Authority for Statistics, 2024). The country is divided into 13 regions and 134 governates. Saudi Arabia is considered to be a high-income country because of its oil reserves, which contribute hugely to its economy (Sajjad and Qureshi, 2020). The country is also considered a religious and spiritual place due to the fact that the two holy Muslim places, Makkah and Madinah, are located there; these are visited by millions of Muslims annually (Henderson, 2011, Rahman and Al-Borie, 2021).

In the context of healthcare resources allocation, it is important to take into account the geographic factors, especially in Saudi Arabia where there are disparities in hospital bed distribution (Kattan and Alshareef, 2024). The unequal distribution of hospital beds highlights regional disparities, particularly in populated areas like

Makkah where the demand for health services often exceeds supply. According to the analysis by Kattan and Alshareef (2024), there are considerable geographical differences within the country, with a national average of 2.4 beds per 1,000 people. Kattan and Alshareef's, (2024) analysis indicated that some areas, including Al-Jouf and the Northern region, reported higher ratios of beds per 1,000 people. In contrast, the Eastern province where this study is conducted may face some challenges because of its growing population. This growth could exacerbate the current shortage of hospital beds, which highlights the need for strategic resources allocation to meet the healthcare needs of the population (El-Farouk, 2016, Kattan and Alshareef, 2024).

1.2.2 Vision 2030

In 2016, Saudi Arabia initiated a national transformation programme encapsulated in Vision 2030, a strategic framework of actions to reduce Saudi Arabia's reliance on oil and diversify its economy using a wide range of sources (Rahman and Al-Borie, 2021, Alasiri and Mohammed, 2022). This ambitious agenda includes a variety of disciplines and recognises that economic diversification necessitates a holistic approach. Healthcare, as a key domain in this transformative vision, is perfectly positioned to make a substantial contribution to the economic objectives outlined in Vision 2030. The programme's healthcare objectives extend beyond enhancing healthcare services; they also support the broader economic agenda. Vision 2030 aims to promote the general well-being of the population by improving access to healthcare services, enhancing the quality and efficiency of healthcare services, and promoting disease prevention through better access to care and preventive services (Alharbi, 2018, Rahman and Al-Borie, 2021). A healthier population can increase productivity, lower healthcare costs and create a more resilient and diverse economy. This integrated approach highlights the critical role that healthcare plays in achieving the economic objectives outlined in the national transformation programme. Furthermore, as healthcare- associated infections continue to pose a serious threat to patient safety and the health system, Vision 2030 focuses on improving infection prevention and control (IPC) practices (Rahman and Al-Borie, 2021, Alasiri and Mohammed, 2022).

1.2.3 Healthcare system in Saudi Arabia

The healthcare system in Saudi Arabia is organised into three main levels: primary, secondary and tertiary healthcare. These services are provided based on the severity of the illness and the patient referral system (Albejaidi, 2010). Primary care is the first point of contact for patients within the healthcare system and it offers essential healthcare services to the general population (Albejaidi, 2010, Al-Sheddi et al., 2023). Primary healthcare services include providing preventive care, managing chronic disease and co-ordinating care with other healthcare services. For instance, primary healthcare centres also refer cases that require more advanced care to public hospitals (secondary healthcare) and cases that require a more complex level of care to specialised hospitals (tertiary healthcare) (Al-Ahmadi and Roland, 2005). Secondary healthcare includes acute healthcare issues and more complex conditions than can be managed by primary healthcare services (Albejaidi, 2010). Tertiary hospitals encompass specialised national services and advanced medical technologies to ensure that patients receive the highest level of specialised care (Almalki, FitzGerald and Clark, 2011). Three main sectors provide healthcare services in Saudi Arabia; 1) the Ministry of Health (MoH) (which provides 60% of the services), 2) the private sector, and 3) other governmental sectors that include teaching hospitals affiliated with universities, national guard health affairs and the armed forces medical service. Each of these sectors has differences in terms of authority, funding, management, infrastructure, target population and workforce (Alkhamis and Miraj, 2020). The MoH has a key role in managing, planning, and establishing health policies and is also responsible for observing all healthcare providers to ensure that the Saudi Government's healthcare goals are met (Ministry of Health, 2024). The MoH is the main healthcare provider in Saudi Arabia with the greatest number of facilities and bed capacity. All citizens are eligible for free healthcare services provided by the MoH (Rahman, 2020). Figure 1.1 shows all three healthcare providers along with the number of hospitals and bed capacity for each (Ministry of Health, 2021).

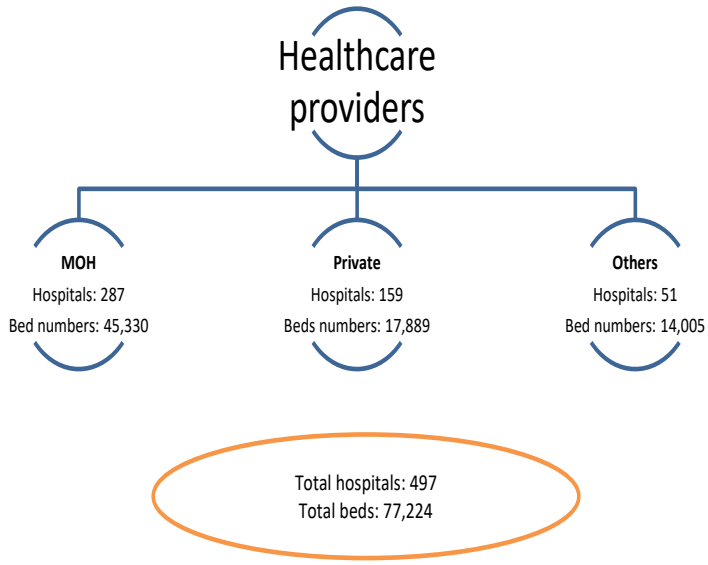

Figure 1. 1 Healthcare providers in Saudi Arabia

The emergence of infectious disease outbreaks, including Middle East respiratory syndrome (MERS) and COVID-19, has posed a significant challenge and highlighted the importance of following effective IPC practices within healthcare settings globally. In Saudi Arabia, lessons learned during the MERS outbreak have had a significant impact on enhancing and shaping IPC practices (Alyami, Alyami and Warraich, 2020, Jaziri and Miralam, 2021). For instance, the Saudi MoH established specialised centres and designated hospitals for isolating and treating MERS patients, which later proved valuable in managing COVID-19 (Algaissi et al., 2020). The Saudi MoH also developed the National Health Laboratory (NHL) to provide advanced diagnostics for infectious diseases. Moreover, there were significant advancement in medical and scientific research on MERS and this was extended to address COVID-19 (Algaissi et al., 2020).

During the MERS outbreak, Saudi Arabia implemented methods including requiring close contacts of suspected or confirmed cases to self-isolate and report to designated medical centres (Alyami, Alyami and Warraich, 2020). They also

prioritised protecting healthcare workers (HCWs) by using personal protective equipment (PPE) and provided community education to raise awareness of prevention measures (Alyami, Alyami and Warraich, 2020, Jaziri and Miralam, 2021). Similar methods were effectively applied during the COVID-19 pandemic (Alyami, Alyami and Warraich, 2020). Thus, the experience gained from MERS contributed to an efficient public health system and infection control policies that heightened awareness and preparedness and helped to contain the COVID-19 pandemic (Algaissi et al., 2020). Moreover, it is important to maintain IPC practices during the annual Hajj pilgrimage, a major global event that takes place in Saudi Arabia. During the Hajj, people from different countries and regions come into close contact with one another, which can lead to the spread of infectious diseases, particularly respiratory infections like MERS. The consequences of these events are well recognised by the international public health community. The Saudi Arabian government employs several IPC practices to reduce these risks. These include mandatory training programmes for HCWs who provide care during the Hajj, vaccination against influenza and meningococcal infections for HCWs and pilgrims, and the provision of IPC facilities to ensure that all the necessary IPC resources are available. Saudi Arabia also establishes and publishes IPC guidelines for the Hajj that are reinforced by awareness campaigns for HCWs, pilgrims and residents of holy cities (Yezli et al., 2019). The Saudi Arabian government has developed evidence-based knowledge and experience of infectious diseases during events like the Hajj, especially after dealing with MERS (Alkhamis and Miraj, 2020).

1.3 Healthcare-associated infections

Healthcare-associated infections (HAIs) are the most common adverse event that can affect both HCWs and patients. They are associated with considerable morbidity, mortality and an increased length of stay and costs (Loftus et al., 2019, Ungar et al., 2023). HAIs are defined as infections that occur forty-eight hours or more after admission, or within thirty days after receiving health care (Revelas, 2012, Haque et al., 2018, Alothman et al., 2020). In addition to patients, other people are vulnerable to HAIs, including HCWs, ancillary staff and visitors (Revelas, 2012, Haque et al., 2018, Alothman et al., 2020). However, the term HAIs (previously known as nosocomial infections) now encompasses infections acquired not only in hospitals

but also in any settings where patients receive healthcare, including family medicine clinics and long-term care (Haque et al., 2018). This term is used in this study. HAIs can be classified into a number of subtypes depending on the infected organ system and the pathogen involved as shown in Table 1.1. Most of these infections can be prevented by applying proven effective measures to reduce the risk of pathogens being transmitted during healthcare assistance. Over the past few years, several international healthcare organisations including the World Health Organization (WHO) have released evidence-based recommendations on preventive measures to reduce the risk of transmission. These include guidelines on the core components of IPC that are published by the WHO (see section 1.6) (World Health Organization, 2016).

Table 1.1: Classification of healthcare-associated infections based on pathogens (Monegro, Muppidi and Regunath, 2017, Haque et al., 2018).

Type of infection	Common pathogens
Central line-associated bloodstream infections (CLABSI)	Candida spp. (particularly in adult ICU), Enterobacteriaceae (in adult wards, paediatric ICUs, and oncology wards) and Staphylococcus aureus
Catheter-associated urinary tract infections (CAUTI)	Enterococcus, Staphylococcus aureus, Pseudomonas, Proteus, Klebsiella and Candida species. Clostridioides difficile is responsible for causing Clostridioides difficile infection (CDI).
Surgical site infections (SSIs)	Staphylococcus aureus, coagulase-negative staphylococci, Enterococcus, Escherichia coli, Pseudomonas aeruginosa, Enterobacter and Klebsiella pneumonia.

Hospital-acquired pneumonia (HAP) and ventilator-associated pneumonia (VAP)	Staphylococcus aureus and Pseudomonas aeruginosa, although Escherichia coli and Klebsiella pneumoniae are seen more commonly in paediatric populations

1.4 Epidemiology and the burden of healthcare-associated infections

Healthcare-associated infections are significant global concerns, within both developed and developing countries (World Health Organization, 2022). Recently, the WHO reported that among every 100 hospitalised patients in acute care hospitals, approximately seven patients in high-income nations and approximately fifteen patients in low- and middle-income countries will acquire at least one HAI during hospital admission (World Health Organization, 2022). On average, one in ten affected individuals will die as a result of their HAI (World Health Organization, 2022). Studies on the prevalence of HAIs and adherence with infection prevention practices in Saudi Arabia are limited (Alrebish et al., 2022). However, Alshamrani et al. (2019) conducted a large-scale study in Saudi Arabia at six tertiary care hospitals with a total bed capacity of over 2,345 beds. Of the 1,666 patient records examined, 114 HAI events were identified in 109 patients, which revealed that the prevalence of HAIs was 6.8%.

1.5 Geographic distribution of healthcare-associated infections

The problem of HAIs has been reported internationally. A large point-prevalence survey (PPS) on HAIs and antimicrobial use was conducted between 2016 and 2017 across 1,735 hospitals in 28 EU/EEA countries and Serbia, counting the UK's administrations separately (Suetens et al., 2018). A PPS is an epidemiological study that determines the percentage of a population with a specific condition at a given point in time (Saleem et al., 2019). It has been used for HAI surveillance for many years (Saleem et al., 2019). In the study by Suetens et al. (2018), data from 325,737

patients in 1,275 acute care hospital were included. The final EU/EEA sample included 310,755 patients from 1,209 hospitals. The prevalence of patients with at least one HAI in the EU/EEA was 5.9%, varying by country from 2.9% to 10.0%. Prevalence rates were higher in tertiary care hospitals (7.1%) compared to primary care hospitals that provide general healthcare services (4.4%) and were significantly elevated in ICUs, where 19.2% of patients had at least one HAI. The overall prevalence across non-ICU specialities averaged 5.2% (Suetens et al., 2018). A recent systematic review and meta-analysis of PPSs by Abubakar, Amir and Rodríguez-Baño (2022) aimed to estimate the prevalence of HAIs in Africa and to identify the associated pathogens and risk factors. The study revealed that the prevalence of HAIs in African hospitals was 12.76%. The prevalence was particularly elevated in ICUs and neonatal wards. The study highlights the need for improved IPC interventions across Africa, which reported higher rates of HAIs than the 5.9% HAI prevalence reported in Europe (Suetens et al., 2018, Abubakar, Amir and Rodríguez-Baño, 2022). In the Middle East, data on the prevalence of HAIs are limited. A recent cross-sectional descriptive study by Alothman et al. (2020) involved a multi-centre PPS within eleven acute care hospitals in seven countries in the Middle East including Saudi Arabia, Egypt, the United Arab Emirates, Lebanon, Oman, Kuwait and Bahrain. This was the first one-day PPS of infections in the region. On the day of the survey, a total of 1,586 patients were included and the results showed a prevalence of HAIs of 11.2% with an increased use of antibiotics, including cases with multi-drug resistance. This represents a serious public health issue in the Middle East, particularly in light of the rising threat of antibiotic resistance. In Saudi Arabia, hospitals continue to face issues with regard to HAIs (Alshehry, 2019). As highlighted previously, Alshamrani et al. (2019) conducted a large-scale study in six hospitals located in five cities and found that the prevalence of HAIs was 6.8% in Saudi Arabia. However, this study only included hospitals of the Ministry of National Guard Health Affairs, which are government-funded tertiary care hospitals that provide services to more than 1.5 million Saudis and only serve Saudi national guard soldiers, employees and their families.

A careful examination is necessary due to the complex relationship between non-adherence with IPC practices and HAIs (McCauley, Kirwan and Matthews, 2021).

Thus, understanding the factors that influence adherence with IPC practices is a vital part of tackling the rate of HAIs in Saudi Arabia and globally. This principle highlights the significance of this study, which examines the factors that affect HCWs' adherence with IPC practices.

In the healthcare context, the terms 'adherence' and 'compliance' are frequently used interchangeably to refer to describe how closely patients or HCWs follow treatment plans, recommended guidelines, evidence-based practice or medical advice. However, it is important to understand the differences between these terms, as they reflect different connotations about the relationship between patients and HCWs (Vrijens et al., 2012). 'Compliance' has traditionally been linked to a more authoritarian or passive approach, in which patients or HCWs follow orders as directed, frequently without significant involvement in the decision-making process (Ogden, 2019). Similarly, the Oxford Dictionary defines compliance as 'the practice of obeying rules or requests made by people in authority'. In the context of IPC, compliance refers to the extent to which HCWs follow the prescribed guidelines and protocols to control the spread of HAIs in healthcare settings. Conversely, 'adherence' emphasises individuals' active and informed engagement in their healthcare decisions, denoting a collaborative approach where patients comprehend and are willing to follow recommendations. According to the Oxford Dictionary, adherence can be defined as 'the fact of behaving according to a particular rule, or of following a particular set of beliefs or a fixed way of doing something'. The term 'adherence' in this study refers to HCWs' commitment to adhering to the suggested IPC practices, which include both following the guidelines and actively maintaining these practices. While both phrases refer to following medical advice, 'adherence' emphasises the value of collaborative decision-making whereas 'compliance' could suggest a more directive one-sided interaction (Vrijens et al., 2012). In the context of IPC, compliance focuses on following established protocols while adherence encompasses a more comprehensive commitment including HCWs' understanding of the importance of these practices and their voluntary commitment to maintaining them. For the sake of brevity in the study's research question, the term 'adherence' will be used. However, it is important to note that the broader scope of both terms was considered in the search strategy as detailed in Chapter 3.

1.6 IPC guidelines

The World Health Organisation highlights that nearly all HAIs could be prevented by implementing fundamental practices such as effective hand hygiene and other essential IPC practices, including wearing PPE (World Health Organization, 2021). In 2009, the WHO introduced foundational guidelines on core components for national IPC programmes (Storr et al., 2017). These guidelines were revised in 2016 based on a systematic review of evidence and expert consensus to better address global health threats including epidemics, pandemics and antimicrobial resistance (AMR) within healthcare settings. The new recommendations emphasised evidence-based practices for both national and acute healthcare facility levels. The 2009 guidelines focused on acute healthcare setting while the 2016 update expanded to include community, primary care and long-term care facilities (World Health Organization, 2016). This comprehensive approach demonstrates an in-depth understanding of the complex elements involved in the implementation of the policy. The guidelines highlight a thorough consideration of several elements including resource implications, the feasibility and accessibility of the recommendations, and staff training. This comprises an extensive approach that aligns with the latest evidence and is flexible to accommodate various healthcare settings. There are eight core components: 1) IPC programmes, 2) IPC polices and guidelines, 3) education and training, 4) HAI surveillance, 5) multimodal strategies, 6) monitoring, evaluation and feedback, 7) workload, staffing and bed occupancy at the facility level, and 8) the built environment, materials and equipment. The Guidelines Development Group emphasised the importance of implementing the basic IPC guidelines in both core components 1 and 2, which include standard precautions, transmission-based precautions and outbreak management (World Health Organization, 2016). In 2019, the WHO published the minimum requirements for IPC programmes and defined them as “IPC standards that should be in place at the national and facility level to provide minimum protection and safety to patients, HCWs and visitors, based on the WHO core components for IPC programmes” (World Health Organization, 2019, p.2). The recommendations within core component 1 highlight that every acute care facility should implement an IPC programme with committed, trained staff in order to prevent HAIs and combat AMR by using IPC best practices. Under core component

2, it was recommended that, in order to lower HAI and AMR, evidence-based guidelines should be created and implemented. In addition, to ensure successful implementation, relevant healthcare staff should be educated and trained on the guidelines' recommendations and their adherence to them should be monitored. Thus, each healthcare facility should adapt and implement standard and transmission-based precautions as a minimum (World Health Organization, 2019). These core components provide the foundation for IPC practices. In addition to these IPC practices, the WHO 2019 guidelines highlight leadership accountability, infrastructure support, surveillance system and fostering a culture of safety through continuous education and multimodal strategies to further reduce HAIs. While not all patients may require the same level of precautions, the implementation of these components is crucial to customise IPC practices based on each patient's unique needs and risks. Although this updated document highlights some recommendations to reduce the rate of HAIs and AMR, the basic IPC guidelines, including standard precautions and transmission-based precautions, remained the same. These guidelines cover a variety of IPC practices including hand hygiene, the use of PPE, safe injection practices, respiratory hygiene, environmental cleaning and safe waste management (World Health Organization, 2016).

The WHO (2016) guidelines on the core components of IPC programmes were adopted by the Gulf Cooperation Council (GCC) Centre for Infection Control in the GCC Infection Prevention and Control Manual (3rd edition), which is used across healthcare facilities in Saudi Arabia and in the current study (GCC Centre For Infection Control, 2018). The focus of the current study is on IPC practices, particularly standard precautions and transmission-based precautions, which were highlighted within both core components 1 and 2 in the WHO guidelines. The current study also considers factors that influence the effectiveness of IPC practices, including training, resources and organisational support. It also examines how these contextual factors impact the effectiveness of IPC practices.

Table 1.2 shows the differences between standard precautions and transmission-based precautions based on the WHO and the GCC (World Health Organization, 2016, GCC Centre For Infection Control, 2018).

Table 1. 2: Standard precautions and transmission-based precautions

Category	Standard precautions	Transmission-based precautions
Definition	The basic infection control practices that are applied universally to all patients to protect HCWs, patients and visitors from the transmission of infections.	The additional infection prevention strategies that are applied when patients are suspected or confirmed to be infected with highly transmissible pathogens and require precautions beyond standard precautions.
Types of precautions	One universal set of precautions for all patients.	Three types: **Airborne**: needed to prevent the transmission of pathogens that remain infectious over long distances when suspended in the air. **Droplet**: measures used to prevent the transmission of infectious agents that are spread by respiratory droplets. **Contact**: measures should be used to reduce the transmission of infections through direct or indirect contact with patients or the patients' environment.

Examples of precautions	• Hand hygiene • Use of PPE • Respiratory hygiene and cough etiquette • Environmental cleaning • Safe use and disposal of sharps • Waste management • Reprocessing of reusable instruments and equipment • Appropriate handing of linen	**Airborne precautions:** N95 masks, negative pressure room. **Droplet precautions:** surgical masks or N95 masks, depending on the pathogen, single room/ cohorting. **Contact precautions:** gloves, gowns, environmental cleaning.
Room requirements	No special room required for standard precautions	**Airborne:** negative pressure isolation rooms. **Droplet:** single room or cohorting. **Contact**: Single room or cohorting if possible.

Diseases Covered	Applies to all patients, regardless of disease or infection status	**Airborne:** measles, varicella, pulmonary tuberculosis, avian influenza, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). **Droplet:** COVID-19 and influenzas. **Contact:** Methicillin-Resistance Staphylococcus aureus (MRSA), Clostridioides difficile (C.diff) infection and Vancomycin-resistant Enterococcus (VRE).
Difference in transmissions	Focuses on reducing general risks of transmission through universal practices.	Tailored to specific mode of transmission: **Airborne:** long distance, stays in the air longer. **Droplet**: short distance, heavier droplets fall quickly. **Contact:** direct or indirect contact with contaminated surfaces.

1.7 The extent of the problem of IPC adherence

Despite the availability of IPC guidelines, the issue of non-adherence with IPC practices has been reported internationally among HCWs in different healthcare settings (Moralejo et al., 2018, AlJohani et al., 2021, Brooks et al., 2021). For instance, Brooks et al. (2021) conducted a review of 56 studies to identify factors influencing HCWs' adherence to IPC practices. The review included studies from different countries including Canada, Saudi Arabia, China, Singapore, South Korea, Vietnam, Turkey, the Netherlands, India, Greece, UK, Australia, USA and Iran, and it highlighted several factors that influenced HCWs' adherence. Some of these factors include a lack of guidance on the IPC guidelines, the availability of resources, the workplace culture and HCWs' perception of the risk of infection. In addition, AlJohani et al. (2021) conducted a review of 28 studies from different regions including USA, Europe and Saudi Arabia to explore the existing literature on HCWs' knowledge and attitudes towards infection control, as well as the potential contributing factors. The review found that a knowledge gap regarding IPC practices among HCWs increased the risk of infections. It also highlighted that adherence to IPC practices varied among professional groups and that positive attitudes towards infection control were associated with higher adherence to IPC practices. Therefore, the issue of adherence represents a global challenge faced by healthcare systems worldwide.

Poor adherence to IPC practices contributes to the spread of infections, including MRSA and persistent HAIs (World Health Organization, 2022). Outbreaks such as SARS, MERS and COVID-19 highlight how lapses in IPC adherence within healthcare environments can contribute to widespread transmission (World Health Organization, 2022, World Health Organization, 2023). However, although IPC breaches are an important factor, other elements including environmental conditions and viral characteristics also play a part in the transmissions of infectious diseases (Chan-Yeung and Xu, 2003). The lack of strict IPC practices has historically contributed to HAIs, resulting in significant morbidity and mortality (Elliott, Storr and Jeanes, 2023). The ongoing global impacts of COVID-19 further highlight the

crucial importance of proactive IPC practices in preventing and controlling infectious diseases.

A cross-sectional study by EE et al. (2018) aimed to assess the attitudes towards and knowledge and practices of Standard Precautions (SPs) of infection control guidelines in a tertiary hospital in the Eastern Province of Saudi Arabia. The study utilised a self-administered questionnaire based on the Centers for Disease Control and Prevention (CDC) guidelines to assess adherence to SPs among 202 HCWs, including physicians and nurses. The study found that the overall adherence to SP was suboptimal. In addition, the study found that physicians had greater knowledge of SP with a mean score of 6.2 ± 1.6, compared to nurses who had a mean score of 5.5 ± 1.4. Since the maximum score is 10, both groups had opportunities for improvement. Furthermore, the study identified a strong correlation between knowledge, attitudes and practices, which indicates that those with greater knowledge tended to have better attitudes towards SP. However, since the study was conducted in a private hospital, the findings of the study may not be generalisable to other hospitals, particularly as the majority of people in the region rely on public hospitals. Furthermore, the reliance on self-reporting questionnaire introduces the potential for self-reporting bias, which may affect the accuracy of the reported adherence level.

Furthermore, data from an observational cross-sectional study conducted by Jalal, Alrajeh and Al-Abdulwahed (2022) assessed the performance of 152 healthcare professionals in preventing VAP in selected hospitals in the eastern region of Saudi Arabia. The study employed a structured questionnaire with an observational tool and found that 40.8% had adequate knowledge of VAP prevention, 51.3% had relatively adequate knowledge and 7.9% lacked sufficient knowledge. It also highlighted that physicians scored highest on knowledge, followed by nurses, respiratory therapists and interns. Although approximately half of the participating healthcare professionals' performance was satisfactory, there was still room for improvement. The study highlighted the need for greater emphasis on training HCWs on clinical guidelines to improve healthcare quality and further lower the rate of VAP. The study would have benefitted from a longer follow-up period to effectively measure sustained adherence to VAP prevention.

Building on the difficulties related to VAP, it is important to explore broader issues of IPC adherence in healthcare settings. In Saudi Arabia, non-adherence to IPC practices, including hand hygiene, was reported by Alshammari et al. (2018), who conducted a quantitative study utilising direct observation and self-reported questionnaires with 87 participants in three hospitals in eastern Saudi Arabia. The study concluded that, although HCWs probably recognise the importance of hand hygiene, they often fail to perform it in their daily tasks. The study suggests that the discrepancy between self-reported beliefs and observed practices could be attributed to inadequate hand hygiene resources, and lack of awareness or training. However, these factors remain speculative since they were not directly investigated in the study. Non-adherence to hand hygiene was also observed in different healthcare settings in Saudi Arabia (Alsubaie et al., 2013, Cruz and Bashtawi, 2016, Humayun et al., 2021).

Some studies also explored issues with adherence to other IPC practices such as PPE. For example, a cross-sectional study was conducted by Abukhelaif (2019) to determine the knowledge, practice and factors that affected adherence to PPE practices among 185 nurses in 2017. Nurses from different hospital departments at Al-Baha King Fahad Hospital completed a self-administered questionnaire. The study identified a discrepancy between self-reported knowledge and the self-reported adherence to PPE use, particularly glove use. The results showed that while the majority of the participants reported excellent knowledge of PPE and good practice, self-reported adherence to glove use was lower than the reported knowledge. This highlights concerns about the reliability of self-reported data, as self-reporting can introduce social desirability bias or an overestimation, in this case of one's adherence to IPC practices. In addition, the study was conducted in a single hospital in Al-Baha Province, which limits its applicability to that region.

The literature also emphasises the importance of conducting observational studies, which can provide valuable insights into real-world practices. Quantitative studies can be used to quantify rates of adherence to IPC practices, but they often fail to explain the underlying causes of these behaviours. This highlights the need for conducting more qualitative studies to complement the current quantitative findings and address the factors influencing adherence in healthcare settings. This study was

conducted in ICUs and medical wards to explore IPC challenges in these environments. To explain this rationale, this section reviews the literature to highlight the relevance of including ICUs, and the following section will justify the inclusion of medical wards in this study. ICUs provide treatment for critically ill patients who are susceptible to infections because of different factors, including long hospital stays, and underlying diseases such as diabetes and cancer (Alp and Damani, 2015, Blot et al., 2022). In addition, the existence of several invasive devices that disrupt anatomical and immunological protective barriers and the administration of various medications were considered (Blot et al., 2022). ICUs account for a high proportion of HAIs, with a rate exceeding 30% of all ICU admissions (Alp and Damani, 2015). The most common HAIs in ICUs are pneumonia, including VAP, surgical site infections (SSIs); catheter-related blood stream infections (CRBSI); CAUTI; and infections caused by multi-drug-resistant organisms (MDROs) (Alshamrani et al., 2019, Blot et al., 2022). HAIs in ICUs result in longer hospital admissions, higher morbidity and mortality rates and increased healthcare costs (Blot et al., 2022). These consequences highlight the significance of implementing IPC practices to reduce the risk of HAIs and improve patient outcomes.

In addition to patient characteristics that contribute to acquiring HAIs, such as age, severity of illness and the extent of exposure to invasive medical devices and procedures, there are other factors in ICUs that make adherence to IPC practices challenging. These include organisational factors such as environmental cleaning and adherence to care bundles, as well as infection control practices (Blot et al., 2022). Adherence to care bundles can be challenging because they require simultaneous and consistent use of multiple interventions. This could be challenging in ICUs due to several factors including the patients' needs, time constraints and the individual attitudes towards the effectiveness of these protocols (Blot et al., 2022). In the comprehensive review by Blot et al. (2022), the recent data on the epidemiology and management of HAIs in adult ICUs across different settings highlighted how the complex nature of the ICUs and the heavy workload contribute to the risk of HAIs. These challenges place a constant demand on HCWs to strictly implement IPC practices to reduce the rate of HAIs in ICUs. Thus, there is a need to further understand the factors that influence adherence with IPC in ICUs. Alhumaid et al.

(2021) conducted a systematic review to explore the factors that influence adherence to IPC measures. The review included 30 studies with 16 studies from high-income countries, including the United States, England, Italy, France, Poland and China. Only one study from Saudi Arabia was included. The review also included studies from lower-middle income countries including Nigeria, Vietnam, India and Nepal, as well as low-income countries including Ethiopia, Guinea and The Democratic Republic of Congo. The review found that adherence levels in ICUs are suboptimal compared to other wards. Furthermore, adherence varies between hospital areas, being lower in rural hospitals compared to urban hospitals, and among professional groups. The review also highlighted the importance of addressing the knowledge gap, workload, staffing and supplies issues. The review underlined how important it is to understand the organisational culture and how it affects adherence to IPC practices. It also suggested that enhancing adherence required a positive safety culture where HCWs feel encouraged and supported to follow IPC practices.

Mahfouz, El Gamal and Al-Azraqi (2013) conducted an observational study to assess hand hygiene adherence among HCWs. It included 536 observations in different ICUs in a southwestern hospital in Saudi Arabia. The authors found that adherence to hand hygiene was low in ICUs, particularly among physicians compared to other HCWs. The study suggests that factors including high turnover rates, unique ICU settings, cultural influences and religious beliefs may play roles in healthcare adherence. However, the high figures identified in the study and the nature of the quantitative design used in the study highlight the necessity for additional qualitative studies to explore the factors influencing hand hygiene adherence.

1.8 The challenge of HAIs and adherence in medical wards

Patients in medical wards are more diverse and more likely to have a range of medical disorders with different stages of illness and treatment requirements (Ojanperä et al., 2022). Moreover, medical wards frequently have elderly patients who are more susceptible to infections. While the risk of HAIs may not be as high as

in ICUs, adherence to IPC practices in medical wards remains important as patients in these areas remain at risk of HAIs (Luo et al., 2010, Ojanperä et al., 2022).

Accardi et al. (2017) conducted a descriptive study using surveys and observation grids to collect data from 245 nurses working in medical and surgical settings to assess their adherence to IPC practices in Milan. The study found that nurses had lower levels of adherence in medical wards compared to surgical wards, which increases the probability of acquiring HAIs. The study suggests that adherence is influenced by nurses' working experience. Furthermore, it was found that nurses in the medical wards had lower adherence rates to specific IPC practices including cleaning, disinfection and sterilisation. This highlights the need for a qualitative study to help in understanding the underlying reasons for the observed differences in adherence rates between medical and surgical wards. However, it is important to acknowledge that this study has some limitations, highlighted by the utilisation of convenience sampling and the fact that the response rate that was lower than anticipated. These limitations affect the generalisability of the results beyond the population of the study. Convenience sampling has the potential to introduce selection bias, which would reduce the finding's external validity. The limitation of the study highlights the necessity for additional research that utilises robust methodologies, diverse samples and higher response rates to improve the generalisability of the results in a range of medical settings. Furthermore, qualitative studies can be valuable to explore the perceptions and experiences of HCWs, which aligns with the current study's aim to investigate the reasons behind adherence variations which emphasise the need for qualitative methods.

Gupta et al. (2018) conducted an interventional study to identify the patterns of HAI cases and the impact of implementing an intervention on the rate of HAIs in a tertiary care hospital in Saudi Arabia. The intervention included day-to-day monitoring of hand hygiene adherence, basic infection control skill training for all HCWs regarding PPE and other IPC practices, and strict monitoring of the implementation of preventive care bundles. The study reported that the majority (47%) of HAIs were reported from critical care areas, which was the primary focus of the study. The study also found a significant decrease of 50% in the rates of HAIs in male medical wards due to an intervention that focused on a strict

implementation of IPC practices. However, the study found a proportional increase in some HAIs including VAP, HAP, SSIs and blood stream infections. The study indicated that 540 patients were admitted to critical care areas in 2016 with a HAI rate of 5.9% and 680 patients in 2017 with a 3.4% HAI rate. A notable limitation of the study is the lack of specific details, including the rate of HAIs in other hospital departments other than critical care, which limits the study's representativeness and generalisability. Despite these limitations, the reduction in the incidence of HAIs highlights the importance of adherence to IPC practices in minimising the risk of transmission infections. The increase in some HAIs highlights the need for more interventions to prevent HAIs.

Moreover, the evidence from the study by Gupta et al. (2018), alongside that from other studies, highlights the need for further research to assess adherence to IPC practices in medical wards and to explore the factors that affect adherence to IPC practices in these areas (Kim and Hwang, 2020, Ojanperä et al., 2022). Kim and Hwang (2020) conducted a cross-sectional study using a self-administered questionnaire with 197 nurses working in ICUs, medical and surgical wards in two hospitals in Korea. The study aimed to assess knowledge, attitudes and adherence, and to identify the factors influencing IPC adherence. Kim and Hwang (2020) recommended conducting further studies in medical wards for several reasons. Medical wards exhibit lower adherence rates than surgical departments, which often have higher rates due to a greater perception of risk associated with invasive procedures. In addition, medical wards may face unique challenges and factors that influence adherence to IPC practices, including the nature of patient care, the types of infections encountered as well as the specific needs of patients. The authors suggested that more research in medical wards could also improve the overall quality of patient care and safety. In addition, conducting more studies in medical wards could help to identify effective interventions to enhance adherence. Furthermore, patients in medical wards frequently move between units, which could facilitate the spread of infections (Donker et al., 2012). Thus, it is important to apply strict IPC practices in these areas. To effectively address the challenges faced in medical wards, qualitative studies are important to explore HCWs' perceptions of IPC adherence, which could inform future interventions and improve adherence.

Considering the scarcity of studies carried out in Saudi Arabia that explore the factors influencing HCWs' adherence to IPC practices, it is clear that there is a gap in the understanding of the dynamics of IPC adherence in this context. More research, incorporating qualitative methods and observation of HCWs' practices, would be particularly valuable and a welcome addition to the current evidence base. To address this knowledge gap and develop the existing evidence base, the current qualitative-methods study has been undertaken to explore the factors that influence the implementation of IPC practices among HCWs. However, the current study was conducted during the pandemic restrictions, which presented challenges related to direct access to healthcare settings. A more detailed discussion of COVID-19's impacts on this current study is provided in Chapter 2, section 2.10

1.9 Research aim and questions:

The overall aim of the current study was to identify and understand the factors that influence HCWs' adherence to recommended IPC practices for HAIs in Saudi Arabia.

The study aims to answer the following research questions:

- What are the factors that influence healthcare workers' adherence to infection prevention and control practices for healthcare-associated infections in the Middle East? (Phase 1)

- What are infection control teams' perspectives and experiences of managing, co-ordinating and implementing infection prevention and control practices and guidance across two hospitals in Saudi Arabia? (Phase 2)

- What are the barriers to and facilitators of nurses' implementation of local/national infection prevention and control practices in medical and ICU settings in two selected hospitals in Saudi Arabia? (Phase 3)

1.10 Structure of the thesis

The thesis consists of six chapters.

Chapter One: this first chapter presents the context and rationale for this study. It discusses the background of HAIs, highlighting the common challenges associated with adherence to IPC and the importance of addressing the issues of non-adherence among HCWs in Saudi Arabia. It reviews the statistics on HAIs globally and in Saudi Arabia, and it also describes the overall aim and research questions of the study.

Chapter Two: this chapter explains the overall methodological approaches used in this study. It describes the research paradigms that underpin the research and explains the rationale for selecting the qualitative multi-methods approach.

Chapter Three: (phase 1) this chapter discusses the systematic review conducted to synthesise the evidence related to the implementation of IPC practices among HCWs in the Middle East.

Chapter Four: (phase 2) this chapter presents the results of the focus groups with infection prevention practitioners.

Chapter Five: (phase 3) this chapter presents the findings of a qualitative study where semi-structured interviews were conducted with HCWs.

Chapter Six: this chapter brings together the results from the systematic review, focus groups and interviews. This is essential to identify recurring themes and key insights, and to highlight the significance of the study's findings. It also discusses the main findings in the light of existing literature in the field. In addition, it presents the conclusion of the study, highlights its main limitations and includes recommendations and suggestions for future research. Moreover, it incorporates a reflective analysis which explores the researcher's journey during the study.

Chapter 2 Methodology

2.1 Introduction

This chapter explains the philosophical paradigms underpinning this study. It also provides a justification for the selected methodological approach. It explains the multi-method qualitative approaches adopted in this study and highlights how these approaches align with study's objectives. Furthermore, this chapter addresses the techniques taken to ensure the trustworthiness of the research and discusses the relevant ethical considerations.

Study aim:

The study described in this thesis aims to identify and understand the factors that influence HCWs' adherence to recommended Infection Prevention and Control (IPC) practices for healthcare-associated infections (HAIs) in Saudi Arabia.

Study objectives:

To identify the factors influencing HCWs' adherence to IPC practices for HAIs in the Middle East (Phase 1).

To explore the infection control teams' perspectives and experiences of managing, co-ordinating and implementing infection prevention and control practices and guidance across two hospitals in Saudi Arabia (Phase 2).

To examine the barriers to and facilitators of nurses' implementation of local/ national infection prevention and control practices in medical and ICU settings in two selected hospitals in Saudi Arabia (Phase 3)

2.2 Research paradigms and philosophical foundations

Prior to conducting a study, it is essential to comprehend the philosophical approaches to research in order to understand their influence on the research process and to ensure that decision-making is aligned with the appropriate

philosophy (Creswell and Creswell, 2022). The selection of a research paradigm and philosophy is important as it shapes the researcher's perspectives and assumptions, and it also defines the entire structure of the study (Maxwell and Mittapalli, 2010). In the field of healthcare research, it is imperative for a researcher to develop a clear understanding of paradigms, which include the interactions between theoretical, philosophical, instrumental and methodological underpinnings, because these paradigms guide the selection of appropriate research methods, influence how data are interpreted, and ensure that findings are applicable and relevant to healthcare practices (Creswell and Creswell, 2022). As per Weaver and Olson (2006), a research paradigm is described as a broad framework that incorporates perceptions, beliefs and awareness regarding different theories and methodologies that influence how research is conducted and applied in clinical settings. Similarly, Gliner, Morgan and Leech (2011) described a research paradigm as the perspective or attitude that directs the research, the process of conducting it, and the way it is implemented. This aligns with the earlier definition by reinforcing the idea that a paradigm serves as a guiding framework, but it also highlights that a paradigm involves a particular orientation or mindset that affects every stage of the research process (Weaver and Olson, 2006, Al-Ababneh, 2020).

2.2.1 Ontological and Epistemological underpinnings

Ontology examines the essence and existence of phenomena, focusing on the nature of reality. Researchers must formulate a position on their understanding of the true nature and function of phenomena (Alharahsheh and Pius, 2020). In the context of healthcare research, it is recognised that researchers hold assumptions about the reality of health behaviours and practices, viewing them either as objective entitles or subjective experiences (Weaver and Olson, 2006). Epistemology focuses on the nature and scope of knowledge, exploring questions around how knowledge is acquired and understood. It entails the methods and justifications that researchers use to interpret phenomena (Alharahsheh and Pius, 2020). In the context of healthcare research, epistemology influences the choice of methodologies for data collection and analysis, guiding researchers to decide between quantitative methods for objective data or qualitative methods for an in-depth understanding of experiences (Mesel, 2013). This aspect of research philosophy underpins the

researchers' approach to gathering evidence, guiding the inquiry's direction based on a spectrum from empirical observation to subjective interpretation. The spectrum of epistemological approaches can be considered as encompassing a range of perspectives rather than polarised extremes. For instance, objectivism assumes that meanings exist independently of human consciousness (Moon and Blackman, 2014). It aligns with quantitative methods, which focus on objective data and statistical analysis to assess trends and correlations. This approach can be useful for evaluating adherence rates to IPC practices, as seen in much of the existing evidence discussed in Chapter 1. On the other hand, constructionism and subjectivism offer alternative views. Constructionism argues that meaning arises through human interactions with the world, which supports qualitative methods including interviews and observations to explore how individuals interpret their experiences (Moon and Blackman, 2014). Subjectivism emphasises that meaning is imposed by the subject (Moon and Blackman, 2014). Subjectivism aligns with the use of qualitative approaches to uncover deep insights into personal and contextual factors influencing behaviours (Alharahsheh and Pius, 2020). The current study is underpinned by subjectivism, which is an appropriate choice based on the nature of the study. Subjectivism acknowledges that meaning is created by personal experiences rather than existing independently of them. This allows the study to capture context-specific perspectives of the participants that represent their subjective realities in their cultural and healthcare environments.

2.2.2 Methodological considerations

In any research study, the methodology includes the overarching strategy and rationale behind the research. It determines how research is chosen to fit the research plan (Al-Ababneh, 2020, Alharahsheh and Pius, 2020). For instance, methodologies might include qualitative approaches including in-depth interviews and focus groups, or quantitative approaches such as surveys (Mesel, 2013). Thus, the methodology acts as a design plan that guides the research process, as opposed to the instrument or methods used for data collection and analysis. It emphasises how the research should be structured and organised to achieve the research aims rather than specifying particular methods for collecting and analysing data (Igwenagu, 2016). Methods, on the other hand, are defined as the specific

procedures and techniques used for gathering and analysing data (Al-Ababneh, 2020).

2.2.3 Research paradigms

According to Maxwell and Mittapalli (2010), scientific research philosophy helps researchers to understand their study topics by providing perspectives on how knowledge can be acquired. Research philosophies can be classified into four types: positivist, pragmatist, critical realist and interpretivist philosophy. Positivist philosophy values objectivity, which emphasises control and the reduction of bias in the research process. This philosophy aligns with quantitative research where data are generated using structured methods that ensure validity and reliability (Maxwell and Mittapalli, 2010). This approach is valuable for measuring IPC adherence rates and statistical corelations, but it might not fully accommodate the exploration of personal beliefs and cultural norms that significantly influence IPC practices, as was required for the current study.

Pragmatism, on the other hand, argues that the selection of a research philosophy is contingent on the nature of the problem, and it allows for a flexible synthesis of objective and subjective criteria (Creswell, 2017). It is frequently appropriate for mixed-methods studies, which combine quantitative and qualitative methods to provide a comprehensive view of the research problem (Creswell, 2017). This philosophical stance is rooted in the belief that research should be guided by practical questions rather than rigid methodological limits, offering a more holistic approach to understanding complex healthcare phenomena (Creswell and Creswell, 2022). While pragmatism is valuable for studies that aim to integrate both numerical data and qualitative insights, its emphasis on methodological flexibility does not align with the specific goal of the current study. The primary aim of this study is to investigate in depth HCWs' subjective experiences, attitudes and beliefs about IPC adherence. Therefore, employing a pragmatic approach that seeks to balance both objective and subjective analyses equally, may reduce the depth of understanding obtained of the personal and cultural factors influencing IPC practices.

Critical realism, on the other hand, has been described as “the view that entities exist independently of being perceived or independently of our theories about them” (Phillips, 1987, P.205). Critical realism has become a feasible choice for conducting significant research, especially within social and practice-based science, including nursing (Schiller, 2016). This paradigm is often used in studies that aim to uncover the underlying structures and mechanisms driving social phenomena (Williams, Rycroft-Malone and Burton, 2017). In the context of IPC practices, critical realism could help to uncover organisational and systemic factors, including institutional policies and cultural norms, that influence adherence behaviours. However, in the current study, interpretivism may offer a more suitable approach since it allows for a deeper exploration of how individuals perceive and interpret their adherence behaviours within their specific contexts.

Interpretivist philosophy emphasises understanding social phenomena from the subjective perspectives of both researchers and participants, valuing in-depth understanding of these phenomena from the perspective of those involved (Weaver and Olson, 2006). This perspective is frequently reflected in qualitative methodologies that aim to uncover the richness of human experiences through detailed narratives (Creswell, 2017). In the current study, interpretivism is the most relevant methodological perspective as it can address the study aim of exploring HCWs’ subjective experiences, attitudes and beliefs about IPC practices. By focusing on how individuals perceive and interpret their social environments, interpretivism can allow for a comprehensive examination of the factors influencing IPC adherence that might not be captured through a quantitative method alone. Furthermore, adopting the lens of interpretivism facilitates the exploration of the personal and cultural dimensions that shape behaviour, which provide insights into the barriers and facilitators that are specific to the experiences of HCWs.

2.3 Qualitative methods in healthcare research

Building on the interpretivist philosophy discussed earlier, qualitative research is an essential approach in the fields of nursing and midwifery, particularly when the goal is to understand human experiences and interactions, which are difficult to quantify using an alternative approach (Neergaard et al., 2009). The aim of qualitative

research is to understand how individuals perceive and experience the world and its phenomena, drawing to attention questions about the "what", "how" and "why" regarding human behaviours, perceptions and motivations (Neergaard et al., 2009). Thus, qualitative methods can be used, as in the current study, to help develop an understanding of what enables or hinders individuals from carrying out particular behaviours. Critiques of qualitative research are categorised into four main areas (Bryman, 2016). The first critique concerns objectivity. It is argued that qualitative research lacks objectivity because of the involvement of the researchers' perspectives and interpretations throughout the process. Hennink, Hutter and Bailey (2020), in contrast, argue that objectivity can be maintained in qualitative research through the careful selection of the research question, applying rigorous methodologies, maintaining transparency throughout the research process and reflecting on the role of the researcher. In the current study, objectivity was maintained by using semi-structured interview guides and ensuring transparency during the data analysis process. When interpreting the data, the researcher documented the decision-making processes, including coding and themes identification, to demonstrate a transparent approach. The second critique involves replicability. It is suggested that qualitative research is influenced by researchers' subjectivity, which means that if other researchers replicate the study in a different context or time, they might not produce the same findings (Denzin and Lincoln, 2011, Bryman, 2016). To address this, qualitative researchers are encouraged to precisely document the study's procedures (Hennink et al., 2020). In the current study, detailed documentation of the methodology and data analysis was maintained, as discussed above. The third critique involves generalisability, questioning whether the findings of a qualitative study are applicable to wider populations and settings. This issue arises from the fundamental principles of qualitative research, which prioritise depth over breadth. Qualitative methods respect the uniqueness of individuals' experiences and focus on understanding how people feel and respond in specific contexts rather than seeking to determine if certain feelings are generally applicable (Patton, 2014). To counter this, researchers have suggested redefining the idea of generalisability to be more applicable to qualitative research (Hennink et al., 2020). Lincoln, Lynham and Guba (2011) introduced the concept of transferability instead of generalisability. Transferability

means that findings can be relevant in other contexts if researchers provide sufficient and transparent details about their study (Creswell and Poth, 2016). Beck (1993) also highlighted the idea of fittingness, which suggests that researchers should assess their findings to determine whether they would apply to other contexts or times. The fourth critique pertains to transparency (Bryman, 2016). Some qualitative research studies are criticised for lacking clarity regarding how the samples were selected and how the conclusions were reached. In the current study, the sample selection process as well as the steps taken during data collection and analysis were documented. These include participants' demographic characteristics, the selection criteria and the methods employed in interviews and focus groups. Creswell and Poth (2016) also point out that qualitative research can be time-consuming and that the close relationship between the researcher and participants may lead to ethical dilemmas. To address these points in the current study, clear boundaries were established to maintain professional relationships and mitigate any ethical concerns arising from the close researcher–participant relationship.

In response to concerns regarding rigour in qualitative research, several methodological strategies have been proposed and employed across different studies. For instance, frameworks like grounded theory (Strauss, 1997) can allow for a systematic development of theory grounded in data, while case study methodologies (Eisenhardt, 1989), provide in-depth understanding through contextual analysis. On the other hand, thematic analysis provides a flexible approach to identifying and interpreting patterns within data (Braun and Clarke, 2006). In the current study, thematic analysis was chosen due to its suitability for exploring the factors influencing HCWs' practices, and barriers to IPC practices. The application of specific strategies to maintain rigour in the current study is later addressed in section 2.7.

2.4 Interpretive description in qualitative research

Interpretive Description (ID) was developed by Thorne (2016) and it provides a methodological framework that is appropriate for practical research in disciplines including healthcare, social work, education and interdisciplinary studies. In order to enhance the field of nursing science, researchers are required to extend their

work from the theoretical to practical application. Practical application emerges from patterns that reflect individual cases and shared experiences (Thompson Burdine, Thorne and Sandhu, 2021). ID is useful in qualitative research in the health professions when the aim is to capture subjective experiences and apply them to inform practice (Thorne, Kirkham and O'Flynn-Magee, 2004). ID allows for comprehension, evidence-based knowledge grounded in the group's experiences, which provide a credible and transparent process for improving clinical practice (Thompson Burdine, Thorne and Sandhu, 2021).

ID is a flexible methodology that can be used by itself or alongside other approaches (Thorne, 2016). It provides researchers with a framework with which to organise their research based on their specific research context rather than by following a strict set of steps (Thorne, 2016). This means that researchers can modify their existing methods to best fit their study needs. For instance, in this study's thematic analysis, steps by Braun and Clarke (2006) were followed to organise and analyse the data to meet the study objectives rather than following a rigid methodology. This flexibility allowed the integration of both inductive and deductive approaches to capture not only what it is happening (descriptive) but also why it is happening (interpretive) (Thorne, Kirkham and O'Flynn-Magee, 2004, Ocean et al., 2022). ID allows researchers to capture the diverse experiences of HCWs, acknowledging the influence of different factors including leadership and organisational culture on their behaviour. This approach encourages the researcher to remain close to the data while interpreting it in a meaningful way for real-world application, which makes it easier to present recommendations for improving IPC practices (Ocean et al., 2022). Thorne (2016) also stated that all decisions made in the process should be documented, clearly explained and critically evaluated. In the current study, the process of analysis is detailed in each chapter for clarity.

ID also presents some challenges that require careful consideration. Some argue that its flexibility could lead to a lack of rigour if not properly controlled (Thorne, Kirkham and O'Flynn-Magee, 2004). This was addressed in the current study by using Braun and Clarke's (2006) thematic analysis, which provided a structured process for analysing qualitative data. This helped to maintain consistency when identifying and analysing themes and still allowed flexibility to explore context-specific issues

related to IPC practices. Another common critique of ID is its tendency to prioritise practical knowledge over theory development (Thorne, 2016, Ocean et al., 2022). Some researchers argue that ID lacks the theoretical depth required for generating new theories or contributing to theoretical debates which makes it less appealing in research fields where theory is more important (Sandelowski, 2000). In the current study, although the main aim was to generate practical knowledge of IPC practices, this critique was addressed by positioning the findings within broader theoretical discussions around healthcare behaviour and infection control. This could allow the research to influence healthcare theoretical discussions in addition to practice.

The following examples illustrate the application of ID in exploring how people perceive and respond to a major health risk (Clostridioides, previously Clostridium difficile). Discussing these examples highlights how ID can provide deeper insights into the complexities of HCWs' perceptions and adherence to IPC practices, which is relevant to understanding similar challenges in the context of this study. Burnett and Corlett (2017) conducted a study to understand the perceptions and responses of the public and HCWs towards Clostridium difficile (C. difficile). The study involved 15 focus groups in two different geographical areas in the UK, one with a highly publicised C. difficile outbreak and the other one without, to gather information on experiences, attitudes and information needs regarding infections. Eight focus groups were conducted with the public (39 participants) and seven with HCWs (29 participants). In Burnett and Corlett (2017), the use of ID provided a more comprehensive and context-specific understanding of how HCWs perceive and adhere to IPC practices. This approach, in contrast to simply descriptive approaches, can facilitate the exploration of how contextual differences affect emotional and cognitive reactions to infection risks, including previous outbreaks and local media coverage. ID also emphasised the importance of engaging with participants' narratives and allowed the researchers to focus on the voices and lived experiences of HCWs to understand their concerns in the context. This approach helped with addressing real-world challenges in healthcare settings. For instance, the findings from Burnett and Corlett's (2017) study provide practical insights for improving health communications and IPC training to address the misunderstandings and concerns that HCWs have about managing C. difficile outbreaks.

Another example of the effective use of the ID qualitative approach when exploring a phenomenon in a healthcare setting illustrates that the use of ID can help to uncover significant factors that affect healthcare practices, which in turn can inform practical recommendations for improving IPC practices. A study conducted by Harris, Maxwell and Dodds (2023) aimed to understand the bioethical impact of contact precautions on patients and HCWs dealing with multi-drug resistant organisms (MROs) and to offer recommendations for managing patients colonised with MROs. The study was conducted in an Australian public health service and involved interviews with 33 participants, 9 patients and 24 health professionals. The study provided a deep understanding of the emotional and behavioural impacts associated with the use of contact precautions. The use of ID allowed the researchers to explore the underlying emotions, beliefs and social dynamics that influenced participants' experiences. This approach indicated how factors such as stigma, moral distress and organisational culture can influence the implementation of contact precautions. Furthermore, the ID approach encourages active participant engagement, which allows individuals to reflect on their own experiences in relation to others. This process of collaboration allows individuals to articulate both similarities and differences in their experiences, which can promote a more comprehensive understanding of the issue at hand. In relation to the current study, the use of ID facilities a deeper understanding of the factors influencing adherence of HCWs to IPC practices. When using this methodology, infection control practitioners and frontline healthcare workers can actively reflect on and validate their experiences. Comparing their experiences and highlighting both similarities and differences can foster a richer collaboration of knowledge, which can help to generate practical recommendations on how to improve adherence to IPC practices.

Inspired by previous research, the current study aimed to explore similar issues in different healthcare settings, including ICUs and medical wards, in Saudi Arabia. The use of qualitative methods will facilitate a deeper understanding of the barriers to adherence to IPC practices, as highlighted previously by Forman et al. (2008), who emphasised the importance of using qualitative approaches in the field of infection control.

2.5 Rationale for the systematic review approach in phase 1

Conducting a systematic review is considered the gold standard method for identifying, evaluating, and synthesising the available evidence to direct clinical practice and inform future research inquiries (Boland, Dickson and Cherry, 2017). The choice of a qualitative framework is justified by a gap in the literature regarding the qualitative synthesis of factors influencing IPC practices in the Middle Eastern context, as discussed in Chapter 3. The decision to adopt a qualitative lens for this systematic review was based on the need to explore the complex nature of HAI prevention practices and it was chosen because of its depth over the breadth approach of quantitative research. Previous quantitative studies have mapped out adherence levels to IPC practices but have lacked in-depth analysis that explores the underlying factors influencing these practices within the region. Qualitative synthesis can provide a rich exploration of contextual influences from cultural to organisational factors, essential for tailoring effective IPC interventions (Thomas and Harden, 2008, Booth, 2016). This systematic review laid the foundation for the subsequent phases of the research by identifying key gaps and challenges in the existing literature. The findings from this phase informed the development of the focus groups and interviews conducted in phases 2 and 3. These phases helped to guide further exploration of the factors that influence IPC adherence in the local context. In addition, a qualitative systematic review can enhance methodological rigour by carefully synthesising evidence from multiple studies, which helps to strengthen the validity and reliability of the research findings. This approach involves a transparent process, data extraction, and thematic analysis, which ensures that the synthesis accurately reflects the existing body of literature (Booth, 2016). The specific methods employed for the qualitative systematic review and its findings are reported in Chapter 3.

2.6 Rationale for the qualitative methodology in phase 2 and 3

As discussed earlier, the decision to employ a qualitative methodology originates from the desire to explore and understand IPC practices within the context of Saudi

healthcare settings. Merriam and Tisdell (2015) highlight that qualitative research attempts to elucidate the significance of findings—in this instance, HCWs' experiences when following IPC practices. According to Creswell and Poth (2016), the qualitative approach is effective at examining comprehension and insights within a particular context. Forman et al. (2008) highlight the exploratory nature of qualitative research and its evolution within real contexts, which highlight the importance of examining phenomena in their natural settings. In this study, the real-world setting of two governmental hospitals in the Eastern province in Saudi Arabia provides the study's background for comprehending HCWs' lived experiences of infection prevention. This approach offers information about the everyday obstacles and enablers encountered through an exploration that extends beyond the theoretical framework.

In the current study, the decision to perform focus groups with infection control teams and semi-structured interviews with frontline staff was carefully considered to align with the study's objectives. Infection control teams are responsible for monitoring adherence and implementing IPC practices. Focus groups were chosen as a method for these participants to allow an exploration of shared experiences and team roles and thus provide a broader view of the organisational culture and its influence on IPC practice. Focus groups are a well-documented method for exploring shared professional practices and decision-making processes (Gill et al., 2008). In the context of IPC, this method allows for a collective exploration of how teams collaborate, interpret guidelines and respond to challenges (Burnett and Corlett, 2017). Involving infection control teams in the focus groups provided a strategic perspective on IPC practices as they had greater awareness of policies and the broader goals of infection control. This strategic viewpoint complemented the perceptions of frontline staff, who may face daily barriers that are less visible to people in leadership roles.

Semi-structured interviews have been used effectively to explore individual experiences and personal barriers to IPC adherence (Henderson et al., 2020, Park et al., 2023). Frontline staff in ICUs and on medical wards face daily challenges but they may not feel comfortable about disclosing their true thoughts or admitting non-adherence in a group setting. Therefore, in the current study, semi-structured

interviews provided these participants with the confidentiality and openness needed to discuss their individual experiences, including barriers to IPC adherence, without fear of judgement. Involving frontline HCWs in interviews offered a more personal perspective of the daily challenges they faced. Furthermore, involving HCWs from different positions and educational backgrounds enriches the data by capturing diverse experiences and attitudes towards IPC. The combination of these methods allowed the researcher to capture both individual and group experiences related to IPC adherence, enhancing the credibility of the findings, which will be further discussed in the rigour and trustworthiness section. The methodological approach's implications are further explored in Chapters 4 and 5, where detailed methods, the data collection processes and analytical strategies are outlined.

The decision to focus on staff working in the specific settings of ICUs and medical wards is grounded in the existing literature, which highlights that ICUs face distinct challenges in maintaining IPC adherence because of the criticality of patient care and high infection risks (Alhumaid et al., 2021, Blot et al., 2022). While medical wards may not deal with patients of the same criticality, they may have diverse patient populations, which can affect the perceived importance of IPC practices (Gupta et al., 2018, Ojanperä et al., 2022). In addition, studies focusing on IPC on hospital wards other than ICUs are limited, as discussed in Chapter 1, and this study aims to address this gap.

2.6.1 Rationale for the language used in the current study

The current study was conducted within Saudi Arabia where Arabic is the main language. However, the English language is widely used and considered a formal language within the healthcare system across the country. The researcher planned to conduct the study in accordance with the participants' preferences for either English or Arabic. Since all the participants were Saudi, the decision to conduct the study in the participants' native language was made to enhance the richness and authenticity of the collected data (Regmi, Naidoo and Pilkington, 2010, Abfalter, Mueller-Seeger and Raich, 2021). Engaging with participants in their first language meant that they were able to express their thoughts, emotions, experiences and cultural aspects more naturally and fully, capturing meanings that might have been

lost if the interviews had been conducted in a secondary language. However, some challenges occurred during the translation of the transcripts and they needed to be addressed to maintain the accuracy and depth of the original data (these challenges and how they were addressed are discussed in Chapter 4). It is important to consider the translation challenges and address them to preserve the cultural and contextual nuances of the participants' responses, and to strengthen the credibility of the findings.

2.6.2 Study settings

The research presented in this thesis (phases 2 and 3) was conducted across two hospitals in the Eastern province of Saudi Arabia. The study was conducted from August 2021 to February 2022. For the purposes of protecting confidentiality and anonymity, the two hospitals will be referred to as Hospital A and Hospital B; however, a description of these and the rationale for their inclusion are presented here.

Both hospitals are run by the MoH, which serves the general public, and they are the main hospitals in the Eastern Province. Hospital A has 400 beds. The departments included in this study were the ICUs and medical wards. There are two adult ICUs (ICUA and ICUB) with a total number of 27 beds, staffed by approximately 80 nurses. The hospital has medical wards with a total of approximately 38 beds and 45 nurses. Hospital B has 500 beds, including one adult ICU with 42 beds, staffed by approximately 135 nurses, and medical wards with a total of approximately 130 nurses. These two hospitals were selected due to their proximity within one geographical region, and they both have comparable organisational structures and levels of management. By selecting hospitals in this region, the study recognises and values the cultural characteristics of the Eastern Province of Saudi Arabia. This region can serve as a representative setting for healthcare practices within Saudi Arabia, particularly due to its diverse workforce. The Eastern Province is home to both local Saudi and international HCWs, which creates an environment that reflects the cultural diversity within Saudi Arabia. Furthermore, cultural factors including the importance of Islamic values, gender norms and traditional hospitability are common across Saudi Arabia and play a role in shaping healthcare practices. These

sites provide a typical yet culturally specific environment where healthcare policies and patient demographics could influence HCWs' practices. In comparison to other areas of the Middle East, the Saudi healthcare system, shaped by its cultural, religious and organisational context, may present different challenges and approaches to IPC. Thus, this research aims to identify cultural and organisational factors that could influence HCWs' practices and contribute to the broader understanding of IPC adherence in Saudi hospitals. In addition, when choosing hospitals for the study, practical considerations including accessibility and collaboration were taken into account. The decision to select these hospitals aligned with the study aims, promoting a thorough understanding of IPC in Saudi Arabia.

2.7 Ensuring rigour and trustworthiness

Ensuring the trustworthiness of qualitative research is essential to validate its findings and interpretations. This study adhered to the criteria of credibility, transferability, dependability and confirmability, as outlined by Lincoln and Guba (1985), to establish its trustworthiness.

Credibility or confidence in the truth of the findings, refers to the extent to which the research reflects the views of the participants and the way the researcher represents them. This is demonstrated through several strategies employed in the development and implementation of the current study. For instance, credibility was established by adhering to methodological guidance during both data collection and the interpretation of the findings. Each of the following chapters, specifically Chapters 4 and 5, provides details of the methods used and the rationale behind their selection. Furthermore, to ensure the credibility of the generated data, HCWs from both ICUs and medical wards were recruited, to represent a range of positions and educational backgrounds. This variety helped to provide a broad perspective on IPC practices. Moreover, the study's credibility was enhanced by transparently presenting the findings, which include excerpts from the interview transcripts. By clearly outlining how the data were collected and analysed, the study demonstrates a transparent approach to the research. This approach allowed a direct connection to be made between the data and their interpretation, which enhanced the trustworthiness of the findings (Tobin and Begley, 2004).

Furthermore, debriefing sessions were used as a technique to enhance credibility (Tobin and Begley, 2004, Johnson, Adkins and Chauvin, 2020). The researcher regularly discussed methodology and data analysis with the academic supervisors, who are experienced qualitative researchers. Moreover, to enhance the credibility during the data analysis phase, a reflective journal was kept to record the decision-making process and initial thoughts on the themes that emerged. This approach can minimise personal biases and assumptions and thus enhance the study's credibility (Noble and Smith, 2015).

Dependability refers to the consistency and stability of the study's findings over time and can be ensured by maintaining a clear audit trail that details the research process within the data collection, analysis and discussion (Lincoln and Guba, 1985). This comprehensive documentation allows for the replication of the study and demonstrates the methodological rigour and transparency of the research process (Murphy and Yielder, 2010). In the current study, dependability was addressed by preserving all the transcripts and notes used throughout the data collection and analysis processes.

Transferability refers to the extent to which the findings can be applied in another context (Tobin and Begley, 2004). Transferability can be achieved by "thick description" and purposeful sampling. In other words, transferability can be facilitated if the researcher provides a detailed description of the research process, including data collection, context of the study and the final report (Anney, 2014). Thick descriptions allow other researchers to replicate the study under similar conditions in different contexts. Purposive sampling is the most common strategy used in naturalistic inquiry and can enhance transferability by selecting participants who are particularly knowledgeable about the research topic (Anney, 2014). Purposive sampling allows the researcher to choose key informants to provide more in-depth insights, which in turn facilitate the transfer of the findings to similar contexts (Anney, 2014). Transferability in the current study is facilitated by providing a detailed description of the study participants, recruitment criteria, data collection methods, study healthcare settings and analysis procedures. These detailed descriptions allow other researchers to assess the applicability of the

findings to similar settings, thereby enhancing the study's utility in other contexts (Hadi and José Closs, 2016).

Confirmability refers to the extent to which the findings are shaped by the participants' experiences rather than by the researcher's biases or preconceptions (Lincoln and Guba, 1985). To achieve this in the current study, a reflective journal was used to capture the researcher's decision-making process throughout the data analysis process. The researcher also documented the coding, themes and patterns while reflecting on their own role and perspective within the study. This approach helped to minimise researcher bias and enhance the study's transparency (Hadi and José Closs, 2016). Finally, the inclusion of the participants' direct quotes served to anchor the study's findings in the real-world experiences of HCWs, which further strengthens the confirmability of the research. These strategies ensured that the findings accurately represent the complexities of IPC practices within the context of Saudi Arabian healthcare settings.

2.8 Reflexivity

Reflexivity is an important strategy in qualitative research that enhances rigour and trustworthiness by acknowledging the researcher's influence on the study (Dodgson, 2019). It involves a continuous process of self-awareness and self-reflection on potential biases, preconceptions, and the researcher's relationship to the research process (Palaganas et al., 2017). In this study, reflexivity was maintained through continuous self-reflection and documentation of the researcher's perspectives and decisions throughout the research process. A reflexive journal was kept to document thoughts, decisions and reflections to promote transparency in the research. Regular discussion with the supervisory team further ensured that the interpretations were grounded in the data which enhanced credibility of the findings. Thus, applying reflexivity allowed the researcher to present an authentic and contextual understanding of the factors influencing IPC adherence among HCWs.

2.9 Ethical considerations in research

2.9.1 Confidentiality and anonymity

Maintaining confidentiality and anonymity was a fundamental aspect of this study to protect the privacy and data of the participants. They were assigned unique identification codes to ensure anonymity in the reporting and analysis stages. Personal identifiers were removed or anonymised from the beginning of the study. In the focus group discussions, while anonymity among participants within the same groups could not be guaranteed, the participants were urged to respect the confidentiality of the discussion. They were encouraged to keep the information shared within the group and not to discuss it outside of the group setting. This approach was emphasised to maintain a secure and trusted environment where all the participants could freely express their views and experiences.

The participants were informed about the measures taken by the researcher to protect and secularly store their data. The nature of the data used in the study was explained to them, along with the secure steps adopted by the researcher for data protection. This included a detailed explanation of how their information would be used in the study and the commitment to uphold their anonymity and confidentiality during the research process and in any subsequent publications.

2.9.2 Beneficence and non-maleficence

The principles of beneficence and non-maleficence guided the ethical conduct of the current study. These principles ensured that the research aimed to benefit the participants and the broader community while minimising harm. The research design was carefully considered to provide benefits, including enhancing understanding of IPC practices, improving patients and HCWs' safety, and contributing valuable insights into the field of infection control. Healthcare workers were given an opportunity to discuss their experiences and the challenges they faced with IPC practices, which can result in improvements in policies and practices. The study's findings are intended to be disseminated through academic publications and presentations at healthcare conferences. This will ensure that the findings reach key

stakeholders who can implement change, thereby extending the benefits beyond the study participants. Furthermore, measures were considered to mitigate any possible distress or discomfort to the participants. This included providing participants with support information and ensuring that they felt comfortable and respected during their participation. The researcher was committed to acting in the best interest of the participants, upholding the ethical obligations of doing good and avoiding harm.

2.10 Adjustments due to COVID-19 impacts

The COVID-19 pandemic necessitated significant methodological adaptations across various research fields, including healthcare studies (Venkatesh, 2020). Accordingly, in relation to this PhD study, several adaptations had to be made to the originally conceived plan. Originally, direct observations were planned as a primary method for collecting data on IPC practices in the selected hospitals. However, due to the impact of the pandemic and the need to ensure the safety of both researchers and participants, secondary data analysis was considered (World Health Organization, 2020). This adaptation aligns with the broader research community's response to the pandemic, emphasising the importance of flexibility in research methodologies to maintain ethical standards and research integrity during public health emergencies (World Health Organization, 2020). Secondary data analysis, especially of existing audit data, offered an alternative for continuing the research without direct contact, thus reducing the risk of virus transmission among HCWs and the research team.

Secondary data analysis is the reanalysis of existing information that was obtained by someone else or for a reason other than the one currently under consideration (Curtis and Drennan, 2013). The researcher explored several alternative tools for secondary data analysis to identify any issues related to HCWs' adherence to IPC practices in the selected hospitals. Three potential tools were reviewed for inclusion in the current study: the Hand Hygiene Assessment Tool, the IPC Clinical Audit Tool for HCWs and the IPC Core Component Tool. After thorough consideration, these tools were ultimately excluded as they did not align with the research aims. For instance, the Hand Hygiene Assessment Tool was not sufficient to answer the research question since it only assesses HCWs' adherence to one element of infection

control measures, namely hand hygiene, but not broader measures. Therefore, it was not considered to be appropriate for the aim of the current study. While these tools were not suitable, their review highlights the researcher's efforts to find alternatives to direct observation during COVID-19, which emphasises a commitment to exploring all possible approaches.

Furthermore, the researcher initially planned to conduct face-to-face interviews. However, due to COVID-19 restrictions, this was not possible, and the interviews were changed to online interviews. The use of online interviews has become increasingly common in qualitative and mixed-methods research, particularly within the health context, as a response to the COVID-19 restrictions (Archibald et al., 2019). Online interviews provide flexibility by eliminating the need for travel or managing geographical distances, ensuring the safety of both the researcher and participants while still allowing for an in-depth exploration of experiences (Saarijärvi and Bratt, 2021). Online interviews, including those conducted by platforms such as Zoom or Skype, maintain many of the benefits of face-to-face interviews, including the ability to observe some nonverbal cues, facial expressions and body language. However, some subtle nonverbal communications might be missed due to the virtual setting (Archibald et al., 2019). A more detailed reflection on the limitations encountered during the research process is presented in Chapter 6.

2.11 Chapter summary

This chapter serves as the cornerstone of the study by clarifying the philosophical paradigms that guided the research and providing a justification for the chosen methodological approach. This chapter provides the rationale for the choice of a multi-method qualitative approach and it describes the phases of the research designs, which include a systematic review and empirical qualitative research involving interviews and focus groups with different groups of healthcare professionals. Each phase of the study was carefully designed to provide a distinct contribution to the overall objective of the study—an in-depth examination of the factors influencing HCWs' adherence to IPC practices.

Chapter 3 Barriers to and facilitators of healthcare workers' adherence to infection prevention and control practices in the Middle East: A qualitative systematic review (first phase of the thesis)

3.1 Introduction

This chapter presents the first phase in this PhD, which was a qualitative systematic review investigating the factors that influence health care workers' (HCWs') adherence to the recommended IPC practices for HAIs in the Middle East. This qualitative exploration provides a broader understanding of the factors affecting adherence in the region to offer insights into both effective practices and areas that require more improvement. In the context of this thesis, the review lays a foundational basis for the empirical work to follow by identifying themes and gaps that can help to shape the study's focus on IPC adherence challenges and enable more targeted explorations in later chapters. Systematic reviews are commonly used to present a summary or overview of current evidence and are an essential method in healthcare research (Chandler et al., 2019). A systematic review aims to synthesise relevant studies that satisfy pre-established eligibility criteria to address a certain research issue, with the goal of minimising bias through the review design (Chandler et al., 2019). By employing systematic and specific approaches, these reviews provide reliable and comprehensive findings from which judgements can be made (Chandler et al., 2019).

There are different types of literature reviews, each with a distinctive purpose and methodology (Samnani et al., 2017). The systematic review undertaken in this chapter is a qualitative systematic review. The rationale for adopting the systematic review approach is discussed in section 3.2.1. The methods used in this study are also discussed and described in this chapter. The review findings are then presented as themes under either organisational or individual factors that facilitate or impede effective IPC practices.

3.1.1 Background

Healthcare-associated infections (HAIs) and infection prevention and control (IPC) practices

As discussed in the introduction chapter, HAIs are a significant cause of concern in healthcare settings across the globe (World Health Organization, 2022). HAIs are defined as infections that patients acquire when they are receiving care in a hospital or other healthcare setting that was not present at admission (World Health Organization, 2011). In the introduction chapter, the definitions and prevalence of HAIs were comprehensively discussed.

As defined previously in Chapter One section 1.6, IPC practices encompass procedures aimed at preventing infections and ensuring the safety of patients and HCWs (Storr et al., 2017). IPC practices encompass several measures including standard precautions and transmission-based precautions. (see Chapter One, section 1.6 for more details on these practices) (GCC Centre For Infection Control, 2018).

Challenges associated with IPC practices

Existing quantitative studies and systematic reviews, including that by Houghton et al. (2020), have shown that HCWs often experience difficulties when implementing IPC practices and they therefore need to be supported by organisations and policy to implement these strategies. The review by Houghton et al. (2020) focused on exploring the factors affecting HCWs' adherence to IPC practices related to respiratory infections such as severe acute respiratory syndrome (SARS), tuberculosis (TB) and seasonal influenza. The review was performed in response to and to manage the COVID-19 pandemic. It included 20 qualitative studies from different areas including Asia, Africa, Australia, and the USA. The studies used qualitative and mixed-method designs to explore HCWs' experiences and perceptions of IPC practices. The quality of the included studies was assessed using the GRADE-CREQual approach to ensure moderate to high confidence in the findings.

Houghton et al. (2020) found different challenges, including unclear communication and assistance from managers, workload issues, inadequate access to and trust in PPE, and poor training and education. However, due to time constraints, the review did not provide detailed analysis of whether these difficulties varied significantly across regions. Additionally, this review did not include Middle East countries since no studies from the Middle East met its inclusion criteria. Moreover, the authors of the review searched only one database (Ovid MEDLINE), which may have limited the breadth of potential studies that could have been included. Since there have been no updated reviews that include countries in the Middle East, it is timely to now conduct a comprehensive review of the literature on the factors affecting HCWs' adherence to IPC practices in Middle Eastern countries.

Qualitative research in the Middle East

The review of existing literature reveals a gap in qualitative studies within the Middle East and highlights the need for updated qualitative research to explore the factors influencing adherence to IPC practices in this region (Houghton et al., 2020, Alhumaid et al., 2021, AlJohani et al., 2021). A large cross-sectional survey study from the Middle East conducted by Nofal et al. (2017) examined HCWs' knowledge, attitude, and adherence to IPC and the factors associated with adherence. The study revealed that the adherence of Jordanian nurses and physicians was significantly influenced by clinical experience, knowledge, and attitude. The study found a high level of positive attitudes towards IPC practices, despite having low knowledge scores. These attitudes were related to the importance of IPC, including PPE, to preventing infections. The authors suggested improving training programmes to address this discrepancy between attitudes and knowledge. However, several limitations of the study were noted. The sample was drawn from only three hospitals in Jordan, which may limit the generalisability of the findings to other healthcare settings. The healthcare practices, polices, and cultural attitudes towards infection control may differ in other regions or countries. Therefore, the findings may not be directly applicable to healthcare settings with different socio-cultural contexts or healthcare systems. In addition, reliance on self-reporting introduces limitations, suggesting the need for more accurate approaches, including observations. To address the discrepancy between attitudes and knowledge and gain a deeper

understanding of the factors influencing adherence, a qualitative approach could explore the underlying reasons for the attitudes and behaviours, providing insights into the contextual factors that influence adherence to IPC among HCWs. Nofal et al. (2017) identified that adherence is influenced by experience, knowledge, and attitudes; however, there is a gap in our understanding of how these factors interact with the environmental and cultural contexts. Paul et al.'s (2020) study expands on the cultural aspects affecting adherence but there is a lack of systematic reviews that gather similar evidence.

A qualitative review was conducted by Smiddy, O'Connell and Creedon (2015) to explore the factors influencing HCWs' adherence to hand hygiene practices. The review included 10 studies from 6 countries: Canada, the United Kingdom, Australia, the Netherlands, the United States and Taiwan. The review found that different factors affected adherence, including social influence, knowledge and education, resources, organisational culture (including the importance placed on IPC practices by organisations), and perceptions of the work environment, which included workload and staff shortages. Some of these factors could be similar to those that influence adherence of HCWs in the Middle East. However, Smiddy, O'Connell and Creedon's review may not fully capture the cultural norms and practices specific to the Middle East. For instance, cultural attitudes towards cleanliness, and religious practices such as ablution in Islam may influence how hand hygiene is perceived and the practices in healthcare settings in the region (Ng, Shaban and van de Mortel, 2017). In addition, gender preferences and interactions in the Middle East differ from those in western contexts and may affect how HCWs approach IPC adherence (Alabdulaziz, Moss and Copnell, 2017). Moreover, hierarchical relationships could influence adherence among HCWs (Alabdulaziz, Moss and Copnell, 2017). In contrast, the current qualitative systematic review can provide valuable insights into the contextual factors that may affect HCWs' adherence to IPC practices in the Middle East. This allows recommendations for practices that are appropriate for the local context.

Quantitative research can indicate factors such as knowledge levels but an understanding of the nature of the relationship cannot be explored. In addition, there may be factors specific to different settings that cannot be captured with

quantitative approaches. Quantitative studies can effectively indicate areas where practices could be improved by highlighting patterns and trends in adherence. However, although this is important, the numerical lens frequently fails to capture the interaction between different factors and the context people work or deliver care in, or the subjective experiences of HCWs. This review deliberately opted to explore HCWs' experiences of the challenges that they face in implementing IPC practices by seeking rich insights from qualitative research.

In this review, the term 'barriers' refers to any factors that prevent healthcare personnel from adhering to recommended IPC practices. On the other hand, 'facilitators' refers to those factors that encourage, motivate, or facilitate adherence of HCWs to required IPC practices.

3.1.2 Review question

What factors influence healthcare workers' adherence to infection prevention and control practices for preventing healthcare-associated infections in the Middle East?

3.2 Methods

3.2.1 Rationale for qualitative methodology

The justification for a qualitative approach was discussed in Chapter 2.

A qualitative approach enables a comprehensive understanding of the context-specific difficulties and facilitators that impact IPC practices by probing HCWs' perspectives, attitudes, and cultural influences. A narrative synthesis is employed to analyse and synthesise the findings from the included studies. Narrative synthesis is defined as "*an approach to the systematic review and synthesis of findings from multiple studies and relies primarily on the use of words and text to summarize and explain the findings of the synthesis*" (Popay et al., 2006, p. 5). The process of narrative synthesis contains four elements: data extraction, identifying relationships, assessing evidence strength, and developing a coherent narrative, as discussed in the analysis and synthesis section (Popay et al., 2006).

This method, which is also used in systematic reviews, is informed by well-established approaches suggested by Popay et al. (2006) that emphasise the integration and interpretation of qualitative data. It was chosen for its flexibility and ability to accommodate a wide range of qualitative research designs. Unlike meta-ethnography, which is primarily focused on translating concepts and metaphors from a limited range of qualitative studies, often within a particular thematic or theoretical framework, narrative synthesis allows for a more comprehensive examination of several studies across different contexts and methodologies (Noblit and Hare, 1988, Popay et al., 2006). Hence, a narrative synthesis could be particularly beneficial for capturing the complex aspects impacting IPC adherence, including potential cultural factors unique to Middle Eastern contexts. Given the specific focus and methodological limitations of meta-ethnography in handling the diversity of qualitative evidence required for this review, narrative synthesis was selected for its ability to holistically capture the different influences on IPC practices among HCWs in the Middle East (Noblit and Hare, 1988, Popay et al., 2006). Meta-ethnography often requires a restricted study style and is less adaptable to the varied and sometimes poorly defined qualitative designs commonly found in healthcare research. In contrast, narrative synthesis offers the flexibility needed to integrate and interpret a wide array of qualitative evidence (Noblit and Hare, 1988, Popay et al., 2006), making it a more suitable approach for this review. The process of how the narrative synthesis was undertaken in this phase is explained in the analysis and synthesis section, 3.2.9.

3.2.2 Protocol and registration

Developing a protocol for a review is an essential phase in order to ensure methodological rigour and transparency throughout the research process (Chandler et al., 2019). Chandler et al. (2019) argue that publishing the protocol before starting the review accomplishes multiple vital functions: it improves transparency by clearly defining the intended methods and analyses, allowing for peer scrutiny and feedback; it helps avoid duplication of work by alerting other researchers to the ongoing work; and it increases the thoroughness and robustness of the review by establishing predefined objectives and methods. This predefined planning is necessary to ensure that the review process is systematic, to lower the potential for

bias, and to improve the reliability and generalisability of the findings. By adhering to a well-designed process, researchers may ensure that the review's conclusion are reliable and applicable in a variety of settings. This approach helped to increase the review's usefulness in guiding practice and policy. This review was carried out following Preferred Reporting items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and it was pre-registered with PROSPERO, the international prospective register of systematic reviews, under number CRD42020223257.

3.2.3 Study selection and screening process

This review considered primary research studies carried out in the Middle East in order to ensure the breadth and depth of the review. The Middle East countries included were: Bahrain, the United Arab Emirates (UAE), Qatar, Kuwait, Saudi Arabia, Oman, Iran, Iraq, Egypt, Israel, Palestine, Lebanon, Jordan, Syria, Yemen, Turkey, and Cyprus. The selection of the study sources was based on the principles outlined in the PRISMA guidelines and it incorporated both peer-reviewed papers and grey literature sources (Page et al., 2021). The emphasis was on qualitative and mixed-methods research that highlighted the contextual factors and individual perspectives that underpinned HCWs' adherence to IPC practices.

According to the Cochrane guidelines, a systematic review should be undertaken by at least two researchers to reduce the likelihood of errors (Cumpston et al., 2019). In this systematic review, ZA was the principal researcher and was responsible for the overall design and coordination, and for conducting the study and allocating specific tasks to BA, a fellow PhD student. The two reviewers, ZA and BA, independently screened the results for relevance to the review question and inclusion criteria (see below), first by title and abstract and then by full-text screening. Disagreement was resolved through discussion with supervisors CMcF or LK. The studies were selected or excluded based on the following criteria:

3.2.4 Inclusion and exclusion criteria

Inclusion criteria:

- qualitative or mixed-method studies (where the qualitative findings could be clearly extracted.

- studies that related to nurses, midwives, dentists, physicians, respiratory therapists, physiotherapists, and radiologists. Diverse HCWs were included to obtain a holistic understanding of the factors that influence IPC in different disciplines. Nurses, for example, serve as frontline carers and frequently have the most direct patient contact. The inclusion of various HCWs was important as this allowed the identification of shared issues and variations within these groups. This in turn helped to shape the creation of targeted interventions for patient safety and IPC practices. By incorporating a wide variety of healthcare disciplines, the study attempted to capture a thorough overview of the obstacles and enablers of IPC practices, ensuring that the findings are representative of the whole healthcare workforce in the Middle East.

- studies that focused on IPC practices and HCWs' adherence to these practices in the hospital setting.

Exclusion criteria:

- studies on the prevalence of HAIs.

- studies conducted in other healthcare facilities such as in a community setting. Studies that did not include the selected group of HCWs (nurses, midwives, dentists, physicians, respiratory therapists, physiotherapists, occupational therapists, and radiologists) were also excluded.

- all study designs other than qualitative and mixed-method studies, including systematic reviews and meta-analyses; review papers; purely quantitative studies including randomised controlled trails (RCTs); cohort studies; case control studies; and cross-sectional surveys.

- reviews and conference abstracts were excluded to include only full primary studies with comprehensive data on study methods and findings. However,

conference abstracts were reviewed where available to check for any full versions of the presented studies.

- studies published before 2010 or not related to HCWs' adherence to IPC practices in the Middle Eastern countries. This focus on recent publications was in line with the review's objectives to synthesise contemporary evidence on the topic (Vrabel, 2015).

The PRISMA flowchart presented in the results section 3.3 depicts the studies included and excluded at each stage of the review process. The PRISMA framework is a commonly accepted guideline in academic research for reporting systematic reviews and meta-analyses. It is agreed to be the best practice when conducting and reporting systematic reviews and meta-analyses. Its application in this review ensures a transparent, systematic, and replicable methodology, and makes it easier to communicate the choices that were made about which research to include or exclude. The use of the PRISMA flowchart improved the review's credibility and methodological rigour by providing an illustration of the comprehensive search and selection approach used, including the number of records found and screened, and the reasons for exclusions (Page et al., 2021).

3.2.5 Language translation

An initial translation was carried out through open-source software (Google Translate) for titles and abstracts that were published in a language that none of the review team was fluent in. There were seven studies in Turkish, Persian, and Korean languages, but these were excluded later after the abstracts were translated because they did not meet the inclusion criteria.

3.2.6 Search strategy

Using electronic databases, a preliminary scoping literature search was carried out. This gave an overview of the literature on the subject and helped to refine the search strategy in advance of the systematic review. Following this, a meeting with the supervisory team was held, and a University of Glasgow librarian was consulted

to advise on prospective databases and the search strategy procedure. An electronic search was originally conducted in 2020 and updated in March 2024. The initial search completed in 2020 informed the development of the study, but the search was updated, and no significantly different findings emerged. The search was conducted in the following databases: MEDLINE, EMBASE, CINAHL, and the Cochrane Library. The search strategy was developed and tested in one electronic database (Medline) and then tailored to the MeSH heading requirements of each database (Appendix 2).

The search strategy incorporated the PEO (Population, Exposure, Outcome) framework, which guides the systematic identification and formulation of research questions in qualitative studies. It focuses on the Population of interest (here HCWs in the Middle East); the Exposure (in this case, IPC practices, including but not limited to PPE, hand hygiene practices, and IPC guidelines); and the Outcomes, which in this study were insights into the factors, perceptions, and contextual influences on IPC adherence, as well as the broader implications of this adherence (or lack of it) on the incidence or prevention of HAIs. Use of the PEO framework enhanced the methodological rigour of this review by promoting a structured yet broad approach to the literature search and selection (Butler, Hall and Copnell, 2016).

For the 'Exposure' component, the selected terms encompassed a wide range of IPC practices, such as 'hand hygiene' and the usage of 'personal protective equipment (PPE)'. The keyword selection was informed by current IPC guidelines and emerging patterns in infection control, to ensure that the literature search was in line with the most recent research and standards in the field.

The PEO framework served as a guide for the systematic exploration of the factors affecting IPC adherence. This approach allowed for the systematic identification of key 'exposures' – IPC practices. Keywords included the following categories: HCWs (i.e., health personnel) and the Middle East (e.g., Saudi Arabia, Qatar, the UAE); infection prevention and control (e.g., PPE, hand hygiene practices), guidelines (e.g., IPC guidelines, protocol), and HAIs (e.g., cross-infections, nosocomial

infection). Table 3.1 provides an overview of the search strategy and some of the specific terms utilised to find relevant literature.

Relevant keywords and subheadings related to each category were combined with the Boolean “OR” and “AND” operators. Studies for inclusion were limited to those published between 2010 and 2021, then updated in 2024. This period was selected to capture the most up-to-date literature. All references retrieved from the electronic sources were exported and added to a web-based systematic review tool (www.covidence.org) for screening and selection by two independent reviewers. Using software such as Covidence facilitates effective data management by simplifying the screening process, ensuring consistency and enabling collaboration between reviewers.

Reference lists of the included articles were searched manually for relevant studies. In addition, the grey literature was searched for unpublished material that might be relevant through several sources, including doctoral theses on the EThOS, Google, and CADTH grey literature search lists; guidelines from relevant health organisations (e.g., the WHO and CDC); meeting records from healthcare conferences; and policies and reports from healthcare associations. The search terms “healthcare-associated infections AND adherence AND Middle East” were used to search the grey literature. Given the large number of potentially relevant documents, a focused strategy was applied, and only the first 100 search results were reviewed, in line with best practices (Godin et al., 2015). This decision was made with the intention of gathering the most recent and current insights while feasibly managing the scope of the review. Titles and abstracts were independently screened by two reviewers, BA and ZA, followed by full-text screening.

Table 3. 1: An overview of the search strategy

Acronym	Definition	Associated Terms
P	Population/patient: the group of individuals or patients being studied.	(health personnel or healthcare personnel or health care personnel or health worker$ or healthcare worker$ or health care worker$ or health care practitioner$ healthcare provider$ or health care provider$ or health practitioner$ or healthcare practitioner$ or health care practitioner$ or health employee$).mp. (doctor$ or physician$). (allied health adj (staff or personnel)).mp. Allied Health Personnel. (hospital staff or hospital worker$).mp. (physician? or doctor? or practitioner? or clinician? or nurse? or nurs* assistant? or midwife or midwives? or dentist? or pharmacist? or physiotherapist? or occupational therapist? or technician? or radiographer? or health manager? or health care manager? or healthcare manager? or clinical officer? or medical personnel? or medical professional? or medical worker? or medical provider? or medical staff or health personnel? or health care personnel? or healthcare personnel? or health professional? or health care professional? or healthcare professional? or health worker? or health care worker? or healthcare worker? or health provider? or health care provider? or healthcare provider? or health staff or health care staff or healthcare staff).mp. exp Middle East. (Bahrain or Bahrain$ or Kuwait or Kuwait$ or Saudi or Qatar or qatar$ or UAE or United Arab Emirates or Emirat$ or Oman or oman$ or Iran or Iran$ or iraq or iraq$, Egypt or eygpt$ or israel or israel$ or Palestine or palestin$ or Lebanon or laban$ or jordan or jordan$ or syria or syri$ or yemen or yemen$ or turkey or turk$ or cyprus or cyprus$ or middle east or middle eastern or middle east$).mp.
E	Exposure: the specific interventions or factors	(infection prevention or infection control).mp. (protective clothing or gown* or coverall* or protective layer* or surgical toga or apron or smock or hazmat or glove* or respiratory protective devices or mask* or face mask* or facemask* or respiratory protection or eye protection or personal protective equipment or PPE or

	being studied to understand their impact.	goggles or safety spectacles or glasses or donning or doffing or respiratory hygiene or clean* or disinfect* or waste management or respiratory hygiene or environmental control*).mp. (Universal Precaution* or standard precaution*).mp. ((Droplet* or contact or isolation) adj3 precaution*).mp. (control adj3 measure*).mp. (guideline* or protocol* or guidance).mp. IPC guideline*.mp. (aerosol or surface or environment or contaminat* or spatial or aerodynamic or disinfectant or cross infection or infection prevent* or infection control or viability or inactivation or indirect transmission or indirect virus transmission or indirect viral transmission or hand rub or hand rubbing or hand rubs or alcohol or hand hygiene or ethanol or hand disinfection).mp. exp Cross Infection. healthcare-associated infection*.mp. (hospital-acquired infection* or nosocomial infection*).mp. exp Disease Transmission, Infectious
O	Outcome: the result or effects observed as a result of the exposure.	("adhere to" or adherence or barrier* or challeng* or compliance or comply$ or facilitat*).mp. exp Guideline Adherence

3.2.7 Data extraction

A data extraction form was created for the review. ZA and BA extracted the key characteristics of each study using the review form developed for this synthesis, including bibliographic citations, study aims, study design/country/setting, data collection, sample, type of IPC, type of HAI, findings on key information regarding the factors influencing adherence to IPC practices, and the summary. The completed form was reviewed by supervisors (CMcF and LK) for accuracy and completeness. Prior to the form's completion, minor amendments were discussed with supervisors CMcF and LK.

3.2.8 Critical appraisal

A critical appraisal of the included studies was conducted independently by two reviewers (ZA) and (BA) using the Qualitative Critical Appraisal Skills Programme (CASP) tool. The CASP tool is the most frequently used tool for assessing the quality of qualitative evidence relevant to health research (Long, French and Brooks, 2020). The tool consists of 10 questions that evaluate the clarity of the research objectives, appropriateness of the research designs, rigour in data collection and analysis, consideration of the researcher–participant relationship, applicability of the findings, and the overall research value (Long, French and Brooks, 2020). These indicators are essential for evaluating the trustworthiness and relevance of qualitative research findings.

Each question in the CASP tool should be answered 'Yes' if the research paper clearly addresses the question. However, if the paper does not answer the question, the response should be 'No'. The response 'Can't tell' is used if there is insufficient information to make a judgement about whether the criterion has been met. In addition, the CASP tool supports assessors with providing comments to justify their decisions, thereby enhancing the transparency of the assessment process and facilitating discussions between reviewers when required (Long, French and Brooks, 2020). All studies were eligible for inclusion regardless of their quality. Recognising the variation in study quality highlights the need for caution when interpreting the synthesis and emphasises the critical need for future research of higher

methodological rigour in this area. Including studies with a variety of quality in the review was a strategic selection to capture a holistic representation of the available knowledge on IPC practices in the Middle East and it highlights the areas that require further exploration. The responses to the quality assessment of the studies, guided by CASP tool, are summarised in Table 3.2. The quality of the included studies is discussed in section 3.3.2 of the Results section.

3.2.9 Analysis and synthesis

The first step in narrative synthesis is to extract qualitative information from primary studies by systematically reading and rereading the findings. The text included quotations from participants and the findings of the original authors and was imported into NVivo 12. Quotations and authors' conclusions both make significant contributions that are separate yet complementary (Popay et al., 2006). Quotations offer direct access to primary data by capturing the opinions and feelings of the participants (Popay et al., 2006) and they increase the credibility of the researchers' interpretation by providing examples to support reported themes (Sandelowski and Barroso, 2006). These quotations directly reflect participants' perspectives, reinforcing the validity and authenticity of the themes identified in the review. In contrast, the authors' conclusions in the primary research studies contextualise individual experiences by combining patterns identified across their studies (Sandelowski and Barroso, 2006). By combining the two, the review provides an in-depth understanding of the evidence, immersing readers in participants' perspectives and making it easier for them to understand synthesised interpretations, resulting in a thorough analysis and synthesis of the research issue. Original research data refers to direct quotations and findings extracted from primary studies. These provide first-hand insights into participants' perspectives and experiences related to IPC practices. Synthesis encompasses the interpretation and analysis of these original research findings. It involves integrating and contextualising the primary data to identify patterns, themes, and broader implications across multiple studies (Popay et al., 2006). Following extraction, the coding process entails analysing and categorising the textual data to determine the essence of participants' experiences and perceptions, and the narratives associated with IPC practices as described in the published articles. Through this interpretive

strategy, recurrent patterns and variations in qualitative data are identified. One reviewer (ZA) coded both verbatim quotations and the summarised findings from the included studies.

In this review, open coding was employed instead of applying a predefined theoretical model, such as a health behaviour or implementation theory. This decision was made to allow the emergent themes to naturally represent the IPC practices in Middle East healthcare settings. By using open coding, the synthesis could weave together various lines of evidence into a cohesive narrative, which highlighted both facilitators of and barriers to the implementation of IPC adherence (Roberts, Dowell and Nie, 2019). This approach allowed for flexible and comprehensive exploration of the data to capture all the relevant insights from the included studies. It also encouraged a more exploratory analysis, where themes could evolve and be refined through iterative review and reflection on the data (Braun and Clarke, 2006). Furthermore, this approach is supported by Creswell's (2017) emphasis on the value of open, data-driven exploration as not applying a preliminary theoretical framework allows perspectives to emerge. Creswell (2017) argues that imposing a theory can constrain analysis, which could lead researchers to overlook some important data. Creswell (2017) advocates developing a rich, complex understanding of the research issue by capturing multiple perspectives to identify the factors influencing a situation.

Moreover, the decision to focus on emergent themes rather than imposing a theoretical model is consistent with the principles of thematic analysis as described by Braun and Clarke (2006). They discuss a flexible, inductive approach. This approach involves familiarisation with the data, followed by coding and theme development, which allow for a richer understanding without the constraints of a predefined theoretical model (Braun and Clarke, 2006). A theoretical model is a broad conceptual framework guiding research, while a coding framework is specifically used for organising and analysing data at a detailed level, thus supporting a bottom-up approach (Roberts, Dowell and Nie, 2019). An open approach seemed appropriate to capture contextual insights into IPC practices in the Middle East. This flexibility provided information for refining the data collection and

analysis processes in later phases to allow a comprehensive understanding that might have been restricted by a theoretical model.

The second step in the narrative synthesis focuses on exploring the relationship between the determined themes or categories (Popay et al., 2006). It entails examining how themes interact, overlap, or diverge among studies in order to gain a deeper understanding and possibly explain differences (Popay et al., 2006).

The third step involves assessing the robustness of the synthesis by evaluating the quality and rigour of the included studies (Popay et al., 2006). It considers study design, methodology, and data collection methods to help determine the quality and strength of the evidence provided, thus ensuring that the synthesis accurately reflects the reliability of the findings (Popay et al., 2006). Furthermore, this step considers whether themes identified in the synthesis are consistently present across all studies or predominately found in studies of varying quality. This approach clarifies which themes are widely supported and highlights how study quality may influence the interpretation of findings (Popay et al., 2006). The current review used the CASP tool to evaluate the quality of the included studies, as discussed in section 3.3.2.

The final step of narrative synthesis involves the development of a comprehensive and coherent story that incorporates the findings of several studies (Popay et al., 2006). This synthesis goes beyond a straightforward summary by contextualising and interpreting the data within the context of the existing body of literature and theoretical framework, which contributes to an in-depth understanding of the research topic (Popay et al., 2006).

In this review, the factors influencing adherence of HCWs to IPC practices are categorised into organisational and individual factors. This categorisation improves understanding of how healthcare environments and personal attributes influence adherence. Organisational factors include elements within healthcare setting including resources and workplace culture. Individual factors encompass the personal beliefs, knowledge, attitudes, and behaviours of HCWs that impact their adherence to IPC practices.

3.3 Results

The search identified 4513 potentially related papers. All papers were imported into EndNote and duplicates were removed; 3467 papers were imported into Covidence software, and a further 215 duplicates were removed, leaving 3252 papers to be screened. The full texts of 48 papers were screened for eligibility, from which 8 papers met the criteria for inclusion in this review. No additional papers were retrieved from the manual search, which primarily involved reference list screenings of the included articles. This manual search aimed to ensure that all relevant studies were included. No relevant grey literature was found, as shown in Figure 3.1. When the updated search was re-run in March 2024, two additional papers were identified that met the inclusion criteria and these were subsequently included in the review. These two additional papers are discussed separately in the section on updated search findings and comparative analysis.

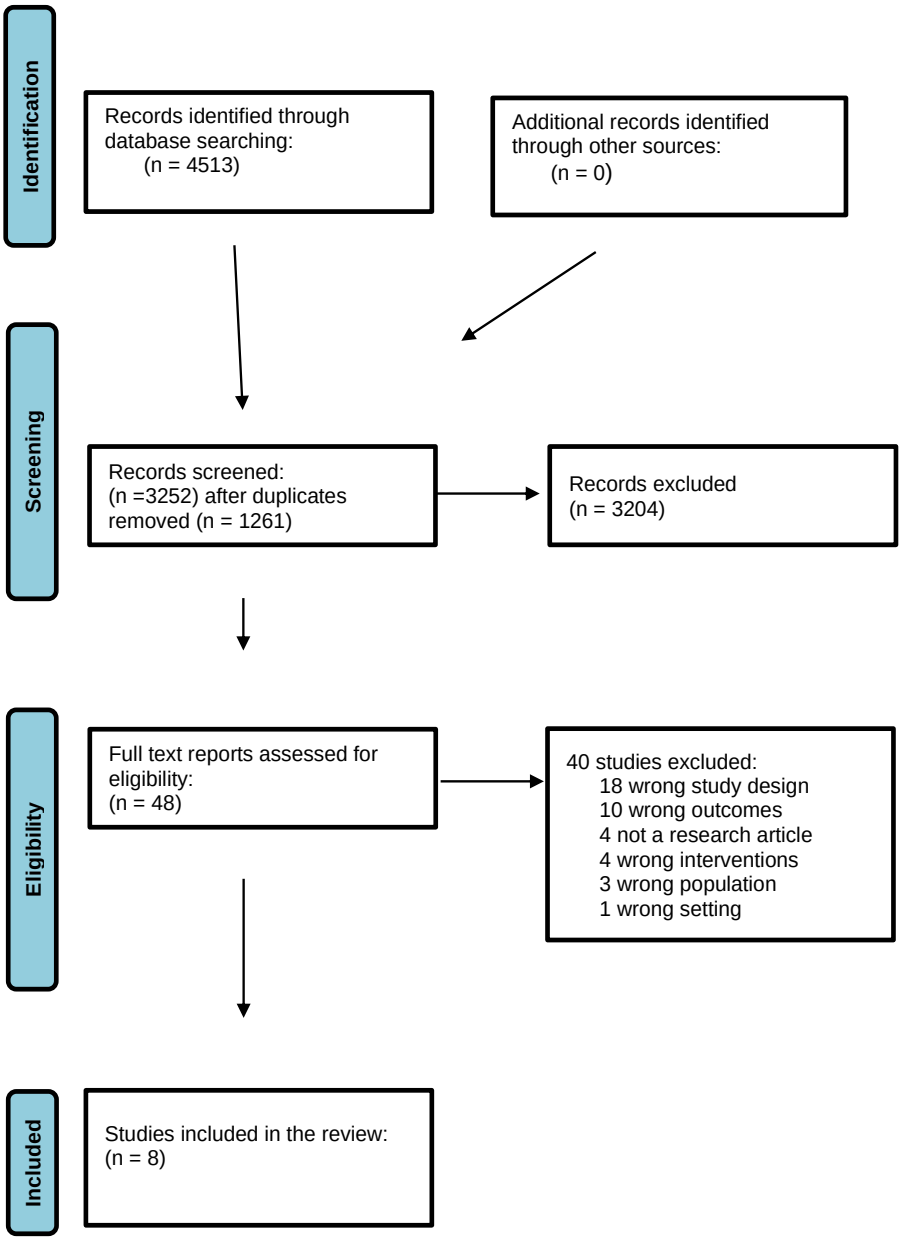

Figure 3. 1: PRISMA flow diagram

3.3.1 Overview of selected papers

In this section, an overview of the general characteristics of the included studies is provided. This section will offer insight into the scope, methodology, and participant demographics of the included studies.

All studies were conducted in acute settings within a range of hospitals, including 3 tertiary hospitals, 4 teaching hospitals, and 2 public hospitals. Two studies were carried out in Egypt, two in Iran, two in the UAE, one in Cyprus, and one in Saudi Arabia. This regional diversity provides an opportunity to explore the potential impact of contextual factors within the Middle East. The participants in the included studies differed in their professional roles. All 8 studies included nurses; 4 studies involved only nurses and a further 4 involved other HCWs including 39 physicians, 2 allied health professionals, and 8 consultants.

In this systematic review, all the included studies included hand hygiene practices as part of the IPC practices that were referred to or explored within the studies. The focus of four of the included studies was identifying the factors that influenced HCWs' adherence to hand hygiene (Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020). Three of the included studies adopted a broader perspective by also including different aspects of IPC practices. These included standard precautions such as using PPE (wearing a gown, mask, and/or apron) as well as effective management of waste and sharps disposal. Inclusion of other standard precautions made a significant contribution to a thorough comprehension of IPC practices within the Middle East context (Efstathiou et al., 2011, Salem and Youssef, 2017, Paul et al., 2020). The study by Atashi et al. (2018) examined IPC guidelines specific to VAP. Even though this study's focus was narrower than the other included studies, it provided information about the standard precautions, including hand hygiene and the use of gloves. These insights contribute to the overall understanding of IPC practices, which this review aims to explore comprehensively.

Eight studies in total were included in the review. Five of the included studies used a solely qualitative approach. The study conducted by Lohiniva et al. (2015) employed focus group discussions in Egyptian hospitals to understand the behaviour determinates of hand hygiene among 96 nurses. Focus groups (32 nurses) were also used by Efstathiou et al. (2011) to explore the factors that affected nurses' adherence to standard precautions in two public hospitals in Cyprus. Three studies collected data using semi-structured interviews (Salem and Youssef, 2017, Atashi et al., 2018, Ghaffari et al., 2020). The study by Ghaffari et al. (2020) was conducted in a university hospital in Iran to determine factors influencing the hand hygiene behaviour of 16 nurses in critical care units including CCU, NICU and ICU. Salem and Youssef (2017) used semi-structured interviews to identify HCWs' (3 medical staff and 10 nurses) perspectives on providing good-quality infection control practices in NICU at an Egyptian hospital. The study by Atashi et al. (2018) was conducted to explore the perspective of 23 Iranian critical care nurses on the barriers to VAP prevention in ICUs. The study by Atashi et al. (2018) is notable for its methodological approach because it employed observation field notes in addition to semi-structured interviews to observe the VAP preventive practices of any nurse in the clinical setting. The use of mixed qualitative methods for data collection can capture both verbal and observational insights in clinical settings, providing a comprehensive perspective of the obstacles faced by critical care nurses to preventing VAP. Interviews alone may not fully capture the contextual detail that the observational data offered, therefore mixed methods enriched the understanding of IPC practices.

The other three studies used a mixed-methods approach, from which only the qualitative components were extracted and synthesised for this review. Ng, Shaban and van de Mortel (2017) employed a sequential explanatory mixed-methods design to explore the hand hygiene knowledge and beliefs of HCWs (31 nurses and 18 doctors) at a university hospital in the UAE. Quantitative data were collected using questionnaires and analysed first, followed by the collection and analysis of qualitative data through focus groups. While the study's surveys primarily assessed knowledge of hand hygiene, the qualitative focus groups aimed to explore the factors influencing hand hygiene adherence among HCWs. These focus group

discussions explored the perceptions, attitudes, and contextual factors affecting hand hygiene practices, which are essential to this review's qualitative inquiry.

In Paul et al.'s (2020) study, the authors also adopted a sequential explanatory design using a quantitative questionnaire to assess the knowledge, attitude, and practice of HAIs and infection control. Subsequently, the study collected qualitative data through interviews and observations to complement and enrich the findings from the quantitative phase. This approach emphasises the role of the qualitative phase in providing a deeper understanding of the quantitative results, rather than directly drawing ideas from them. The study was conducted at a tertiary care hospital with 40 participants (16 nurses, 16 residents, and 8 consultants). Thus, the qualitative methods employed by Paul et al. (2020) attempted to provide a more complete picture of HCWs' knowledge, attitudes, and practices related to HAIs and IPC practices to explore the complexities that the quantitative data revealed. The qualitative phase allowed for deeper exploration of the underlying factors influencing HCWs' responses and actions, enriching the overall analysis of the study.

Khuan, Shaban and van de Mortel (2018) aimed to examine how religion and cultural beliefs affected hand hygiene practices among 10 participants (2 doctors, 2 nurses, 2 allied health professionals, and 4 Islamic scholars) at a university hospital in the UAE. The study utilised a sequential exploratory design, conducting interviews with HCWs as the first phase, followed by a survey. In contrast to the other two mixed-method studies, this study used qualitative data from interviews to identify key themes and to inform the subsequent quantitative survey, enhancing the depth of understanding regarding religious, cultural, and personal factors influencing hand hygiene practices in the UAE.

3.3.2 Quality of the included studies

The available body of literature in this specific research context is limited. Although the available studies were of a good quality overall, due to the limited available literature, studies of varying quality were included to ensure a comprehensive review and capture a broad range of perspectives, practices, and findings from the

current literature. Using the quality assessment within the CASP tool, all the included studies were rated for methodological quality. Seven were rated as good quality, which indicates strong methodological quality (Efstathiou et al., 2011, Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Atashi et al., 2018, Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020, Paul et al., 2020), while Salem and Youssef (2017) was rated as moderate due to an unclear relationship between the researcher and the participants. All the included studies clearly stated their aims, employed appropriate qualitative methodologies, and used suitable research designs. The recruitment strategies and data collection methods were clearly explained in all the included studies. Most studies adequately considered the researcher–participant relationship, except for Salem and Youssef (2017), where the researcher did not critically examine their own role, potential bias or influence during the study's formulation. Ethical considerations were addressed, and the data were rigorously analysed.

Four of the included studies had a notable limitation regarding the lack of clarity on whether data saturation was achieved and how it was defined (Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Khuan, Shaban and van de Mortel, 2018, Paul et al., 2020). This highlights a methodological gap, which inhibits a thorough exploration of the factors influencing HCWs' adherence to IPC practices. To ensure that a study's findings are both credible and comprehensive, data saturation – the point at which no new information or patterns emerge from data - should be achieved (Saunders et al., 2018). Although these studies have insufficient information on data saturation, they provide detailed information regarding the study design, data collection, and analysis. The clarity of this information provides a foundation for evaluating the reliability and trustworthiness of the study findings. Thus, these studies may still provide insightful information despite the limited discussion of data saturation. Furthermore, these studies applied recruitment strategies that were appropriate to their aim and they rigorously addressed ethical considerations by considering informed consent and confidentiality, adhering to the standards for ethical qualitative research (Creswell, 2017).

The findings from the reviewed studies are supported by participants' quotations, enhancing the credibility of the studies' findings. According to Patton (2015), direct

quotes play a crucial role in qualitative research since they ground the analysis in real-world evidence and enhance the study's transparency and trustworthiness. Despite limitations around data saturation in some studies, these methodological strengths (clear research objectives, adequate requirements, and ethical rigour) offer useful insights into HCWs' adherence to IPC practices, which highlights the importance of providing detailed evidence to support qualitative research findings.

Additionally, three studies were conducted in a university teaching hospital (Salem and Youssef, 2017, Atashi et al., 2018, Ghaffari et al., 2020). The unique educational role of teaching hospitals necessitates a continuous flow of up-to-date knowledge and the most recent healthcare practices, including those related to IPC practices (Ayanian and Weissman, 2002). This aspect relates to the applicability of the findings to other healthcare settings. The focus on education ensures that HCWs in teaching hospitals are frequently exposed to the most recent guidelines and evidence-based practices, which may encourage a high level of adherence to IPC practices. Furthermore, the role of teaching hospitals as centres for research and innovation may help to raise awareness and implementation of advanced IPC practices (Ayanian and Weissman, 2002). This integration of research activities with clinical care facilitates the adoption of innovative practices and encourages a questioning attitude among HCWs, which improves adherence to IPC practices. This is especially important in the context of preventing HAIs, where evolving strategies and technologies play an essential role. However, the unique characteristics of teaching hospitals also raise questions regarding the transferability of their findings to the various healthcare settings across the Middle East. In non-teaching or less-resourced healthcare facilities, the infrastructure, organisational culture, and resources that support high standards of infection control may not be prominent. This discrepancy highlights the need for caution when applying the findings from teaching hospitals to broader healthcare environments (Schloemer and Schröder-Bäck, 2018). Furthermore, the presence of highly specialised and continuously rotating staff, including students, residents, and fellows, might introduce variability in adherence levels. Although educational settings encourage learning and adherence to best practices, the continuous influx of new staff necessities continual training and supervision to maintain high standards of infection control, which can be both a

difficulty and an opportunity to improve adherence practices. Considering these dimensions is essential for interpreting the implications of studies' findings on HCWs' adherence to IPC practices. Teaching hospitals provide valuable insights as they focus on education, research, and innovation. However, exploring how these practices adapt to different healthcare settings highlights the need for diverse research to facilitate a comprehensive understanding of the factors influencing IPC adherence in the Middle East healthcare landscape.

Furthermore, five of the included studies used convenience sampling, which may impact the transferability of the findings to similar healthcare settings (Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020, Paul et al., 2020). The reliance on convenience sampling, which involves selecting participants based on their availability and willingness to participate, could limit the broader applicability of the findings to other healthcare settings. Thus, the use of convenience sampling here may affect the transferability and confirmability of the studies (Etikan, Musa and Alkassim, 2016). Despite this limitation associated with convenience sampling, the qualitative findings offer information on the factors influencing HCWs' adherence to IPC practices in the specific context of the Middle East. These insights can inform practices and policy within similar healthcare settings.

Table 3. 2: Results of the critical appraisal of the included studies (CASP tool)

Statements	(Efstathiou et al., 2011)	(Lohiniva et al., 2015)	(Ng, Shaban and van de Mortel, 2017)	(Salem & Youssef, 2017)	(Atashi et al., 2018)	(Khuan, Shaban and van de Mortel, 2018)	(Ghaffari et al., 2020)	(Paul et al., 2020)
1. Was there a clear statement of the aims of the research?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Is a qualitative methodology appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Was the research design appropriate to address the aims of the research?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Was the recruitment strategy appropriate to the aims of the research?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Was the data collected in a way that addressed the research issue?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6. Has the relationship between researcher and participants been adequately considered?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
7. Have ethical issues been taken into consideration?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. Was the data analysis sufficiently rigorous?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9. Is there a clear statement of findings?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10. How valuable is the research?	By exploring healthcare	The researchers	The researchers	The researchers	The researchers	The study provides	The researchers	The study is important for

	workers' experiences in depth, the research highlights key areas for improvement in IPC practices.	discuss the contribution the study makes to existing knowledge	identified new areas where research is necessary.	identified new areas where research is necessary.	discussed whether the findings can be transferred to other populations .	insights into IPC practices, offering clear recommendations for improving adherence in healthcare settings.	identified new areas where research is necessary. The researchers discussed whether the findings can be transferred to other populations.	its unique focus on a specific region, offering context-specific factors.

3.3.3 Key findings

This section presents the key findings of the narrative synthesis on the factors affecting HCWs' adherence to IPC practices in the Middle East. The data were extracted and are outlined in the table of evidence below (Table 3.3).

Table 3. 3: Table of evidence

Reference	Aims	Study Design /Country/ Setting	Data Collection	Sample	Type of IPC	HAIs	Key Findings	Summary/ Relevance
Lohiniva et al. (2015)	To understand the behavioural determinants of hand hygiene. To inform interventions to promote hand hygiene in hospitals.	Qualitative Country: Egypt Adult ICU, paediatric ICU, and surgical wards at two university hospital sites.	Focus group discussion (n = 14)	Convenience sampling 96 nurses, vocational and graduate	Hand hygiene	All HAIs, which include any or all HAIs such as urinary tract infections, surgical site infections, bloodstream infections and ventilator associated pneumonia.	Adherence was similar between sites and vocational/graduate nurses. Factors influencing hand hygiene: Poor knowledge of hand hygiene requirements and products. Individual assessment of requirement for hygiene based on visual inspection rather than prevention. Workload and time. Preference for soap and water over alcohol gel. Lack of role models and social norms Lack of monitoring of practice or promotion of hand hygiene practices.	Cultural concepts and 'norms' have a significant influence on practice, including promoting, monitoring, and providing role modelling for washing. Without supervision/ monitoring, nurses were less likely to comply with IPC guidance. Side effects of hand washing was a significant factor for choosing to wash hands or to use gel.

Ng, Shaban and van de Mortel (2017)	To examine the hand hygiene knowledge and beliefs of health professionals at a tertiary care hospital in the United Arab Emirates.	Mixed methods Country: UAE Setting: all hospital departments	A survey and focus groups (n = 9)	Convenience sampling **Survey:** Nurses and doctors (n = 109) 78.9% of respondents were women and had 3 to 4 years' service at the hospital. **Focus groups:** 31 nurses and 18 doctors	Hand hygiene	All HAIs	Complying with WHO guidelines and scientific evidence will reduce HAIs. Peers' reminders, observing others, and drawing comparisons with colleagues trigger hand hygiene compliance. Hand hygiene was traditionally practised at home and for religious rituals. Using ultraviolet hand scanners enhanced beliefs in the efficacy of hand hygiene. Side effects of the overuse of alcohol-based hand rub or hand washing with hot water. Hand hygiene practice is affected by professionalism. Practising hand hygiene for self-protection, rather than for patients. Accessible hand hygiene supplies improve compliance. Effective leadership and continued feedback on HAI	The study found that HCWs need further education on hand hygiene, particularly the use of alcohol-based hand rub (ABHR). Many factors can affect their adherence including peers, religious beliefs, allergies to hand hygiene products, professionalism, accessibility of hand hygiene supplies and leadership.

							statistics and hand hygiene performance are important.	
(Khuan, Shaban and van de Mortel, 2018)	To explore HCWs' and Islamic scholars' perceptions of the religious and cultural beliefs influencing hand hygiene behaviours in the United Arab Emirates.	Mixed methods Country: UAE Setting: all hospital departments in a tertiary hospital	Interviews and a survey Interview guides were based on theory of planned behaviour (TPB)	**Interviews:** Convenience sampling 10 participants 4 Islamic scholars, who were not HCWs, and 6 HCWs (2 doctors, 2 nurses and 2 allied health professionals) HCWs were identified as Muslims (n = 3), Christians (n = 2), or Hindu (n = 1)	Hand hygiene	All HAIs	Themes associated with HCWs' hand hygiene behaviour in the context of TPB variables: **Behavioural beliefs:** Advantages (i.e., right practice; clean feeling; eliminating microorganisms; protecting oneself and others from HAIs) Disadvantages (i.e., cost-effectiveness of hand washing; limitations of ABHR on soiled hands; hand rub retains dead microorganisms) **Normative beliefs:** Supportive (i.e., influence of Ignaz Semmelweis; supervisors' preference; experts' expectations; agreement by peers; patients' demands) Unsupportive (i.e., doctors' disagreement)	The study identified cultural and religious beliefs that affect the hand hygiene behaviour of healthcare workers in the UAE. The factors were classified based on TPB components. Barriers to and facilitators of hand hygiene were identified, including the accessibility of hand hygiene facilities. Factors not related to TPB were identified (religious and cultural beliefs) from the

				Survey: Random sample from all nurses and medics (n=349)			**Control beliefs:** Facilitators (i.e., personal beliefs; professionalism; existing policies and regulations; accessibility of ABHR) Barriers (i.e., inaccessibility and unavailability of hand hygiene facilities; skin-product incompatibilities) The study also identified themes related to religious and cultural beliefs that influence hand hygiene.	perspectives of HCWs and some Islamic scholars. Only perspectives of HCWs were included in the current review.
Ghaffari et al. (2020)	To determine factors affecting the hand hygiene behaviour of the nursing staff in Shariati Hospital of Tehran, Iran.	Qualitative Country: Iran Shariati Hospital of Tehran University of Medical Sciences CCU, NICU, ICU	Semi-structured interviews	Convenience sampling 16 nurses Average age: 34 years Average work experience: 11.34 years Gender: most of the nurses were female	Hand hygiene	All HAIs	**Attitude:** *Behavioural beliefs*: good feeling and satisfaction after hand washing. *Evaluation of behavioural outcomes*: valuing their own and their family's health. **Subjective norms:** *Normative beliefs*: emphasis by supervisors and doctors on hand washing. *Motivation to comply*: Importance of leadership in hand washing. *Descriptive norms*:	The study identified factors affecting hand hygiene behaviour and these were classified based on the TPB framework. The study also identified additional factors outside the TPB. All participating nurses had a positive

				Position: head nurse (n = 3) nursing staff (n = 13)			effect of behaviour of physicians **Perceived behavioural control:** *Control beliefs:* negligence, laziness, crowded wards, and heavy workload *Perceived power:* feasibility of adherence under any circumstance. **Determinants of hand hygiene (outside TPB)** Supervision and monitoring: Reinforcement: system of rewards and verbal encouragement. Cues to action: a motivation source that causes a desire to accomplish something. Availability and accessibility: e.g., availability of a sink. Preferences for hand hygiene products Modelling: nurse and head nurse behaviours.	attitude towards hand hygiene. Participants also mentioned that their hand hygiene behaviour was influenced by supervisors and doctors. Results outside the TPB include perceptions such as disease progression, the prevention of infection transmission, length of patients' hospital stay, and the control of infections resistant to treatments. Other factors included: education, awareness, lifestyle, personality, and organisational culture.

							Outcome expectations: preventing infection. Perceived barriers: skin dryness, the destruction of nails. Education: lack of awareness of hand infections. Organisational Culture: Salience: understanding the role of hand hygiene Lifestyle: culture of hand hygiene (family and community). Personality: having a strong personality. Morality: conscience, fairness, feeling responsible towards others	Hand hygiene as a moral norm in preventing the transmission of infection.
Efstathiou et al. (2011)	To examine factors that affect nurses' adherence to standard precautions in order to prevent occupational	Qualitative design Country: Cyprus Settings: Different departments in two public general	Focus groups (n = 4)	Purposive sampling 32 nurses The majority of participants were female nurses (26)	Standard precautions	All HAIs, which includes any or all HAIs such as urinary tract infections and surgical site infections.	The study used the health belief model (HBM) to understand the factors that influence nurses' compliance with standard precautions. These factors are as follows:	The barriers constructed by the HBM incorporated most of the factors that represent those that may prevent nurses from

	exposure to infections.	hospitals in Cyprus, e.g. general surgery, neurosurgery, plastic surgery, internal medicine, operating theatres, ICUs, cardiology intensive care units, ear-nose-throat surgery departments, paediatric and orthopaedic departments, and burns units.					Lack of availability of protective equipment. Negative impact of protective equipment on nurses' appearance. Changing current behaviour. Lack of knowledge or awareness of the guidelines. Fear of infections. Lack of time. Lack of support from colleagues and supervisors. Inadequate training. Inadequate communication. Inadequate feedback. Inadequate monitoring. Inadequate resources.	conforming with the guidelines. The study also identified some factors that had not been reported before, such as the negative impact of protective equipment on nurses' appearance.
Salem and Youssef (2017)	To identify healthcare providers' perspectives on providing good-quality infection control measures.	Qualitative design Country: Egypt Setting: NICU Cairo University Hospital	Semi-structured interviews	Purposive sampling 3 medical staff and 10 nurses. All study participants were women.	Infection control measures	All HAIs	The study identified barriers to infection control measures, including: Shortage of staff. Limited access to protective equipment.	The staff face different challenges to implementing infection control measures. These include shortage of nursing staff, limited opportunities

				Most of the participants were married and aged between 28 and 55 years. 3 to 25 years of work experience. All nurses had attended infection control courses.			Lack of health education materials. Lack of continuous training in infection control skills. Lack of time to apply infection control standard guidelines due to workload and patient-to-nurse ratio. **Suggestions/modifications** Leadership: Feedback from colleagues on their adherence to infection control guidelines	for infection control training, workload, and lack of time to apply the infection control measures.
Paul et al. (2020)	To Identify HCWs' perspectives on HAIs To identify current problems in ICP and potential solutions.	Mixed methods Ethnography Country: Saudi Arabia Tertiary care - single site Paediatric ICU, adult ICU, emergency, surgical, and anaesthetics	**Survey:** Self-completion questionnaire developed for this study. Pilot data discarded. Good validation process for tool. **Interview** Semi-structured	HCWs with >6 months' experience **Survey:** Random sample from all nurses and medics (n = 50) 34% nursing staff and 56% male **Interview**	General in phases 1 & 2 In phase 3, "routine sterile procedure" recorded. Maintaining a sterile field.	All HAIs	**Interviews**: Participants reported regular IPC updates from the organisations. Knowledge about PPE use, blood spills, and waste management was poor but was better amongst nurses than medics. Limited knowledge about HAIs among Saudi-trained staff.	Excellent consideration given to potential bias, including the Hawthorne effect, although potential bias in recruitment process for qualitative phases. VRR and discussion/ reflection were

			Observation Video reflexive recording (VRR) and discussions	Convenience/ snowballing (n=40) 40% nurses (16); 40% residents (16); 20% consultants (8). 6% adult ICU **VRR** Sub-sample of interview sample			Recommendations to have regular information and practical sessions. **VRR** Observation: areas of poor compliance from time of handwashing to use of mask to maintaining a sterile field. Face covering: noted that nurses in particular wearing a face covering perceived this was adequate for IPC and did not add a mask. Time pressure was a barrier to good IPC practice.	useful research tools. Participants requested additional information but were not utilising information already available. The authors state that education may not improve practice but also identified significant gaps in knowledge of IPC and HAI among the sample.
Atashi et al. (2018)	To explore the perspectives of Iranian critical care nurses on the barriers to VAP prevention in ICUs.	Qualitative Country: Iran Setting: ICU in a teaching hospital	Semi-structured interviews. Observations and field notes. Observations lasted 0.5 hr-7 hrs with a mean of 1.90 hrs	Purposive sampling 23 critical care nurses aged between 20 and 50 years 20 had a bachelor's degree in nursing, 3 had a	Ventilator bundles	Ventilator-associated pneumonia (VAP)	The study identified three main barriers to the prevention of VAP. **Unfavourable professional attitudes:** Limited professional knowledge. Low level of motivation for the job. Limited professional accountability **Environmental factors:**	This study looked at the challenges to VAP prevention in ICUs from the perspective of critical care nurses. These barriers included personal, environmental, and

			The total length of the observations was 100 hours.	master's degree 4 nurses had less than 1 year's experience in ICU, 14 had 1-5 years, and 5 had more than 5 years of professional experience. Position: 19 nurses, 1 head nurse, 3 supervisors			Non-standard physical structure. Inadequate or inappropriate equipment. Heavy workload. **Human resource management:** Staff shortage. Inadequate staff training. Ineffective supervision.	organisational barriers.

Table 3.4 below summarises the factors that affect HCWs' adherence to IPC practices. During data analysis, certain themes related to HCWs' adherence to IPC practices began to emerge. These themes fell into two categories: organisational and individual factors. This categorisation was informed by both the data from the reviewed studies and relevant literature. Organisational factors were identified based on discussions of external structural issues within the healthcare system including leadership, training, the overall safety culture and resources. The categorisation was further supported in the literature e.g., Houghton et al. (2020) which similarly defines organisational influence. Individual factors were identified in the reviewed studies and aligned with prior research where participants discussed their personal beliefs, attitudes, and motivations related to IPC adherence. These themes were categorised as individual factors as they reflected personal, internal influences on behaviours (Houghton et al., 2020).

Table 3. 4: Summary of the key findings

Organisational factors	Individual factors
1. Theme: leadership and organisation culture Subtheme: Monitoring and feedback Subtheme: Leadership influence and reward system Subtheme: Influence of peers on IPC adherence **2. Theme: Impact of education and awareness on IPC practices** Subtheme: Lack of continuous training programmes Subtheme: innovative educational strategies **3. Theme: Environmental factors** Subtheme: Workload Subtheme: Supplies Subtheme: Adherence challenges during emergency situations	**1. Theme: knowledge and awareness of IPC practices** **2. Theme: Beliefs in IPC and the value placed on it** Subtheme: Moral and ethical beliefs Subtheme: Cultural and habitual practices Subtheme: Balancing self-protection and protecting others in IPC adherence **3. Theme: Impact of patients' characteristics on adherence**

3.4 Organisational factors

This category consists of all the factors related to the structural and cultural components of healthcare settings that influence HCWs' adherence to IPC practices. It explores how leadership, the general safety culture, training, and resources either facilitate or impede HCWs' adherence to IPC practices (Henderson et al., 2020, Houghton et al., 2020).

3.4.1 Theme: Leadership and organisation culture

Based on the findings from four studies, this theme illustrates the potential role of leadership and role modelling in encouraging and discouraging HCWs' adherence to IPC practices.

3.4.1.1 Subtheme: Monitoring and feedback

The findings from four of the reviewed studies indicated that, while there was some recognition of the importance of monitoring, there was a lack of strong evidence demonstrating its effectiveness in practice (Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Salem and Youssef, 2017, Atashi et al., 2018).

Participants in Atashi et al.'s study (2018), which was conducted in a mixed ICU in a teaching hospital in Iran, involving 23 nurses, anticipated that supervision could enhance adherence among HCWs. However, the study revealed that supervision, in practice, was found to be ineffective as the current supervisors had insufficient skills or insufficient knowledge of supervision. This highlights a gap in the healthcare system's infrastructure concerning support for effective infection control oversight. Thus, while supervision was initially considered a potential mechanism for enhancing adherence, the actual barrier to its effectiveness was the lack of sufficiently skilled and knowledgeable supervisors.

"… our participating nurses and nursing managers noted that they had no adequate time for supervision, received no supervision-related training and had limited knowledge and skill for effective supervision". Authors' interpretation (Atashi et al., 2018).

The limitation imposed on supervisory monitoring may result in deficiencies in monitoring adherence, which could compromise the ability of healthcare facilities to maintain strict IPC practices and consequently patient safety.

Participants in the study by Lohiniva et al. (2015), conducted in teaching hospitals in Egypt, also emphasised the broader issue of the hospital's monitoring of hand hygiene guidelines among nurses (n = 96) through focus groups in all units. They stated that no one was monitoring hand hygiene practices in the studied

departments. This lack of monitoring raises concerns about the prioritisation of IPC practices across different areas of the hospital. While Lohiniva et al. (2015) did not specifically address this, it suggests a lack of consistency in safety culture, which may result in varying levels of adherence to IPC practices. The lack of monitoring suggests a potential weakness in patient safety protocols, which could lead to inconsistencies in the quality of care and safety standards across different hospital departments. The perceived lack of monitoring could be attributed to factors including organisational priorities, leadership approaches, staff attitudes, workload, and the perceived importance of IPC within each department. While these factors were discussed in the study, a detailed comparison of these factors between the included departments was not provided. Furthermore, the use of focus groups in Lohiniva et al. (2015) introduces a different dynamic to data collection. While it may result in greater understanding of collective experiences, the perceptions of supervision, and feedback in hospital settings, the group setting might also limit individual disclosure, particularly on sensitive topics related to supervision, compared to one-to-one interviews used in other studies.

Participants in Salem and Youssef (2017) described their approach to monitoring infection control practices in the NICU at an Egyptian university hospital. The authors justified their focus on the NICU due to the high rates of infections reported in several NICUs. Their monitoring approach included a two-level system. The first level involved daily visits by a paediatric specialist to the neonatal ICUs, focusing on monitoring adherence to IPC practices. The second level contained daily rounds by the infection control team nurses throughout all hospital wards, with subsequent reports to the head of the infection control team. While this structured approach aimed to maintain high standards of infection control practices across the hospital departments, this approach was ineffective due to different factors such as leadership, shortage of staff, and the availability of resources. For instance, ineffective leadership may have led to a lack of support and prioritisation for infection control initiatives; staff shortages hindered the ability to consistently monitor and enforce adherence to practices; and resources constraints such as training further compromised the effectiveness of monitoring strategies. Moreover, the nature of these daily rounds and whether they involved inspections, observations of practice, or other activities was not reported in the study.

Furthermore, participants in Ng, Shaban and van de Mortel (2017) suggested that benchmarking can motivate them to be more adherent, stating,

"I compare the hand hygiene compliance rate in my unit with other units. If I see other units have higher compliance rate than my unit this month, it will motivate me and my colleagues." Participant from a focus group (Ng, Shaban and van de Mortel, 2017).

Benchmarking, as a form of monitoring, draws on the human tendency to compare our own performance with that of peers, in this case prompting efforts to increase adherence rates. These types of interactions highlight the importance of designing systems that openly discuss hand hygiene adherence rates among units to promote a healthy sense of competition and continuous improvement. This approach encourages a culture of accountability and collective responsibility for adherence with IPC, in addition to encouraging units to raise their standards.

3.4.1.2 Subtheme: Leadership influence and reward system

This subtheme examines how clear expectations set by leaders establish the groundwork for IPC practices. Leadership is important for establishing IPC expectations, as highlighted by six studies (Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Salem and Youssef, 2017, Atashi et al., 2018, Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020). This subtheme includes the following: role modelling, rewards, and incentivisation.

Role modelling

Khuan, Shaban and van de Mortel (2018) conducted a mixed-methods study and identified factors influencing hand hygiene among HCWs based on the TPB in the UAE. Their findings highlighted the influence of the IPC committee on HCWs' adherence to hand hygiene.

"The infection prevention and control committee has the strongest influence on me and they always expect me to perform hand hygiene." Participant doctor (Khuan, Shaban and van de Mortel, 2018).

This quote highlights the potential impact of leadership on motivating HCWs through clear, consistent expectations and highlighting hand hygiene as a crucial component of patient care and worker safety.

Although these opinions are valuable in understanding the factors that HCWs believe influence their behaviour, they indicate a deeper need for exploring the mechanisms underlying such beliefs. It specifically highlights concerns over the translation of leadership directives and committee efforts into measurable actions and outcomes. While the study primarily aimed to explore cultural and religious factors that influence hand hygiene adherence, it is worth noting that the participants reported feeling motivated when observing good practices. This suggests that leadership behaviour contributes to the culture of hand hygiene within healthcare settings, which emphasises the importance of effective role modelling in promoting adherence.

Further evidence from the study conducted by Salem and Youssef (2017) supports the role of leadership in promoting IPC culture. The study employed a qualitative approach that involved 10 nurses and 3 medical staff working in an Egyptian university hospital. The participants reported that the IPC culture was influenced by the leadership of the organisation and that having supportive leaders was important for the successful implementation of educational programmes. However, the study did not examine the impact of leadership on hand hygiene practices which could be attributed to the use of a qualitative approach. In other words, the study focused on capturing the participants' experiences and perceptions rather than quantitatively measuring the direct impact of leadership on hand hygiene practices.

"The respondents affirmed that the culture is influenced by the leadership of the organization. If you do not have the culture, you can have the best education programme in the world, but it will not be taken up at all if it is not supported by the leaders". Authors' interpretation (Salem & Youssef, 2017).

Role modelling was perceived as largely positive by some studies, including that by Ghaffari et al. (2020). However, both Ghaffari et al. (2020) and Lohiniva et al. (2015) reported instances where poor role modelling by leaders contributed to a negative

workplace attitude. Ghaffari et al. (2020), who conducted 16 in-depth semi-structured interviews at a university hospital in Iran, suggested that observing leaders practising hand hygiene can have a positive impact on HCWs' attitudes and perceptions towards hand hygiene practices, as shown in the following excerpt.

"They (supervisors and doctors) are really effective. Those above us set a model for us. When, for example, I see that the head nurse washes hands always when visiting a patient, I get impressed." Participant nurse (Ghaffari et al., 2020).

While the study did not provide direct evidence of whether being impressed by supervisors actually led to increased adherence to hand hygiene, the concept of positive role modelling aligns with the TPB, which was used in Ghaffari et al. (2020). Based on the TPB, subjective norms, which include perceptions of what significant others expect or approve of, can affect individuals' intentions and behaviours. Therefore, the impression made by a leader's adherence to IPC practices potentially encourages a culture of adherence and individual accountability among HCWs, thereby bridging the gap between admiration and real adherence.

The duality of role modelling in healthcare settings—its ability to encourage or discourage hand hygiene practices—is further examined through the lens of Ghaffari et al.'s (2020) study. This highlights role modelling as a mechanism that can serve as both a potential facilitator and a potential barrier to IPC practices, based on the consistency of leaders' actions with their messages.

"*When my top rank does a certain thing, I do too. Also, if I think that the head nurse, although she recommends hand hygiene but does not practice this behaviour herself, this behaviour of her will have a deterrent effect for me and others like me*." Participant nurse (Ghaffari et al., 2020).

This finding emphasises the need for alignment between recommended hand hygiene practices and leaders' actual behaviours, demonstrating how role modelling can influence HCWs' adherence to IPC practices, either fostering a sense of commitment or undermining trust in the advocated protocols.

Additionally, some participants, particularly the nurses in Lohiniva et al.'s (2015) study, reported a concerning practice that acts as an example of poor role modelling.

"… respondents explained that they sometimes continued their work with blood on their hands following the example of physicians." Authors' interpretation, (Lohiniva et al., 2015).

The study by Lohiniva et al. (2015), conducted in teaching hospitals in Egypt among nurses (n = 96) through focus groups, highlighted that nurses often found it challenging or embarrassing to ask doctors for permission to wash their hands while working. This particularly occurred when doctors did not prioritise hand hygiene. This aspect suggested that while poor role modelling by doctors and lack of enforcement of hand hygiene polices were important factors, the reluctance of nurses to proactively engage in hand hygiene practices due to social norms and perceived barriers also contributed to their non-adherence. Thus, hand hygiene practices in the study were influenced by a combination of factors, including poor role modelling, lack of enforcement, and social norms.

Furthermore, the analysis of the supervisory influence on hand hygiene practices, especially the preferences for alcohol-based hand rubbing, was highlighted by participants in the study by Khuan, Shaban and van de Mortel (2018).

"My supervisors are always focusing on alcohol-based hand rubbing than handwashing because it is more practical." Participant doctor (Khuan, Shaban and van de Mortel, 2018).

The findings of the study indicated that supervisors' preferences and practices can influence IPC practices and potentially lead to higher adherence, as well as a higher preference for alcohol hand rubbing among HCWs. Although efficacy and practicality are important factors, effective leaders should advocate a balanced approach, so that HCWs also understand the importance of traditional hand hygiene in certain situations. This ensures optimal infection control and patient safety.

The role of leadership in IPC adherence has been illustrated in four studies conducted in Iran, the UAE, and Egypt. These studies have highlighted the important influence of leadership on HCWs' adherence to IPC practices. However, this theme was not explored in the reviewed Saudi studies. This gap in the literature presents an opportunity for future research to explore the role of leadership in influencing IPC adherence in Saudi Arabian healthcare facilities to enhance infection control practices and patient safety.

Rewards and incentivisation

An essential component of developing a supportive organisational culture is the implementation of reinforcement and reward systems, as reported in three studies. This section explores how rewards can play a role in motivating HCWs to improve IPC practices. For instance, participants in the study by Atashi et al. (2018) suggested that rewards and reinforcement could motivate them to be more adherent. Similarly, participants in Ghaffari et al. (2020) highlighted the importance of rewards and recognition to encourage adherence to IPC practices. However, this aspect was not specifically addressed in their findings. The study primarily focused on the influence of leadership behaviours, social norms, and environmental factors on adherence, rather than directly examining rewards as a motivator.

On the other hand, the participants' experiences with disciplinary actions, introduced by Ng, Shaban and van de Mortel (2017), highlighted the negative consequences of punitive measures in the context of IPC adherence:

"*I was washing my hands at all times and my name was reported just because I forgot to perform hand hygiene once. I was not praised when I was doing well but I was punished when I made a mistake only once*." Participant nurse (Ng, Shaban and van de Mortel, 2017).

The statement highlights the importance of recognition and positive reinforcement in promoting hand hygiene practices. However, the study did not explicitly mention the influence of recognition and reinforcement on enhancing adherence. Although accountability is important, the punitive strategy suggests that these actions could have unforeseen negative effects, including demoralisation and possible

disengagement from IPC practices. Creating an organisational culture where positive reinforcement and constructive feedback are valued more than punitive actions is the key to achieving the right balance. Recognising and praising adherence, as well as providing constructive feedback for development, can promote motivation and adherence to IPC practices. This approach is consistent with broader strategies aimed at developing a supportive organisational culture, where rewards and encouragement play a role in fostering desired behaviours. Ghaffari et al. (2020) and Atashi et al. (2018) offer perspectives on IPC from critical care units such as ICU, CCU, and NICU, which could potentially limit the transferability of the findings to other settings. However, Ng, Shaban and van de Mortel (2017) included all hospital departments, reflecting a more comprehensive view of the factors related to IPC practices, particularly concerning the culture of the organisation.

3.4.1.3 Subtheme: Influence of peers on IPC adherence

Data from four studies showed the potential positive influence of peers on HCWs' adherence to IPC practices (Ng, Shaban and van de Mortel, 2017, Khuan, Shaban and van de Mortel, 2018, Saleem et al., 2019, Ghaffari et al., 2020). While some participants in Salem and Youssef (2017) identified the potential role of feedback from colleagues on adherence to infection control practices at a hospital in Egypt, the majority of them reported that they felt reluctant to advise their colleagues on IPC practices. This reluctance could be due to the lack of a supportive culture fostered by leadership, which is important for encouraging open communication and feedback among staff. When leaders do not actively promote a culture of safety and collaboration, HCWs may feel uncomfortable about addressing their peers' adherence due to fear of conflict. In addition, hierarchical structures within the workplace can further discourage open communication, which makes staff hesitant to speak about IPC issues.

Ng, Shaban and van de Mortel's (2017) study in the UAE further highlights the impact of peer influence on hand hygiene practices among HCWs, revealing that,

"Peer reminders, witnessing others' performance and making comparisons with peers and colleagues were considered triggers for HCP to perform hand hygiene." Authors interpretation (Ng, Shaban and van de Mortel, 2017).

This demonstrates the important role of social interaction and the observations of peer behaviours in encouraging adherence to hand hygiene practices. In addition to providing a means of social accountability, peer reminders and observing colleagues actively practising hand hygiene serve as facilitators, leveraging communal norms to improve adherence. These peer-driven effects highlight the need to foster an environment in which positive IPC practices are promoted and openly demonstrated.

Furthermore, some of the reviewed studies did not mention the influence of peers, which could be because they did not identify peer influence as an important finding due to the nature of the collected data or the specific focus of their research. On the other hand, the mention of peer influence in the above four studies might be due to the methodological approaches of these studies. For instance, both Ghaffari et al. (2020) and Khuan, Shaban and van de Mortel (2018) used the TPB. Thus, it is not surprising that the role of peer influence in shaping individual behaviours was discussed, as it could be linked to subjective norms within the TPB; people are influenced by their perceptions of what their peers expect them to do. Moreover, peer influence was identified and discussed by Ng, Shaban and van de Mortel (2017), possibly due to the use of focus groups or specific interview questions. In addition, both of the studies by Ng, Shaban and van de Mortel (2017) and Khuan, Shaban and van de Mortel (2018) were conducted by the same authors in the UAE. Therefore, the contextual factors of the healthcare settings in the same area could influence the interpretations of the findings of the study. For instance, cultural norms and practices in the UAE may influence HCWs' perceptions and discussions about peer influence. Furthermore, the way researchers design their studies and develop their questions could be shaped by existing evidence or specific hospital and team dynamics. Moreover, insights from Ghaffari et al. (2020) in Iran shed light on the important roles of peer influence in shaping hand hygiene behaviours among nurses, with similar observations reported by Ng, Shaban and van de Mortel (2017), Salem and Youssef (2017) and Khuan, Shaban and van de Mortel (2018), offered a broader perspective by including doctors, nurses, and allied HCWs, providing a holistic view of peer influence.

3.4.2 Theme: Impact of education and awareness on IPC practices

3.4.2.1 Subtheme: Lack of continuous training programmes

The participants from four studies showed that some HCWs did not receive training in infection control due to a lack of training in their particular settings (Efstathiou et al., 2011, Salem and Youssef, 2017, Atashi et al., 2018, Paul et al., 2020). Thus, this could act as a potential barrier to effective IPC. The desire for more frequent training and workshops was also discussed under this theme.

Paul et al. (2020) was assessed to be a high-quality study. It employed a mixed-method approach at a tertiary care hospital in Saudi Arabia and revealed a gap in IPC training. For instance, some participants highlighted that the training related to PPE was insufficient,

"I have not received proper training on PPE." Participant paediatrics consultant (Paul et al., 2020).

While Paul et al. (2020) emphasised the importance of training programmes for junior residents, the consultant's statement suggests that inadequate training may also extend to senior HCWs. This observation raises questions about the presumption that training deficiencies are limited to junior staff. Although the study highlights the need for training initiatives, it does not explicitly address the training needs of senior HCWs, indicating a potential oversight in the study. This indicates that healthcare organisations need to review and improve their PPE training programmes to ensure they are adequately comprehensive, accessible, and tailored to meet the needs of all HCWs, regardless of their experience or rank. Proper training on PPE is essential to protect HCWs and prevent the transmission of infections within healthcare settings. This also highlights the need for further studies exploring the factors influencing IPC adherence among HCWs with different levels of experience. Therefore, this was further explored in the context of Saudi hospitals in phase 3 of the current PhD study.

Furthermore, Salem and Youssef (2017) found that only nurses, from a sample consisting of 3 medical staff and 10 nurses, demonstrated a willingness to attend IPC trainings. Even then, their participation was often restricted by their schedules and

workloads. The director of the infection control unit noted that based on their observations, doctors in particular were not interested in participating in IPC training. This perception may stem from a misconception among some doctors that they are not accountable for IPC practices, which leads to the belief that IPC training is primarily the responsibility of nurses. However, it is important to consider whether these observations reflect a consensus among the broader medical staff, especially given that only 3 doctors participated in the study, which limits the range of perspectives. The analysis in the study suggests that a combination of factors, including the content and delivery of educational programmes as well as misunderstandings over roles in IPC practices, acts as a potential barrier to attending these programmes. However, the narrow participation base highlights the study's limitations in capturing a comprehensive perspectives of IPC attitudes across all groups of HCWs.

Furthermore, the study by Salem and Youssef (2017) explained that the lack of knowledge of HCWs' roles in infection control and the importance of infection control training is attributable to insufficient IPC training in Egyptian medical education at both undergraduate and postgraduate levels. This explained the non-participation and the knowledge deficit among doctors. The moderate quality of the study by Salem and Youssef (2017), which is marked by methodological problems yet is reinforced by efforts to achieve data saturation, highlights the significance of addressing these educational disparities. However, the specific participant selection could limit the transferability to other healthcare settings or professional groups. Even with its minor limitations, the study's findings provide insights into the organisational challenges involved in implementing successful IPC training programmes and highlight the need for inclusive training approaches that include the entire healthcare team. Salem and Youssef (2017) also highlighted that the current traditional education programmes in their hospital are ineffective and need to be improved, which is further discussed under the subtheme innovative educational strategies.

Atashi et al. (2018) conducted a study at an Iranian teaching hospital with critical care nurses. It highlighted similar findings to the study by Salem and Youssef (2017) in addition to other challenges related to training programmes as described by the

participants. These included inadequate and ineffective IPC training programmes, and a lack of critical performance evaluation at the end of the provided training. Overall, the collective findings of these three studies highlight the need to improve the quality, relevance and effectiveness of IPC training programmes to support HCWs in providing safe patient care.

3.4.2.2 Subtheme: Innovative educational strategies

The importance of improving education was consistently highlighted by participants in three of the included studies (Efstathiou et al., 2011, Salem and Youssef, 2017, Ghaffari et al., 2020). However, these studies discussed the need for enhanced IPC education rather than demonstrating that such improvements were already being implemented. Participants emphasised the necessity of updating IPC education with interactive and practical strategies, but the effectiveness of these strategies in improving IPC practices was not identified in these studies. In order for IPC training to be effective, this subtheme suggests that it should incorporate methods that engage learners, promote active engagement, and are directly related to their everyday experiences and challenges in healthcare settings.

Participants in the included studies highlighted the need to improve educational strategies and suggested various such strategies for improving HCWs' adherence to IPC practices. These included audiovisual materials (such as desktop computers, messages, and LED displays) (Ghaffari et al., 2020, Salem and Youssef, 2017) and case studies (Salem & Youssef, 2017). In addition, participants in both Efstathiou et al. (2011) and Ghaffari et al. (2020) suggested that constant “reminders” could greatly improve adherence. These would include distributing leaflets to nursing staff, putting up small posters around the wards, and providing regular reminders from senior nursing officers about the risk of infections and the benefits of following IPC practices. However, it is important to note that Ghaffari et al.’s (2020) study did not include details on the content, implementation or effectiveness of these strategies, including audiovisual aids, in promoting hand hygiene adherence. The limited mention of detailed educational strategies in Ghaffari et al. (2020) could be due to the use of qualitative content analysis, which may have not captured the nature of the educational interventions needed for effective IPC adherence. Furthermore, the use of focus groups in Efstathiou et al. (2011) allowed for a

collective reflection on these strategies, revealing how reminders could effectively sustain IPC adherence. These data also highlighted the willingness of the patients to be more educated about IPC practices to enable them to follow IPC practices.

Furthermore, Ghaffari et al. (2020) and Ng, Shaban and van de Mortel (2017), explored teaching strategies used to reinforce hand hygiene practices in their healthcare settings. For instance, a participant in Ghaffari et al. (2020) highlighted the previous use of random hand culture tests to illustrate the significance of hand hygiene for preventing the spread of infections. The observable outcomes of these tests served as an immediate feedback mechanism. Similarly, the study by Ng, Shaban and van de Mortel (2017) indicated that the use of ultraviolet hand scanners as an educational tool reinforced the need for proper hand hygiene among HCWs. However, although the majority of the participants in Ng, Shaban and van de Mortel (2017) reported the effectiveness of ultraviolet hand scanners as an educational tool, the actual impact of this tool was not examined in the study due to the study's focus on exploring the knowledge and beliefs of HCWs regarding hand hygiene.

3.4.3 Theme: Environmental factors

This theme examines how different aspects of healthcare settings affect HCWs' adherence to IPC practices, including workload, supplies, and emergency situations.

3.4.3.1 Subtheme: Workload

One of the most common factors influencing HCWs' adherence identified in this review is workload. The study by Salem and Youssef (2017) emphasised the obvious but significant link between a high patient-to-nurse ratio and an increase in workload, which restricts nurses' time and compromises their adherence to IPC practices. A high workload due to issues with staffing levels was highlighted by most of the included studies (seven) . Moreover, the presence of time pressures and heavy workloads may result in rushed procedures and therefore lower hand hygiene adherence, acting as a significant barrier to maintaining IPC practices (Efstathiou et al., 2011, Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Salem and Youssef, 2017, Atashi et al., 2018, Ghaffari et al., 2020, Paul et al., 2020). The

following statement made by the nurses in Salem and Youssef (2017) illustrates the influence of workload on IPC adherence:

"It is the workload, sometimes things are more difficult when you have many patients and you have to do everything very fast, and there is a lack of time even to wash your hands." Participant nurse (Salem and Youssef, 2017).

This highlights the conflict between IPC adherence and patient care requirements and shows how directly an excessive workload affects the ability to maintain IPC practices. In three studies (Efstathiou et al., 2011, Salem and Youssef, 2017, Atashi et al., 2018), a purposive sampling approach was used to select participants with diverse experiences in critical care areas. This strategy allowed for an in-depth exploration of how HCWs perceive the impact of workload on IPC adherence. For instance, in Atashi et al. (2018) the shortage of competent staff was identified as another barrier to effectively preventing VAP. The lack of these competent nurses increased workload, caused fatigue and burnout among the staff, and exposed patients to VAP. Furthermore, the participants in most of the studies reported that there was a need to increase the staffing levels, particularly of nurses, to reduce the workload level and enhance the staff's ability to adhere to IPC practices, suggesting increasing staff numbers as a potential facilitator of better IPC adherence. This reflects a broader systematic issue within healthcare settings that requires strategic interventions (Efstathiou et al., 2011, Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Salem and Youssef, 2017, Atashi et al., 2018).This collective body of evidence makes a compelling case for addressing workload as a crucial factor in determining IPC adherence and it highlights the necessity of organisational and policy changes to ensure sufficient staffing and support for HCWs.

In addition, the consistent impact of workload on IPC practices across varied healthcare settings and disciplines in the reviewed studies indicates a universally applicable challenge. Although these studies acknowledged workload as a barrier to IPC adherence, the analyses of Ghaffari et al. (2020) did not explore in depth specific aspects such as staffing ratios. The depth of exploration of these workload-related factors may have been influenced by the use of the TPB as the theoretical framework of the study.

3.4.3.2 Subtheme: Supplies

All of the included studies identified issues with resources. A lack of resources, including hand hygiene supplies (soap and alcohol hand rub) and PPE, was a consistent barrier to adhering to IPC practices. However, the nature of these challenges differed over time and across various clinical areas. For instance, participants in the study of Atashi et al. (2018) commented on the lack of some essential equipment needed to perform the necessary preventative measures for VAP, including a double-lumen endotracheal tube for subglottic suctioning. Lohiniva et al. (2015) and Khuan, Shaban and van de Mortel (2018) reported that hand hygiene products were not available, including soap and alcohol hand rub; Efstathiou et al. (2011) reported a shortage of PPE, including gloves and masks; and Paul et al. (2020) reported a shortage of gowns. Furthermore, participants in five studies found that a lack of access to supplies was a common issue that restricted HCWs' adherence. This issue is often due to the physical structure of departments, such as a limited number of sinks being available (Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Salem and Youssef, 2017, Atashi et al., 2018, Khuan, Shaban and van de Mortel, 2018).

"The hand washing sink is not accessible everywhere." Participant nurse (Khuan, Shaban and van de Mortel, 2018).

While the majority of the reviewed studies emphasised the importance of addressing barriers related to the availability and accessibility of supplies required for IPC practices, they did not explore in depth factors such as supply chain issues, budget allocation, or administrative support. This could be due to the focus of these studies, which was primarily on identifying factors influencing adherence to IPC practices. However, the two Egyptian studies by Lohiniva et al. (2015) and Salem and Youssef (2017) reported that the issue of a lack of supplies was common in healthcare facilities in Egypt. In addition, Lohiniva et al. (2015) reported briefly that the lack of supplies was due to the unavailability of people responsible for managing the supply stores which hindered supply accessibility. Addressing these supply and infrastructure-related issues is critical for maintaining patient and HCW safety, as well as maintaining adherence to IPC practices. This discrepancy between policy and practice necessitates a re-evaluation of the current healthcare system, urging a shift

towards a more supportive environment that aligns with IPC practices and the operational demands of HCWs.

It is noteworthy that one of the most recent studies included in this review, that by Paul et al. (2020), presents an outlier perspective. The participants reported no significant shortcomings in the availability of basic hand hygiene products such as soap. This finding prompts a reflection on the potential advancements in resource allocation and infrastructure that might have occurred over time within healthcare settings. It also raises questions about the disparities in resource accessibility among various institutions or regions, which highlights the need for consistent standards to provide all healthcare facilities with equitable access to hand hygiene resources.

3.4.3.3 Subtheme: Adherence challenges during emergency situations

Three studies found that HCWs had difficulties adhering to IPC practices during emergency situations such as those encountered in ICUs (Efstathiou et al., 2011, Ng, Shaban and van de Mortel, 2017, Atashi et al., 2018). For instance, the use of PPE could be compromised due to the urgency of providing life-saving care, as highlighted by the participants in the study conducted by Efstathiou et al. (2011). Similarly, participants in the study of Ng, Shaban and van de Mortel (2017) reported that hand hygiene practices are not prioritised when providing care for critically ill patients.

"I find it difficult to wash my hands properly if I have to handle three ventilated critically ill patients." Participant nurse (Ng, Shaban and van de Mortel, 2017).

Furthermore, the mention of difficulties with adherence to IPC practices in these three studies could be attributed to the use of focus groups in Ng, Shaban and van de Mortel (2017) and Efstathiou et al. (2011), as well as to the use of purposive sampling in Atashi et al. (2018). The group dynamics in focus groups may have revealed collective perspectives on the challenges associated with emergency situations. Similarly, the use of purposive sampling in ICUs by Atashi et al. (2018) could lead to the inclusion of HCWs who have experienced IPC challenges during emergencies. This methodological approach may therefore highlight particular challenges that might be less evident in studies using other sampling approaches.

3.5 Individual factors

This category addresses factors that are tied specifically to individual HCWs' beliefs, attitudes, practices, and decisions in the context of IPC (Henderson et al., 2020, Houghton et al., 2020). The focus is on exploring internal factors that immediately affect the implementation of IPC practices within healthcare settings.

3.5.1 Theme: Knowledge and awareness of IPC practices

This subtheme demonstrates variances in HCWs' knowledge of IPC practices across five studies (Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Atashi et al., 2018, Ghaffari et al., 2020, Paul et al., 2020). A knowledge gap was seen specifically regarding hand hygiene practices across all these studies. In addition, Paul et al. (2020) found low awareness of the types of HAIs and the use of PPE. This difference in awareness could be attributed to the aim of these studies, which was primarily to explore the factors influencing hand hygiene adherence. However, the Saudi study conducted by Paul et al. (2020) examined the perspectives of HCWs on HAIs and all IPC practices, and it showed differences in HCWs' awareness. The knowledge gap on hand hygiene was also noted by Atashi et al. (2018), who explored the perspectives of Iranian nurses on the barriers to the prevention of VAP.

While the five studies demonstrated a knowledge gap over IPC practices, those by Khuan, Shaban and van de Mortel (2018) and Ghaffari et al. (2020) provided a more extensive range of examples that illustrated low awareness compared to the other three studies. When comparing these two studies, it was evident that both analysed their data using the TPB, which could structure their interpretation and explain their findings. However, the use of TPB could limit their ability to explore broader contextual and systematic factors influencing hand hygiene practices. For instance, Ghaffari et al. (2020) identified barriers including skin irritations, forgetfulness, and a lack of proper hand hygiene products as factors that contributed to this low awareness. Similarly, the study by Khuan, Shaban and van de Mortel (2018) not only used the TPB but also explored HCWs and Islamic scholars' perceptions of the religious and cultural beliefs affecting the hand hygiene practices among HCWs in the UAE. This study found that the majority of participants demonstrated a low

awareness of the effectiveness of alcohol hand rubs compared to hand washing, as illustrated in the following example.

"… participants commented that alcohol-based hand rub retains dead microorganisms on hands." Authors' interpretation (Khuan, Shaban and van de Mortel, 2018).

Khuan, Shaban and van de Mortel's, (2018) study revealed misconceptions regarding the persistence of killed bacteria on hands following the use of ABHRs, suggesting a potential misunderstanding of the function of these products and indicating a barrier to hand hygiene adherence due to a knowledge gap. The majority of the participants reported that they preferred to wash their hands with soap and water. These preferences indicate a perceived superiority of handwashing in achieving complete decontamination, possibly due to the physical removal of pathogens. The comparison of different views among HCWs, including doctors, nurses, and allied health professionals, highlights important queries regarding the factors affecting HCWs' adherence to hand hygiene practices. It emphasises the necessity of educating individuals and maintaining clear communication regarding the effectiveness and appropriate use of various hand hygiene techniques.

Another two studies found that the participants had knowledge deficits with regard to hand hygiene practices (Lohiniva et al., 2015, Atashi et al., 2018). They highlighted a misconception that hand hygiene was not essential when hands appeared visually clean, demonstrating a knowledge gap about cross-infections and hand hygiene practices. This was illustrated by a participant in Atashi et al. (2018) who stated that,

" I do not wash my hands unless I find them really contaminated, because I believe that infection is not transmitted as easily as they say." Participant nurse (Atashi et al., 2018).

This highlights a fundamental challenge in IPC adherence related to the influence of personal perceptions and misconceptions of hand hygiene adherence. Cultural attitudes towards hygiene in the Middle East including Iran and Egypt may prioritise visible cleanliness over the less apparent aspects of infection control, contributing

to these misconceptions. Beliefs that minimise the ease of infection transmission put patients, HCWs and the broader healthcare environment at risk. This finding supports the suggestions for improved educational strategies as discussed under the subtheme of innovative educational strategies and highlights the need for targeted educational interventions that address and correct the misconception about the spread of infection. It further emphasises the importance of hand hygiene as a cornerstone of successful IPC practices. To promote a culture of adherence and safety, it is important to reinforce the evidence-based realities about how infections spread within healthcare settings.

Many nurses in Lohiniva et al. (2015) held the misconception that wearing gloves was sufficient to avoid infection. This belief highlights a knowledge gap in understanding the role of gloves as a complement to, rather than a replacement for, hand hygiene practices. Similarly, some participants in Atashi et al. (2018) highlighted practical difficulties in following hand hygiene practices, noting that nurses found it challenging to wear new gloves for each patient suctioning due to the high frequency of such procedures during a shift. These insights point to misconceptions about hand hygiene and the practical obstacles to its use. In order to address these issues, the participants in other studies including Salem and Youssef (2017) highlighted the need for real case studies as part of their educational strategies.

Additionally, both Saudi and some Egyptian HCWs in Paul et al. (2020) and Lohiniva et al. (2015), respectively, had low awareness of HAIs. For instance, some participants in Lohiniva et al. (2015) were unaware of the fundamentals of infection transmission and started that HAIs, including airborne infections, could not be addressed by hand washing (Lohiniva et al., 2015). While hand hygiene does not directly prevent airborne infections, it plays an important role in interrupting the chain of infection transmission and reducing the risk of transferring infections to surfaces and other people, which could occur during airborne infections. The findings highlight the necessity of focused training to address misunderstandings about IPC and cross-infections.

A gap in knowledge was also noted in other IPC practices among participants in the study of Paul et al. (2020). For instance, some of the participants reported that PPE was required only in ICUs and isolation rooms, rather than acknowledging its

importance in various healthcare settings and during different procedures where potential exposure to infectious agents exists. Moreover, the study by Paul et al. (2020) demonstrated a varying understanding of waste and spill protocols and that nurses were more knowledgeable than doctors and junior residents. This insight was derived from the qualitative component of the study, where participants were informative in their responses. Nurses in this study demonstrated greater understanding of the IPC practices related to waste and spill management, which could be due to their frequent involvement in these activities as part of their everyday role and responsibilities. Another factor that could enhance their awareness is that they receive more specific and frequent training and education, which develops their understanding of IPC practices.

"Nurses tended to have a better idea than doctors and junior residents, as they often deal with blood spills using a blood spill kit." Authors' interpretation (Paul et al., 2020).

Furthermore, the study found that some HCWs failed to adhere to PPE guidelines in some situations due to their low awareness of IPC practices. This could include issues such as insufficient mask coverage, including men wearing masks that did not entirely cover their beards. Moreover, the use of non-standard alternatives to masks among females, including face-covering veils during procedures, reveals a failure to follow IPC practices. The national guidelines employed in this study suggest that a surgical mask should be worn behind the veil/face covering and that face shields must be used over the veil to protect it from droplet spray (Ministry of Health, 2018, Paul et al., 2020).The challenges of poor adherence reflect the fact that some HCWs, particularly physicians, have insufficient knowledge of IPC practices, and this should be addressed by different educational interventions. This would encourage collaborative practices among HCWs that would enhance IPC adherence and overall patient safety. Furthermore, the use of non-standard alternatives to masks is impacted by cultural or religious practices. In healthcare settings, it is critical to recognise and respect cultural diversity; however, it is also important to ensure that these traditions do not compromise IPC practices or patient and HCWs' safety. Thus, the study would benefit from further exploration of the cultural and contextual factors that affect the use of PPE, which would enhance the depth of its findings.

After addressing different misunderstandings surrounding IPC practices, it is also important to consider the subjective perceptions that affect HCWs' adherence. Many participants in Lohiniva et al. (2015) reported that their hand hygiene decisions were not solely based on the objectives of IPC practices but were also affected by their opinions about their surroundings and interactions. The correlation that exists between feeling unclean in response to certain specific patient behaviours or disorganised settings highlights the psychological and emotional factors that impact IPC adherence. It implies that enhancing the physical work environment and addressing HCWs' perceptions and comfort may inadvertently help to improve adherence. However, the study's selection criteria, including the level of nursing experience, previous involvement in hand hygiene campaigns, or specific hospital roles, were not extensively detailed. This limits the transferability of its findings as understanding the specific context and backgrounds of nurses is important for assessing how insights might apply to different settings. Furthermore, a richer description of the participant selection process would have improved the study's contextual understanding, allowing for an in-depth appreciation of IPC practices within the specific environment.

Two studies illustrated the difficulties faced by HCWs regarding changing their behaviour, despite being aware of their mistakes. This was seen among older nurses and doctors who reported difficulties with implementing infection control techniques; they cited their extensive training and ingrained behaviours, such as avoiding using gloves when performing specific tasks such as changing wound dressings (Efstathiou et al., 2011). This issue was reported by senior doctors in a later study; they resisted practising hand hygiene despite the relevant education that was provided (Khuan, Shaban and van de Mortel, 2018). This resistance was observed to have the potential to influence the overall hand hygiene culture within healthcare facilities and make it challenging to encourage consistent adherence among HCWs.

"We are having troubles educating or reinforcing the hand hygiene practices to old and senior doctors. They just don't believe it." Participant doctor (Khuan, Shaban and van de Mortel, 2018).

3.5.2 Theme: Beliefs in IPC and the value placed on it

This theme explores the diverse attitudes towards IPC and the perceptions of HCWs. Within this theme, three subthemes emerged: moral and ethical beliefs; cultural and habitual factors; and balancing self-protection and protecting others through IPC adherence.

3.5.2.1 Subtheme: Moral and ethical beliefs

Two studies found that adherence to hand hygiene is influenced by the belief that practising hand hygiene is the morally right action (Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020). According to Khuan, Shaban and van de Mortel (2018), morally right refers to the participants' belief that practising hand hygiene is consistent with universal standards of cleanliness and hygiene that extend beyond religious and cultural backgrounds. This intrinsic motivation underlines the universal values of cleanliness and hygiene, and emphasises how important they are in determining a person's commitment to infection prevention practices (Khuan, Shaban and van de Mortel, 2018). Therefore, in this context, morally right is described as consistency with what is perceived as professionally and procedurally correct in healthcare settings. It includes the belief that adhering to hand hygiene is a moral obligation based on broader societal values, as well as a procedural requirement. This belief acts as a facilitator for hand hygiene adherence, reinforcing adherence through personal conviction rather than external enforcement. Furthermore, it suggests that individuals may have beliefs on hygiene even in the absence of explicit awareness of infection prevention, which reflects a deeply rooted relationship between moral principles and good hygiene practices.

"I perform hand hygiene not because people approve or like it. I am doing it because this is the right thing to do." Participant nurse (Khuan, Shaban and van de Mortel, 2018).

However, achieving a high level of adherence is influenced by different factors, including different personal beliefs, contextual challenges, and different interpretations of the importance of particular practices. For instance, participants in Ghaffari et al. (2020) reported that the differences in people's practices are

influenced by their conscience and morals, which emphasises that a person's commitment to infection prevention could be driven by intrinsic ethical values. In contrast, adherence to professional skills and standards provides a defined framework for appropriate procedural practices that are directed by established protocols. Thus, both intrinsic ethical considerations and external procedural norms play a significant role in determining adherence.

"One's perceived morality of a behaviour as well as perceived feeling of responsibility seriously affect one's performance of an action or refraining from that." Author interpretation (Ghaffari et al., 2020).

While Ghaffari et al.'s (2020) study recognises the importance of moral and ethical beliefs in hand hygiene practice, it lacks a detailed analysis in this area. Specifically, there is an insufficient exploration of the underlying ethical considerations, with only a brief mention of hand hygiene as a moral norm and its role in adherence. A deeper understanding of the ethical and moral dimensions would provide a deeper understanding of their influence on IPC practices. In contrast, Khuan, Shaban and van de Mortel (2018) highlighted that hand hygiene in UAE healthcare settings is influenced by religious and cultural beliefs, which indicates that these beliefs, consistent with the perspectives of Islamic scholars, may have moral and ethical implications for HCWs. Thus, the inclusion of morality in the study by Khuan, Shaban and van de Mortel (2018) could be attributed to the aim of the study, which was focused on exploring the impact of HCWs' religious and cultural beliefs on hand hygiene practices within the TPB.

3.5.2.2 Subtheme: Cultural and habitual factors

Some studies suggested the potential effects of deeply ingrained routines that are influenced by cultural norms (which are described as shared behaviours, practices, and beliefs among specific cultures) and traditions concerning hand hygiene behaviours (Ng, Shaban and van de Mortel, 2017, Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020).Three of the included studies highlighted the importance of these ingrained practices in both healthcare and daily contexts, which emphasised how hand hygiene is easily incorporated into routines. It also highlights the influence that cultural norms have on infection control behaviours (Ng, Shaban and van de

Mortel, 2017, Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020). In other words, participants from the study by Ghaffari et al. (2020) described the incorporation of hand hygiene into everyday routines as something that is deeply ingrained within and functions at a subconscious level. Although the study did not explicitly mention the influence of Islamic culture here, the study was conducted in an Islamic country, which could be influenced by cultural factors including those related to Islamic practices of cleanliness and hygiene. Similarly, participants in the study by Ng, Shaban and van de Mortel (2017) highlighted that hand hygiene is practised at home as part of the culture for hygienic purposes and family protection, and for ritualistic reasons for daily prayers by Muslims. Moreover, the participants in the study conducted by Khuan, Shaban and van de Mortel (2018) highlighted the differences between using ABHRs as a workplace-introduced behaviour and handwashing with soap and water as a culturally embedded habit, which emphasises the important impact of cultural norms on IPC practices.

"Participants identified that hand washing was a ubiquitous cultural practice, whereas alcohol-based hand rubbing was a work-associated behaviour." Authors' interpretation (Khuan, Shaban and van de Mortel, 2018).

Additionally, the emphasis on cleanliness as a basic component across religious groups including Islam and Christianity, as noted by the participants in Khuan, Shaban and van de Mortel (2018), highlights the universal importance of hygiene within diverse cultural and religious contexts. The specific mention of cleanliness in the holy texts of both Islam and Christianity reinforces this notion and suggests that hand hygiene practices, including the use of ABHRs, are seen as consistent with religious teachings, despite potential concerns about alcohol use. The participants' agreement that ABHR is acceptable for Muslims even if alcohol use is prohibited, suggests an understanding and interpretation of religious directives in the context of modern healthcare practices. This acceptance reflects an adaptability within religious practices to accommodate medical advancements, highlighting the significance of incorporating cultural and religious considerations into IPC practices.

The findings from the three studies provide insightful analyses of the role of cultural factors in IPC practices. Khuan, Shaban and van de Mortel (2018), in particular, demonstrated cultural sensitivity by exploring the influence of religious and cultural

beliefs, especially those rooted in Islam, on hand hygiene practices. This provides insights into tailoring hand hygiene interventions that are effective and culturally and religiously congruent.

3.5.2.3 Subtheme: Balancing self-protection and protecting others through IPC adherence

The subtheme of 'protection' emerged from five studies (Efstathiou et al., 2011, Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020).The participants in these studies expressed their motivation for adhering to IPC practices, which emerged from the dual aim of self-protection and safeguarding others such as patients, colleagues, and family members.

For instance, participants in Efstathiou et al. (2011), Lohiniva et al. (2015), Khuan, Shaban and van de Mortel (2018) and Ghaffari et al. (2020) described the importance of adhering to IPC practices for self-protection and to protect others from the spread of infections. For example, a participant nurse in Ghaffari et al. (2020) stated:

"There was another human being I cared about. For the respect I pay health of him and myself, I do not wish to transmit infections to him or get them from him." Participant nurse (Ghaffari et al., 2020).

In contrast, the study of Ng, Shaban and van de Mortel (2017) highlighted that HCWs adhere to hand hygiene practices to protect themselves rather than their patients due to concerns about personal safety in physically or emotionally dirty situations, leading to increased consciousness. This was further emphasised by Efstathiou et al. (2011), who reported that some HCWs tended to wear gloves for a prolonged period of time to support their sense of safety when providing care for infectious patients, who are perceived as ‘dirty’ patients. This suggests a potential barrier to IPC practices (Efstathiou et al., 2011). These findings pointed to a potential imbalance in the motivation for adhering to IPC, with a stronger emphasis on self-protection in certain contexts.

These findings suggest that the perception of threat—whether to oneself, patients or family—affects HCWs' motivation to adhere to IPC practices. The different

emphasis placed on one's own safety as opposed to that of others may reflect broader cultural, institutional, or personal factors that influence HCWs' attitudes towards IPC. However, the fact that Efstathiou et al. (2011) is an older study may have an impact on the relevance of the findings to current healthcare settings. Updates to IPC guidelines, increased awareness of infection risks, and changing healthcare environments may affect the applicability of these older insights to contemporary settings.

The findings also revealed that HCWs' adherence to hand hygiene is influenced by the effect of hand hygiene products on skin health. For instance, participants in four studies expressed concerns about skin irritation and allergies when using hand hygiene products, which hindered their adherence to hand hygiene practices (Lohiniva et al., 2015, Ng, Shaban and van de Mortel, 2017, Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020).

"The reason for not using alcohol rub or washing hands regularly was because it made their hands dry and occasionally caused an allergic reaction or even sores." Authors' interpretation (Lohiniva et al., 2015).

While participants in Khuan, Shaban and van de Mortel (2018) emphasised that hand dryness was only associated with using ABHR, the study of Ng, Shaban and van de Mortel (2017) concluded that skin health issues can be prevented by the use of hand lotions and that the majority of the participants did not experience dry hands or skin-related issues. This discrepancy in findings could be attributed to the focus on the factors related to the use of ABHR in Khuan, Shaban and van de Mortel (2018) compared to the research question in the study by Ng, Shaban and van de Mortel (2017). The absence of a consistent mention of skin-related issues in other studies suggests that such challenges to hand hygiene adherence may not be universally experienced but could vary greatly based on individual practices, availability of preventative measures including lotions, and perhaps the specific combination of ABHRs used in various healthcare settings. The limited reporting of skin health issues in these four studies could also be due to the focus of these studies, which was primarily on the factors influencing hand hygiene practices rather than all IPC practices, which led to an in-depth exploration of barriers, including the quality of hand hygiene products. This variability highlights the need for tailored strategies to

address and prevent skin health issues. It also emphasises the need for healthcare facilities to offer hand hygiene products that are safe and gentle on the skin, in addition to being effective against pathogens. This will help to ensure that IPC practices are both sustainable and beneficial to worker well-being.

3.5.3 Theme: Impact of patients' characteristics on adherence

This theme describes how adherence to IPC practices is influenced by HCWs' perceptions of patient characteristics, which was noted in two of the included studies. For instance, the participants studied by Efstathiou et al. (2011) expressed the belief that adults are more susceptible to infectious diseases than children, meaning that adult patients were seen as a high-risk group and children considered to be a low-risk one. Thus, some participants believed that IPC practices were unnecessary when working with children due to the perception of low risk that is associated with this age group, which can act as a potential barrier.

Conversely, when compared to the more recent study by Lohiniva et al. (2015), this perspective raises questions. The results of Lohiniva et al. (2015) highlighted that hand hygiene was inadequately implemented in the hospital setting they were considering, except in the neonatal unit, where doctors were considered to be more adherent and tended to encourage nurses to follow hand hygiene practices. This possibly due to the increased supervision by superiors in the neonatal units, as discussed under the theme regarding leadership and organisation culture.

Furthermore, the participants in the study by Efstathiou et al. (2011) highlighted a barrier due to patient perceptions of PPE usage by nurses and its psychological effects on patients, who could interpret the use of masks, gowns, or gloves as a sign of a critical or worsening health condition. This association can lead to patient distress or anxiety, which makes it more difficult to follow IPC practices. As a result, nurses must balance adhering to strict IPC practices with considering the emotional and psychological well-being of their patients. Notably, the limited reflection of this concern in other studies within this review and the age of the study suggest that the understanding of the interaction between PPE usage and patient perception is based on data that may not accurately reflect the current healthcare context. This gap emphasises how important it is for current research to revisit how patients and HCWs

view PPE, especially in light of evolving IPC practices and patient awareness, to address any potential psychological effects.

3.6 Updated search findings and comparative analysis

Upon updating the search in March 2024, two additional studies were identified that met the inclusion criteria of the review. One study was conducted in a Saudi referral hospital involving ten HCWs (5 nurses, 4 physicians, and 1 respiratory therapist) and utilised semi-structured interviews based on the social-ecological model to explore the factors influencing IPC adherence in a NICU setting (Alshehri, 2023). The social-ecological model examines the interaction between individual, interpersonal, organisational, community, and policy-level factors in shaping behaviour (McLeroy et al., 1988). The study reported similar findings to those of the previously included studies, including lack of knowledge of IPC practices and a shortage of supplies. The participants in the study also reported the lack of a monitoring system and they provided more insights into the factors contributing to workload, including a shortage of staff. A significant issue identified was absenteeism among staff, leading to increased workload for the present HCWs, as captured by a participant's observation:
"My colleagues in some situations, are not coming to work; their cases will be distributed among those nurses who join the work." Participant (professional group is not identified) (Alshehri, 2023).

The issue of absenteeism exacerbates the workload burden and impedes IPC adherence. Although there was no direct mention of the pandemic as a cause, it is possible that the pandemic contributed to this issue due to increased healthcare pressures and personal challenges among staff. Moreover, the scarcity of senior nurses was spotlighted as a factor contributing to increased workload and diminished IPC adherence. Newer nurses might lack the requisite experience and awareness.

"we have many new staff with little experience. They sometimes look after critical baby patients. You can see them sometimes not wearing gloves, not washing their hands, and not following infection control practices." Participant (professional group is not identified) (Alshehri, 2023).

The participants also expressed concerns regarding the shortage of essential resources, including basic hand hygiene supplies and crucial equipment such as thermometers, which are important in preventing cross-infections. While one of the most recent Saudi studies included in this review by Paul et al. (2020) suggested a potential alleviation of these shortages, this issue was prominently highlighted once more here. This could also be due to the consequences of the COVID pandemic since Alshehri's (2023) study was conducted in 2021.

The addition of this study to the review further highlights the impact of staff availability and experience on workload and adherence, and the critical role of sufficient resources in supporting effective IPC practices. These findings suggest the need for targeted interventions that address specific barriers to IPC adherence, including mitigating the impact of absenteeism on workload, ensuring adequate staffing, particularly of experienced staff, and securing essential IPC resources.

A second additional study was conducted in three Iranian hospitals with 15 nurses and complements and expands this review's findings on hand hygiene adherence (Kaveh et al., 2022). It highlights patients' dual role as motivators by reminding nurses about hand hygiene, and as barriers when patients or their companions ask nurses to hurry and ignore hand hygiene. They view their needs as urgent or more important than hand hygiene, which compromises hand hygiene practices. This presents an organisational challenge where external pressures impact adherence to IPC practices. This finding addressed the suggestions made by Efstathiou et al. (2011), which recommended increasing patient education to enable them to implement IPC practices. Moreover, a notable gap in awareness among nurses was identified, with some relying on perceived natural immunity over hand hygiene. This misconception highlights the need for targeted educational interventions. These insights provide a deeper understanding of the factors affecting hand hygiene adherence, emphasising the need to address organisational challenges and improve awareness. Furthermore, Kaveh et al. (2022) also suggested including IPC practices in the nursing performance appraisal accompanied by rewards, to promote adherence to IPC practices. This finding could be relevant and transferable to other regions including Saudi healthcare settings, given the shared cultural similarities and challenges.

3.7 Discussion

This systematic review has sought to identify factors that influence HCWs' adherence to recommended IPC practices for HAIs in the Middle East. Eight studies met the inclusion criteria for this review. The factors identified in this review have been classified into two broad categories: organisational and individual factors. Within these categories, certain elements have been identified as either facilitating or impeding IPC practices based on their impact as described in the studies. The interpretation was developed using a narrative analysis approach. In order to enhance the clarity and effectiveness of understanding, the analysis was further refined to define a facilitator as any organisational or individual factor that positively influences HCWs' adherence to IPC practices. This refinement helps to clearly identify and categorise the elements that support IPC adherence, thereby providing a comprehensive overview of the factors. On the other hand, barriers are described as components that negatively influence adherence and produce obstacles that hinder the effective implementation of IPC practices. This discussion will explore these facilitators and barriers, examining how they interact with organisational and individual contexts to influence IPC adherence.

The findings of this review highlight that the most frequently mentioned factors are organisational factors, including leadership roles and organisational culture, and environmental factors, including workload and supplies. Some of these factors were perceived as potential facilitators and fell under the category of individual factors, including beliefs about IPC practices. In addition, education and awareness factors were reported under the organisation factors, although they relate to both categories.

The pivotal role of leadership in influencing IPC practices is demonstrated in the global literature. Wider research consistently shows that leadership commitment to IPC practices has a major impact on HCWs' adherence to IPC practices (Henderson et al., 2020, McCauley, Kirwan and Matthews, 2021). These studies corroborate the findings of this review of studies situated within the Middle East, which highlight the significance of leaders, not just in policy setting but in actively participating in and advocating for IPC practices. For instance, the comprehensive review by McCauley,

Kirwan and Matthews (2021) examined studies from different countries including Australia, China, Jordan, Italy, Cyprus, South Korea, England, Switzerland, the Netherlands, and the United States. The review explored factors that influence nurse's adherence to IPC practices and found that the visible adherence to IPC practices by senior staff motivates other HCWs to be adherent. This reinforces the essential role of leadership in cultivating an environment conducive to optimal IPC practices.

Furthermore, McCauley, Kirwan and Matthews (2021) mentioned the importance of recognising staff efforts as part of positive leadership and highlighted that effective leadership can improve the overall culture of a department, particularly regarding IPC practices. For instance, when leaders acknowledge and appreciate staff efforts and adherence, they will feel valued, which can then motivate them to be more adherent. Therefore, positive leadership can create a workplace culture that values safety and adherence. In the current review, the findings suggest that recognition and positive reinforcement can motivate HCWs' adherence to IPC practices. While the role of leadership was not identified in the Saudi studies in this review, it is reasonable to suggest that findings from other Middle Eastern studies can be applicable and transferable to the Saudi context. This is due to the similar cultural and organisational context observed across healthcare settings in the region, which may influence IPC practices in comparable ways.

A qualitative systematic review by Smiddy, O'Connell and Creedon (2015) was conducted to explore the factors influencing HCWs' adherence to hand hygiene practices. The review synthesised findings from 10 studies across different countries including Canada, the United States, Taiwan, the Netherlands, and Australia and it highlighted the importance of immediate feedback in improving adherence among HCWs. Although feedback can improve adherence, the findings of the current review highlight that many HCWs feel reluctant to provide it due to concerns about potential negative consequences. This is consistent with the findings from Smiddy, O'Connell and Creedon (2015), who reported that cultural factors including a lack of openness and fear of retaliation can compromise effective communication. To address this, healthcare organisations should encourage a culture of safety and openness to encourage constructive feedback without fear of repercussions.

The findings from the current review highlight that workload, shortage of staff and shortage of supplies are crucial organisational factors that negatively influence IPC adherence. The literature confirms that high patient-to-nurse ratios, and inadequate staffing and resources compromise care quality, including IPC practices (Smiddy, O'Connell and Creedon, 2015, Gibson, Ventura and Collier, 2020, Houghton et al., 2020). Addressing staffing, workload, and resource issues is important to reduce IPC barriers and enable HCWs to adhere to safety protocols effectively. It was also noted in this review that these organisational barriers can be exacerbated by a pandemic. An observational study was conducted by Alsubaie et al. (2013) in five ICUs at a university hospital in Saudi Arabia among 242 HCWs with a total of 3940 hand hygiene opportunities. Alsubaie et al. (2013) examined hand hygiene adherence and the factors associated with non-adherence. The study found that hand hygiene adherence was higher among technicians and therapists than among doctors and nurses, which could be because of fewer patient interactions. The study was also coincidentally conducted during a H1N1 swine flu pandemic, which could have affected workload. The authors acknowledged that the hospital experienced understaffing and high workload during that time, which influenced the rate of adherence to hand hygiene. This demonstrates that pandemics can impact adherence to IPC practices due to the high workload, inadequate supplies, and staffing shortages.

This review identified a critical barrier to effective IPC: a significant lack of knowledge among HCWs regarding HAIs, cross-infections, and IPC practices including PPE use, particularly within diverse cultural and religious contexts. For instance, the Saudi study included in this review by Paul et al. (2020) found a knowledge gap among their participants related to inadequate mask coverage. Women wore only the traditional face-covering veils and men wore masks without entirely covering their beards (growing a beard is considered Islamic practice among many men). The review findings emphasised the necessity of targeted educational interventions that consider cultural and religious sensitiveness, yet are uncompromising on IPC practices. Although these practices are against the Saudi Ministry of Health guidelines (Ministry of Health, 2018), this finding could be transferable to other

healthcare settings in Saudi Arabia that may experience similar challenges that need to be addressed.

The reviewed studies also indicated the need for innovative training approaches like audiovisual materials and real patient case studies to potentially improve IPC adherence. Although the effectiveness of these educational strategies in improving IPC adherence remains unproven within the reviewed studies, the wider literature presents convincing evidence that regular training programmes using interactive strategies can be effective in enhancing IPC adherence (Valim et al., 2014, Donati et al., 2019a, Donati et al., 2019b).

Furthermore, the inclusion of studies from countries influenced by religions such as Islam and Christianity could impact the findings of this review. This review found that both moral and religious considerations play an important role in promoting HCWs' adherence with IPC practices. Ethical considerations, which include the belief that hand hygiene is a morally right action, and a strong sense of having an obligation to keep patients safe act as motivators for adhering to IPC practices. This sense of duty aligns with religious teachings in Islam and Christianity but is also central to secular healthcare ethics. Many professional codes of ethics worldwide, including the Nursing and Midwifery Council (NMC) Code of Practice in the UK and other international healthcare standards, emphasise a duty of care and patient safety as foundational principles (NMC, 2013).

In addition, incorporating countries across the Middle East allows for an examination of contextual similarities and differences. For instance, while only one reviewed study was conducted in Saudi Arabia, findings from the Middle Eastern countries are relevant and transferable to this setting due to shared cultural and religious contexts. Thus, targeted interventions that consider cultural differences would be helpful (Brooks et al., 2021). While religious beliefs can significantly influence ethical considerations, it is important to acknowledge that moral commitment to IPC practices can also arise from secular ethical frameworks. This highlights the universal importance of ethics in promoting IPC adherence.

The earliest included study, Efstathiou et al. (2011), is generally well structured, with a clear alignment between the research objectives and the methodology. However, it was analysed with caution since it was conducted in Cyprus and in a unique and multifaceted culture that fuses Mediterranean, European, and Middle Eastern cultures due to its historical and geographical context. The study highlighted some issues that influence adherence to IPC practices, including HCWs' appearance, judgement of patients by appearance or ethnicity, the impact of this on HCWs' adherence, and the perception of patient risk for infection based on their age group. The study also discussed how IPC adherence was influenced by patient perceptions of IPC and the influence of IPC practices on nurses' skills. These findings provided valuable information into the potential variations in IPC adherence. However, these findings have not been consistently supported in subsequent studies, raising questions about whether they reflect broader trends in IPC adherence or are specific to Cyprus' context at that time. Thus, this discrepancy implies that the findings of this study may not be applicable to other settings.

The findings from this review have important implications that directly influence the design of subsequent studies. Firstly, the knowledge gap among HCWs in Saudi Arabia, particularly regarding IPC practices, highlights the need for interventions that address both organisational and individual factors to enhance IPC adherence. To address this, the current research focuses on a qualitative approach that allows for an in-depth exploration of HCWs' experiences and perceptions of IPC practices.

Moreover, the review identified the need for innovative IPC training programmes tailored to the local healthcare context. This finding influenced the decision to explore how current IPC training is perceived by staff and the areas for improvement that need to be addressed. By exploring HCWs' perspectives of educational strategies, the study aims to provide specific recommendations for the design of training, considering local practices, cultural norms, and differences in cultural backgrounds.

Finally, the review highlights the importance of studying the interaction between organisational and individual factors that affect adherence to IPC practices. The current study explores these interactions qualitatively and examines how HCWs'

beliefs, attitudes, and experiences intersect with institutional practices and cultural expectations.

3.8 Strengths and limitations

Strengths:

This systematic review benefitted from a thorough qualitative assessment carried out with the CASP checklist. By systematically examining the included studies, the review ensured a comprehensive evaluation, enhancing the reliability of its findings. In addition, the inclusion of context-specific data from the Middle East enriched the review's relevance and applicability. Insights into cultural, religious, and organisational factors specific to the region provided valuable context for understanding HCWs' adherence to IPC practices. Furthermore, this systematic review used a qualitative narrative synthesis to offer a comprehensive picture of this adherence. The narrative synthesis allowed for a thorough description of the underlying factors affecting IPC behaviours. By incorporating diverse data sources, the review expanded its scope of analysis and captured a range of perspectives and insights on IPC adherence. The review adhered to the PRISMA guidelines to promote transparency in the reporting of the process and the quality of the included studies. The design of the review followed rigorous methodological principles, which further strengthened its overall reliability and validity.

Limitations:

Despite its strengths, the review encountered some limitations. Some of the included studies lacked discussions on achieving data saturation, indicating a methodological gap that could potentially limit the comprehensiveness of findings regarding factors influencing HCWs' adherence to IPC practices. Moreover, although insights from teaching hospitals provided valuable perspectives on IPC practices, their transferability to broader healthcare settings might be limited, necessitating caution in interpretation. In addition, it is important to note that while the studies met the predetermined inclusion criteria and the search was not restricted to only studies written in English, potentially relevant studies conducted in languages other

than English may have been excluded. Despite efforts to ensure inclusivity, access to data that would have improved the review was limited due to the absence of eligible research in other languages. Future initiatives could explore how to overcome language barriers more effectively in an effort to gain a more thorough picture of IPC practices.

Additionally, the decision not to employ a predefined theoretical model in this review stemmed from a recognition of the intricate and context-specific nature of IPC practices. As discussed in the analysis and synthesis section, a structured framework such as the Health Belief Model or the TPB focuses primarily on individual motivations. However, these theories did not align with this study's objectives. The narrative approach provided flexibility to explore these institutional factors alongside individual motivations, which creates a more comprehensive understanding of the factors influencing HCWs' adherence in clinical settings. Furthermore, although the timeframe of the review was expanded to capture more recent studies, some studies might have been missed due to several factors. It is possible that alternative search terms or additional databases could have retrieved further studies.

3.9 Conclusion

This chapter has provided an overview of the research methodology, methods, and findings of this qualitative systematic review. The chapter began by outlining the context and significance of this research and emphasising the critical role of IPC practices. The steps of a narrative synthesis proposed by Popay et al. (2006) were discussed to clarify how data were synthesised across two domains: organisational and individual factors influencing IPC adherence. Within these domains, key themes and subthemes related to potential facilitators of and barriers to IPC adherence were highlighted. Key findings included the influence of leadership on the promotion of a culture of IPC adherence, and the need to improve IPC education and training programmes to address knowledge gaps among HCWs. It was also highlighted that environmental factors are among the main barriers to IPC practices. The review also highlighted the impact of cultural and religious factors in Middle Eastern countries, which can shape HCWs' attitudes and adherence to IPC practices.

Furthermore, the findings of this review identified a gap in the representation of studies from Saudi Arabia. Only two Saudi studies were identified, which highlighted a limited understanding of IPC practices in this specific context. This significant gap underscores the necessity of a more focused and in-depth exploration tailored to the unique socio-cultural and healthcare context of Saudi Arabia. Thus, this thesis seeks to address this gap by conducting an in-depth exploration of the factors that influence adherence to IPC practices among nurses in Saudi Arabia.

Chapter 4 Phase 2: Focus groups

4.1 Introduction

This chapter presents the methods, findings and discussion of phase 2 of the research – focus groups with infection control teams from the study sites. Following a description and justification of the methods, the findings are presented, followed by a discussion of the findings in the context of the other phases of this study and the existing literature.

4.1.1 Background to study 2

In the first phase of this PhD study, a qualitative systematic review was conducted to explore the factors influencing HCWs' adherence to IPC practices in the Middle East. The systematic review indicated that leadership behaviour, for instance through role modelling, plays an important role in influencing HCWs' adherence to IPC practices (Lohiniva et al., 2015, Salem and Youssef, 2017, Khuan, Shaban and van de Mortel, 2018, Ghaffari et al., 2020). However, although the review highlighted the importance of leadership, the mechanisms through which infection control teams influence daily practices were not fully explored. This gap points to the need for a deeper understanding of how infection control teams who are positioned as strategic leaders within the organisation hierarchy perceive their role in IPC adherence, as well as how their strategies are implemented in daily healthcare settings.

The review also identified a gap in the publication of Saudi qualitative studies, with only two Saudi studies found (Paul et al., 2020, Alshehri, 2023). This highlights the need for further investigation of IPC practices within the specific socio-cultural and healthcare context of Saudi Arabia. The wider literature identifies that qualitative studies can be particularly valuable for understanding how cultural, organisational, and interpersonal factors impact adherence to IPC (Houghton et al., 2020). Therefore, a qualitative approach to this was considered appropriate and valuable for the current study.

Henderson et al. (2020) aimed to determine the factors that influence adherence to IPC practices among 11 nurses experienced in infection control. They used a qualitative design with semi-structured interviews in Australia. The study reported important factors that influenced HCWs' adherence from the perspective of infection control nurses. These included barriers related to the health system such as funding shortfalls, insufficient staffing, and health policy issues. The study also highlighted that environmental barriers are considered to be the second main barriers to IPC adherence, and included ward layout and access to supplies. In addition, Henderson et al. (2020) identified organisational factors as the third barrier, including a lack of managerial support. Therefore, the perspectives of infection control teams are important as they operate at both strategic and organisational levels, thus providing a different viewpoint from frontline staff. Their insights are important for understanding the overarching strategies and policies that guide IPC practices, as well as the practical challenges encountered in their implementation. This phase of the study bridges the gap between intended and actual practices, thereby enhancing understanding of IPC practices. By involving the infection control teams, this study captures a unique viewpoint that highlights both the overarching strategies and the ground-level barriers, which enriches the overall findings.

4.1.2 Focus group study aim and research questions

The aim of this phase of the PhD study was to explore infection control teams' perceptions and experiences of managing and organising infection control practices at both the strategic and organisational levels. Focus groups were conducted to identify the potential challenges, barriers to and facilitators of HCWs' implementation of infection control practices and behaviours, which were then further explored in the next stage of the study with frontline staff.

The current focus group study aimed to answer the following research question:

What are infection control teams' perspectives and experiences of managing, co-ordinating, and implementing infection control practices and guidance across two hospitals in Saudi Arabia?

4.1.3 Study settings

The research presented in this thesis (phases 2 and 3) was conducted across two hospitals in the Eastern province of Saudi Arabia, as was discussed in the methodology chapter.

4.1.4 Population

The target population for the focus group discussions was infection control teams working in the selected hospitals. This choice was made to gain insights from those directly responsible for implementing and overseeing IPC practices. The rationale is further elaborated in the methodology chapter, section 2.6.

Inclusion criteria:

Participants were eligible if they were:

- were registered as healthcare professionals from the Saudi Commission for health specialties.
- worked in the infection control department at one of the hospitals included.
- able to understand verbal and written English or Arabic sufficiently to complete the consent forms/understand the participant information sheet, which were available in both languages.

Participants were excluded if they:

- were unable to provide verbal informed consent.
- did not work in the infection control department at either of the two included hospitals.

4.1.5 Sampling approach and sample size

Since the focus of this phase was exclusively staff working in infection control teams, a purposive sampling approach was used to identify and recruit potential

participants from each hospital. Purposive sampling was selected because infection control team members have specialised insights and experience at the organisational level, which allow them to provide valuable perspectives on infection control policies and practices. This expertise is essential for understanding the strategic and operational challenges associated with IPC practices. The recommended size for a focus group is 6 to 10 participants; however, groups can work successfully with a minimum of 3 participants (Gill et al., 2008, Guest, Namey and McKenna, 2017). Small groups risk having limited debate, while larger groups can be difficult for the moderator to handle and can be overwhelming for participants, limiting their opportunities to contribute (Gill et al., 2008).

One focus group was conducted in each hospital. In the selected hospitals, there were a total of 28 members working in the infection control teams. Considering that not all staff would be available to take part, the estimated sample size was set as 18-24. Based on this guidance, the study aimed for 2-3 focus groups with 6 to 8 participants each to ensure a balance between having a sufficient number of participants to generate diverse discussions and keeping the group manageable for effective moderation. This strategy was also designed to enhance the richness of the data collected while considering that each participant had sufficient opportunities to express their views and experiences.

The professionals were selected due to their direct involvement and varied experiences across different departments, including medical wards, surgical wards, obstetrics and gynaecology, renal dialysis, triage, adult ICU, burns unit, paediatric ICU, neonatal ICU, paediatric medical and surgical wards, and dental clinic. Participation was voluntary, and the participants chose to join the study based on their willingness to share their insights and experiences. All members of the infection control teams were invited to participate in this study to provide a comprehensive insight into infection control challenges. Participants who took part in the study were responsible for auditing the included study sites, medical wards and ICUs, making them key informants.

The number of focus groups was initially guided by the total number of available participants, which was 28 and the estimated size of each focus group. This approach

aimed to balance the number of participants with practical considerations of organising the discussions.

4.1.6 Recruitment and informed consent

The first essential step in the recruitment process was engaging with a gatekeeper across the selected hospitals. The gatekeepers were people working in the infection control teams who possessed managerial roles. The researcher met them in person and discussed the study's research proposal with them, providing them with a copy of the invitation letter. Once the gatekeepers had agreed to assist with the recruitment process, they were asked to post the invitation letter and the participant information sheet (Appendix 3) on announcement boards in their departments. They were also asked to send an email with the invitation letter to the infection control teams in order to draw more attention to the study and help the recruiting process. The email also included a participant information sheet, a privacy notice (Appendix 7), and the researcher's contact details. Infection control members from both hospital sites contacted the researcher after receiving the invitation letters to show interest in participation. The researcher replied to ask if they had any questions and if they were still interested in participating. This recruitment approach was facilitated by gatekeepers to ensure effective access to the targeted population. In addition, posting information on announcement boards and sending email are efficient methods for engaging participants in research (Creswell, 2017).

An electronic consent form was then sent to potential participants who met the inclusion criteria and wished to take part. Potential participants did not need to return this to the researcher, as consent was intended to be obtained verbally, due to the impact of COVID-19 as discussed in the methodology chapter, section 2.10. During this process, at the beginning of the focus group meeting, the researcher read through each section of the consent form with the participants to ensure that they understood and agreed to all the terms before proceeding. This verbal consent was then recorded as an affirmative statement from the participants expressing their desire to participate in the study. This decision was made to minimise in-person interactions and follow social distancing protocols while maintaining ethical

standards during the COVID-19 pandemic. This approach was in line with current evidence from the ethics committees at the time of the study and approved by them (see Appendix 11). It acknowledges the necessity for flexibility in obtaining consent during unusual circumstances like a global pandemic (Newman, Guta and Black, 2021).

4.2 Data collection

4.2.1 Topic guide

The focus group topic guide (semi-structured questions) was developed based on a thorough literature review (as reported in Chapter 1) and the findings from the systematic review (reported in Chapter 3). The focus group guide was specifically developed to extract insights unique to the work conducted by the infection control teams in both hospitals to address IPC. In particular, the questions were designed to identify the strategic and organisational elements influencing IPC practices that frontline clinical staff might not observe. For example, infection control teams are responsible for the implementation of training programmes, monitoring adherence, and surveillance of infection trends, tasks that frontline staff might not directly engage with. The topic guide of the focus groups explored team roles, the effectiveness of monitoring strategies, and systematic barriers or facilitators to IPC implementations, aiming to identify gaps between policy and practice. For instance, although policies may mandate certain IPC practices, the literature found that the actual adherence to these practices can vary due to different factors including staff workload, availability of resources, and staff training and awareness.

The topic guide was developed to be flexible to allow for the exploration of any new concerns brought up during the discussion (Stewart and Shamdasani, 2014). A semi-structured approach was important for offering flexibility, as it enabled the moderator to adapt the flow of the discussion based on the participants' responses (Stewart and Shamdasani, 2014). This approach is also effective in promoting natural group discussions among group members, as it allows participants to engage with each other's responses which fosters a richer conversation (Stewart and Shamdasani, 2014). The questions in the topic guide were open-ended questions complemented

by prompts to encourage deeper reflections and detailed responses from the participants. To enhance the credibility of the topic guide, it was piloted with a few colleagues to identify any issues with clarity or comprehensiveness to ensure that the questions were well understood. This practice aligns with the recommendation in the literature for ensuring the reliability and relevance of qualitative research instruments (Cronin, 2008, Stewart and Shamdasani, 2014). In addition, the literature review revealed insufficient data on the effectiveness of existing monitoring processes. By focusing on these aspects, the study aimed to understand how well the policies were being implemented and what improvements might be needed, thereby addressing the gap in the literature. This exploration was essential for understanding organisational influences on IPC adherence, setting the stage for deeper individual investigations with clinical staff in phase 3, in order to build a comprehensive view of the IPC adherence. Appendix 5 presents the topic guide developed for the study.

4.2.2 Conducting online focus groups

As discussed in Chapter 2, section 2.10, online focus groups were employed due to COVID-19 impacts. Following recruitment, the participants were contacted to schedule a suitable date and time for conducting the online focus groups. Focus groups were held online using Zoom and were facilitated by the researcher. The participants from each focus group joined together in one room at work rather than individually from different locations. It is recognised that this arrangement could have had implications for their freedom to participate openly, confidentiality and anonymity. For instance, since they were at work, they could have had concerns about being overheard by colleagues or supervisors, which could have prevented them from expressing their views fully. In order to mitigate this, efforts were made to ensure that the discussion was held in a private room, where only focus group participants were present, to enhance confidentiality and encourage open conversation. Despite these efforts, the workplace setting might still have influenced the participants' desire to share sensitive information, which may impact the depth of the collected data.

At the beginning of each session, the researcher introduced herself and welcomed the participants. The participants were given an opportunity to ask further questions regarding the study, and their verbal consent to participate was reconfirmed and recorded. In addition, the researcher reminded the participants that they could withdraw from the study at any time. It was clarified that the discussion aimed to capture their experiences and perceptions, emphasising that there were no right or wrong answers. Participants had the opportunity to talk in Arabic or English, and were informed that the discussion would be audio recorded. All the participants were bilingual, which ensured that everyone could follow the discussion regardless of the language used. The discussions were primarily in Arabic, but the participants switched to English when using known terminologies, including those related to IPC practices. This ensured that the technical terms were accurately conveyed. However, it is worth noting that some participants might have been more fluent in English than others, which may have influenced the depth and clarity of their contributions. Efforts were made to balance this by encouraging the participants to express themselves in their preferred language, and clarifications were provided as needed to ensure comprehensive understanding and participation.

The researcher, serving as the moderator, utilised the topic guide to steer the discussion while inviting active participation from all attendees. The role of the moderator is to manage the discussion flow and encourage comprehensive responses from the participants. Thus, the researcher's responsibilities included setting the agenda, guiding the discussion, and promoting inclusivity (Cronin, 2008). Participants were encouraged to offer any additional insights or questions after the primary questions had been addressed. To ensure confidentiality, participants were assigned numerical codes during transcription, and the coding method was used to anonymise the interview data for analysis and writing up.

4.2.3 Justification for conducting online focus groups

The rationale for conducting online focus groups with infection control teams was to ensure the safety of researchers and participants during COVID-19 and was in line with global restrictions. Online interviews offer a safe, accessible method to collect data without exposing participants or researchers to unnecessary risks (Bauman,

2015). Online platforms can create a more comfortable environment for participants, especially when discussing sensitive topics such as IPC adherence (De Villiers, Farooq and Molinari, 2022). However, online interviews also have disadvantages. One potential drawback is the lack of nonverbal cues, which can be important for understanding participants' emotions and reactions (De Villiers, Farooq and Molinari, 2022). To address this, the researcher turned on her video and encouraged participants to do the same in order to foster a more personal connection and allow the observation of nonverbal cues. The researcher was also trained to actively listen and ask follow-up questions that prompted participants to elaborate on their thoughts and feelings to compensate for any limitations.

Another disadvantage is the possibility of technical issues, including a poor internet connection, which could disrupt the flow of conversation (Bauman, 2015, Żadkowska et al., 2022). To mitigate this risk, the researcher prepared alternative communication methods including telephone calls and other network connections in case of technical difficulties. Although online platforms can create a more comfortable environment for discussing sensitive topics, some participants may still feel less engaged compared to in person interactions. To enhance engagement, the researcher used warm-up questions and established rapport before discussing more sensitive topics to ensure that participants felt comfortable and valued the interview (De Villiers, Farooq and Molinari, 2022, Żadkowska et al., 2022). Furthermore, online interviews reduced logistical constraints associated with in-person interviews, increasing accessibility and enabling participation across various departments and shifts. This flexibility was essential for capturing diverse perspectives from HCWs in different roles and shifts. Therefore, online interviews facilitated data collection during a critical period.

4.2.4 Ethical considerations

4.2.4.1 Research ethics approval

The current study received ethical approval from the University of Glasgow, College of Medicine, Veterinary and Life Science Research Ethics Committee, under Application No. 200200149 (see Appendix 11). Additionally, ethical approval was also

secured from the local Committee for Research Ethics at King Fahd Hospital in the Eastern region in Saudi Arabia and the Institutional Review Board (IRB) committee at each of the local hospitals studied.

4.2.4.2 Informed consent

In this study, the principle of informed consent was adhered to strictly to ensure the participants' autonomy and respect for their decision making. Participants were thoroughly informed about the study's aims, procedures and potential benefits. Emphasis was placed on the voluntary nature of their participation, highlighting that they could withdraw from the study at any point without facing any consequences.

To facilitate clear understanding, detailed information sheets were provided, offering participants an opportunity to ask questions and receive clarifications on any aspect of the study. Some participants reached out with questions, which were addressed promptly. No participants decided not to proceed after receiving this information. However, some participants had work commitments that prevented them from attending the focus group sessions.

This process ensured that consent was fully informed and given freely, without a penalty for non-participation. Due to COVID-19 restrictions and the need to minimise in-person interactions, verbal informed consent was secured from each participant at the start of each interview to confirm their agreement to participate under the outlined terms. Given the group setting of focus groups, potential peer pressure was considered. Efforts were made to create a comfortable environment where participants felt safe to express their willingness to continue or withdraw without judgement. This consent procedure complied with ethical standards outlined by the University of Glasgow and the local ethics committees, reinforcing the participants' rights to privacy, confidentiality, and the secure handling of their data throughout the study's duration.

For detailed discussion on the ethical principles guiding this study, including informed consent, confidentiality, anonymity, beneficence and non-maleficence, see the methodology chapter, Chapter 2.

4.2.4.3 Participant withdrawal

All participants were informed that they could leave the study at any point, without being obliged to give notice or provide any explanation. If a participant chose to withdraw, any data they had provided up to that point would be used, as explained to them and permitted by the ethics committee.

4.3 Data analysis

The data derived from focus groups were analysed using codebook thematic analysis (Braun and Clarke, 2022). This method was chosen for its flexibility in identifying, analysing and reporting patterns (themes) within data, able to accommodate both inductive and deductive approaches (Braun and Clarke, 2022). This choice was driven by the study's aim to explore IPC practices among HCWs in Saudi Arabian hospitals, which necessitates a nuanced examination of participants' experiences and perceptions. A codebook thematic analysis approach was adopted, predominantly utilising a deductive framework for its structure and systematic nature. This approach started with a set of codes derived from an initial literature review and the study's objectives. However, recognising the nature of qualitative data, the analysis remained open to emergent themes to provide an understanding of IPC practices within the specific cultural and operational context of Saudi Arabian hospital practices (Guest, MacQueen and Namey, 2012, Braun and Clarke, 2013).

In the current study, the six steps of thematic analysis outlined by Braun and Clarke (2006) were followed, which are considered a robust and useful approach for qualitative data analysis. The steps are:

Familiarisation: listening to audio recordings, reading transcripts (which were transcribed by the researcher) and reading repeatedly to immerse oneself in the data, crucial for capturing the subtleties of IPC practices within the Saudi healthcare context.

Coding: following the familiarisation phase, where immersion in the data occurs, coding was systematically applied using the pre-developed codebook based on

existing literature. This codebook provided a structured framework for the initial analysis. However, Braun and Clarke (2006) emphasise that coding should remain flexible and responsive to new themes that emerge from the data itself. Thus, while the pre-developed codebook guided the initial coding, the process also incorporated new codes and themes identified during the analysis, ensuring that both known and emerging factors influencing IPC adherence were explored.

Theme development: organising codes into themes, guided by the codebook and incorporating additional themes that emerged during the analysis.

Reviewing themes: refining themes to accurately represent the data, aligning with the aim of the study.

Defining themes: clearly defining what each theme encompasses and naming them to capture their core meaning.

Reporting: selecting illustrative quotes and relating findings back to the research question and literature, offering in-depth insights into IPC practices.

Those steps were carefully applied to the analysis of the data obtained from both focus group discussions. Given that these interactions were conducted in Arabic, special consideration was given to the nuances of translation and its impacts on the research's trustworthiness (Regmi, Naidoo and Pilkington, 2010, Abfalter, Mueller-Seeger and Raich, 2021). In order to facilitate supervisors' support during the initial analysis, the transcripts were translated into English. Translation, the act of converting data from one language to another, poses challenges due to the deeply ingrained socio-cultural aspects of language (Regmi, Naidoo and Pilkington, 2010, Abfalter, Mueller-Seeger and Raich, 2021). For instance, certain terms and phrases used in the Arabic language may carry specific cultural connotations or implications that are challenging to translate directly into English. To mitigate these challenges and preserve the integrity of the participants' expressions, the researcher employed the back-translation methods of Brislin and Freimanis (2001), refined and utilised effectively by Chen and Boore (2010). This includes the following steps:

- Initial translation: the researcher first translated the focus group content from Arabic to English, aiming to retain the original meaning as closely as possible.

- Independent back-translation: an independent bilingual PhD researcher at the University of Glasgow, experienced in academic writing and translation, unaware of the original Arabic texts, translated the English version back into Arabic.

- Comparison and reconciliation: the researcher compared the back-translated Arabic version with the original transcripts to identify discrepancies or potential loss of meaning. No major issues were encountered and minor discrepancies were resolved through discussion between the researcher and the translator to ensure that the final version reflected the participants' intended meaning accurately.

- Refinement: where discrepancies were found, adjustments were made to the English translation to better reflect the original Arabic meaning, ensuring conceptual rather than literal equivalence.

Further details of the translation and its justification can be found in the methodology chapter.

4.4 Findings

4.4.1 Demographics of infection control practitioners

In this study, a total of 8 HCWs from the infection control teams participated across both focus groups, each session lasting between 50 and 90 minutes. The first focus group involved 5 HCWs, and 3 participants took part in the second focus group. The majority of the participants had a nursing background and only one came from a microbiological background. All the participants were female. They held various positions ranging from infection control nurses to infection control specialists. The participants' years of experience ranged from 1.5 to 16 years.

Table 4. 1: Demographic details of infection control staff from the focus groups

Profession	Nationality	Current gender	Age	Years of experience	Educational background	Clinical areas of responsibility
Infection control nurse	Saudi	Female	35	6	Nursing	ICU
Infection control specialist	Saudi	Female	29	1.5	Microbiology	Paediatric ICU, newborn ICU, paediatric surgical and medical wards, dental clinic
Infection control specialist	Saudi	Female	29	2.5	Nursing	Medical wards, female surgical ward, obstetric and gynaecology, haemodialysis, and triage
Infection control nurse	Saudi	Female	35	10	Nursing	Triage
Infection control nurse	Saudi	Female	37	12	Nursing	Medical ward
Infection control nurse	Saudi	Female	33	7	Nursing	Surgical wards

Infection control specialist	Saudi	Female	38	16	Nursing	ICU and burn unit
Infection control specialist	Saudi	Female	41	16	Nursing	Renal dialysis

4.4.2 Themes and subthemes

The main themes identified in the focus groups included the role of the infection control team, the perceptions of the infection control teams, and the facilitators of and barriers to the implementation of IPC practices. Participants' illustrative quotes are also included as evidence to illustrate the main themes and subthemes. These themes and subthemes are illustrated in Table 4.2 Quotes are labelled with the participants' identifiers, where "ICN1", "ICN2", etc., refer to individual infection control nurses, and "FG1" or "FG2" indicates the focus group from which the quote was extracted. Themes and subthemes will be discussed in the following section and supported with data extracted from the focus group transcripts.

Table 4. 2 : Summary of themes and subthemes

Themes	Subthemes
Theme 1: role of infection control team	Monitoring IPC practices Staff education and training
Theme 2: perceptions of infection control teams on adherence	Differences in IPC adherence across professional groups Culture of feedback Perceptions on adherence to each standard precaution
Theme 3: barriers and facilitators	Environmental factors Patient-related factors Staff characteristics and their impacts on IPC practices Communication skills Staff evaluation and upgrading staff

4.4.3 Theme 1: Role of infection control team

Infection control teams involve staff based in the infection control department who are responsible for overseeing IPC in different areas, including ICUs and medical wards. This team also includes link nurses who act as intermediaries between the IPC team and other HCWs, which facilitates communication and ensures adherence to IPC practices. The infection control team reported a range of different activities that they performed as part of overseeing and ensuring adherence to IPC practices. These included monitoring adherence of HCWs, as well as education and training.

These responsibilities formed the subthemes contained in this theme and are reported on further below.

4.4.3.1 Subtheme: Monitoring IPC practices

This subtheme comprised participants' reports of the different ways in which they monitored IPC practices amongst clinical staff working in the included hospitals. Observations were the most commonly used method for monitoring practices. This included direct observation as well as covert observations. Direct observation allows for immediate feedback and education, which was identified as an essential element for correcting improper practices and improving adherence. There were also examples from both study sites of covert observation and how they helped to identify areas for improvement. These included conducting observations with technologies such as cameras, as well as observations by an unknown observer and observations made during the non-working hours of the infection control team, such as during afternoon shifts, as demonstrated by the following:

ICN8: "When we had afternoon shifts in a few days, we could observe some non-compliance" (FG2).

ICN8: "If there is malpractice, it will happen when we are not around. We can see that when a new staff member of infection control observes them, and no one knows her, then she can see the non-compliance" (FG2).

However, the effectiveness of these covert observations was limited in the current context as infection control teams only worked one shift in the morning and were only able to conduct afternoon observations on a few occasions. Moreover, observations by unknown observers were not feasible due to the limited number of members of the infection control team, which restricted the frequency and the scope of these methods

Direct observations were identified as important for identifying incorrect practices. However, the participants reported that the effectiveness of this method was restricted to the time of observation. In other words, some HCWs tended to correct

their practices only when under the observation of the infection control teams. This suggests that HCWs' adherence is influenced by the Hawthorne effect, which is when individuals modify their behaviours in response to their awareness of being observed. Thus, direct observations can temporarily improve adherence but they may not lead to sustained adherence. The influence of direct observation was reported by different staff on both sites and it is illustrated in the following example:

ICN2: "Unfortunately, some health staff have information about hand hygiene, but they do not wash their hands before touching or entering the patient's room unless they see a member of the infection control team" (FG1).

For the above reasons, some of the infection control staff attempted to mitigate the influence of the Hawthorne effect by using different observation methods. For instance, they found that when the observer remained in a specific area for an extended period, typically at least 20 minutes, the staff became accustomed to the observer's presence, leading to a normalisation of their behaviour. This allowed the observers to witness actual practices, providing a more routine adherence and non-adherence with IPC practices. The participants reported that this technique was effective in monitoring IPC practices, as illustrated in the following quotations. However, the analysis of the data suggests that this strategy only allows malpractice in IPC to be observed, and may not lead to sustained adherence to IPC practices.

ICN4: "That is why I prefer to sit in the place for a period of time, at least 20 minutes, until the staff get used to seeing me and then forget about my presence in the place and work normally without any improvement in their performance. I read this information from one of the sources and I agree with it".

ICN5: "Indeed, I apply this method and find it effective" (FG1).

Although the above strategy did not seem to be effective in sustaining IPC adherence, it demonstrated the effort that infection control staff put into monitoring IPC practices and their commitment to finding innovative solutions. It also highlights that infection control staff are aware of the potential drawback of

direct observations, and emphasises the need for exploring the factors influencing staff behaviours.

Some participants also highlighted another observation strategy, covert observation, that facilitated monitoring non-adherence to IPC practices. They described that the use of cameras in isolation rooms has been acknowledged to have potential benefits in identifying non-adherence. However, it was limited by the lack of recording capability, which prevents infection control staff from observing HCWs' adherence outside the observation periods, including night shifts. The following participant demonstrated the perceived utility of these cameras in identifying non-adherence practices during their visits,

ICN1: "In ICUs, there are cameras only in the isolation rooms, but they do not record the events so you can only watch what is happening right now. We make use of these cameras when visiting the department and can see some malpractices without the health staff knowing that someone is watching them" (FG1).

Although the use of cameras was acknowledged by the participants as a potential tool to identify non-adherence, they reported the limitations of using them. The infection control team discussed the possibility of using surveillance cameras in various units within the hospital to monitor IPC adherence. The medical director suggested putting special surveillance cameras in ICUs to be used by the infection control team. However, this proposal was rejected due to ethical considerations, particularly regarding patient privacy.

ICN2: "The medical director suggested putting special surveillance cameras in ICUs for the purpose of monitoring the nurses and other HCWs. But his proposal was rejected because this is against the patients' privacy and there is a need to do the patient's morning care" (FG1).

This analysis suggests that while the use of cameras can be a tool to identify non-adherence at specific times, concerns about patient privacy make this method ethically challenging. Furthermore, the effectiveness of cameras in monitoring IPC practices is limited by the lack of real-time feedback. Without immediate feedback,

HCWs might not be able to correct their practices in real time, which reduces the potential for these cameras to support sustained adherence to IPC practices. Thus, even though using cameras as a monitoring tool is common in some settings, the ethical implications and limitations in real-time feedback pose significant challenges for their broader application in monitoring IPC adherence.

Additionally, the studied hospitals attempted to use technologies for monitoring IPC practices. Two participants from hospital B shared their experiences of using technology for monitoring hand hygiene practices, including hand hygiene sensor-based devices. However, a critical challenge of wearable devices was that they were compromised by practical use conditions, including being obscured by protective clothing. Despite these challenges, the potential benefits of such technologies, as noted by successful applications in other hospitals, suggest that overcoming these barriers could enhance IPC monitoring efficiency.

ICN7: "Actually, we didn't continue using it because of some challenges, especially when the sensor becomes weak under the gown, but I know that some hospitals got really good results when they continue using this device" (FG2).

As discussed above, observations involved both infection control staff and link nurses, who directly observed HCWs during their routine audits. When members of the IPC team were concerned, link nurses performed ongoing observation and education with HCWs. This targeted approach helped to maintain a sustained emphasis on areas of concern to reinforce that improvements were made, and standards were consistently met. Moreover, if repeated breaches in practices were observed, the IPC team raised the issue to the management of the department. This step ensures that there is accountability at all levels and more formal handling of major or persistent non-adherence.

"ICN3: We speak and advise other employees directly when we see that they do not adhere to the precautions and focus on it during other visits, or the infection control link nurse will be asked to monitor it and follow up. We also inform the management of his department if the wrong practice is repeated" (FG1).

Additionally, the infection control staff highlighted that the role of the link nurses is to provide routine observations, as well as sending reports to the infection control department to promote ongoing adherence to IPC practices. Link nurses, who are part of the nursing staff in clinical areas, act as liaison officers with the infection control team to observe practices and foster a culture of IPC adherence. Through routine and follow-up observations, link nurses help to identify patterns of non-adherence, which allow for targeted support and training. However, the participants noted that link nurses' reporting practices were often influenced by hierarchical issues and professional affiliations, which can impact accountability. Participants reported that link nurses were more likely to formally report non-adherence by surgeons to the infection control department than non-adherence by their nursing colleagues. This tendency could be due to the perception that surgeons are the most nonadherent professional group, and possibly due to the hierarchical status that surgeons hold over nurses, which affects reporting practices.

ICN4: "I think that there is some bias, as you know that she is a nurse, so when the mistake is made by a doctor, she will most likely report it, but when the employee at fault is a nurse or a colleague of hers, she will most likely advise her and cover it up" (FG1).

This feedback suggests that hierarchical influences and a reluctance among link nurses to report non-adherence by fellow nurses can limit the effectiveness of current IPC monitoring efforts.

4.4.3.2 Subtheme: Staff education and training

Furthermore, the infection control team provides education and corrective guidance to HCWs, as well as conducting competency testing.

Education is provided in different ways, including regular training sessions and ad hoc discussions within departments. These educational efforts can be specific to one component of IPC such as hand hygiene or related to particular infections such as surgical site infection. Regular training sessions ensure ongoing education and reinforcement of best practices, while ad hoc discussions address immediate

concerns and emerging issues as they arise. However, while education and training sessions have shown to be effective in promoting adherence to IPC practices, there are still challenges and limitations. For instance, some HCWs have knowledge about hand hygiene but do not consistently employ it unless they see infection control staff, as discussed under the monitoring subtheme.

ICN6: "In addition to some specific training that is given separately, including catheter care like central line and foley catheter. Bundles care and education about surgical site infections or other infections based on the department that HCWs work on" (FG2).

Since there are still challenges related to hand hygiene, the participant mentioned that they arranged regular campaigns to highlight the importance of IPC practices and emphasised the importance of hand hygiene while providing any education.
ICN4: "When we give special education to a particular department, we always talk about the issue of hand hygiene because it is the key to solving infection control problems. This is in addition to the World Hand Hygiene Day and other campaigns that we carry out" (FG1).

Furthermore, to reinforce the importance of hand hygiene practices, the infection control teams also focus on the practical application and understanding of hand hygiene practices among HCWs. The infection control staff tend to ask HCWs to demonstrate the five moments of hand hygiene in real-world scenario in their clinical departments during their regular rounds. The infection control staff also ask HCWs to clarify the purpose of each moment of hand hygiene. This approach reinforces the importance of these practices and ensures that HCWs understand both 'how' and 'why', which can lead to better adherence.

Infection control teams highlighted that they also provided orientation programmes for newly hired staff, which covered essential infection control practices including hand hygiene and PPE use. However, they perceived these programmes as inadequate for maintaining consistent adherence in clinical practice. This inadequacy could be influenced by staff characteristics, which are discussed further under the subtheme related to staff characteristics in section 4.4.5.3.

ICN7: "The orientation programme that is given to the newly hired staff focuses on infection prevention. It includes hand hygiene, the use of PPE..." (FG2).

Moreover, some participants reported that the infection control team provided updates on recent HAIs, which highlights the proactive role of the head of the infection control department in staying informed about emerging infectious diseases and disseminating this knowledge to the staff. This proactive approach demonstrates effective leadership, the value of early preparedness in mitigating the impact of infectious diseases, and the importance of educational and training. The proactive efforts of the head of the infection control department before the COVID pandemic also likely influenced staff attitudes and behaviours, contributing to better adherence to IPC practices and preparedness for the pandemic. This proactive approach could be integrated into all IPC practices to ensure continuous improvement and readiness for future infectious diseases.

ICN2: "Also, at that time [before COVID spread around the world], the head of the infection control department was very interested in getting updates on infectious diseases and infection control… She gave lectures about this virus before it spread around the world and asked us to prepare ourselves by teaching the staff about ways to combat this infection…" (FG1).

The proactive approach of the IPC leader before the COVID-19 pandemic seemed to have raised awareness among HCWs, which prompted them to seek more information and actively engage in IPC- related activities, as shown by an increase in attendance at IPC lectures and staff requests for additional training.

ICN4: "The health staff became more aware and were asking us for advice and additional information. When giving lectures, there was greater attendance" (FG1).

The emergence of COVID-19 further reinforced the importance of IPC practices, as HCWs demonstrated heightened adherence to IPC, including the donning and doffing of PPE as in the following:

ICN8: "They all know the proper way of donning and doffing the PPE, particularly after the emergence of COVID" (FG2).

ICN8: "I think the emergence of COVID was a good factor. We could see that all staff were really compliant at that time" (FG2).

The heightened commitment observed during the pandemic suggests that consistent, proactive, and intensive training might be beneficial in sustaining IPC practices, even outside crisis periods.

Furthermore, the infection control team reported that they performed the annual competency test, which contains some basic infection control questions. These tests are designed to evaluate nurses' knowledge in different areas, including IPC practices, and they usually take place at a scheduled time. However, these tests have limitations as they can be influenced by recall bias, where participants might remember and recite information during the test that they do not consistently apply in their daily practice. This limitation suggests that while the test might assess knowledge retention, they may not accurately reflect the actual adherence to IPC practices.

Moreover, a few participants reported that staff education and training extend beyond direct supervision to include strategies such as mentorship, particularly for new staff, which helps to builds staff competence and confidence. This strategy can embed IPC practices into daily routines. It also reinforces the organisational culture of accountability and collaboration.

ICN8: "We also ask the new staff to accompany the existing staff to get some experience and prevent the mistakes that can happen, before assigning patients" (FG2).

4.4.4 Theme 2: Infection control teams' perceptions of adherence

This theme addresses how the infection control teams perceived adherence to IPC practice among HCWs. Participants from the infection control teams highlighted

perceived variation across different professional groups, clinical settings and different standard precautions.

4.4.4.1 Subtheme: Differences in IPC adherence across professional groups

There was a general agreement within and between the groups that doctors and surgeons are the least adherent to IPC practices. This consensus emerged from both focus groups, which reflects a shared perception across different settings. This could be due to several factors including perceived urgency and habitual practice in surgical settings. For instance, the participants believed that doctors, particularly those providing care for critical and bedridden patients, prioritised urgency over strict adherence to IPC practices,

ICN6: "I think doctors are not compliant because they deal with critical patients and bedridden patients, so they are always in a hurry" (FG2).

This perception highlights the challenge of balancing the demand of patient care and the requirements of infection control, which suggests that work pressure may result in lapses in IPC adherence.

The participants noted variations in IPC adherence across professional groups and reported that some groups appeared to be more consistent in their practices than others. For instance, although all the participants were trained in IPC practices, certain contexts such as the operating theatre require an increased focus on maintaining sterile techniques. Therefore, some professionals may prioritise IPC adherence in specific environments but view adherence as less important in other areas, especially when the setting or tasks do not seem as critical.

ICN1: "Surgeons are committed to taking precautions inside the operating rooms, and when they leave the operating rooms, they do not apply any of them" (FG1).

ICN6: "Even if the patient is under contact precaution, they [surgeons] may remove the dressings to check their wound without wearing PPE. I would say all doctors are considered the least adherent to infection control practice" (FG2).

A few participants initially expressed that lab technicians, radiologists, and pharmacists were more adherent. However, the discussion revealed disagreements and explanations that challenged this perception, as highlighted in the following quotes:

ICN8: "I think other professions are compliant, including the pharmacists, lab technicians and radiologists."

ICN6: "… because these actually have a phobia of patient contact." (FG2).

The perception of adherence among these professionals was attributed to a "phobia" or fear of patient contact, which motivates them to adhere to IPC practices. However, other participants highlighted specific instances of non-adherence, particularly among radiologists. These professionals were observed using the same PPE across different departments, which highlights a misunderstanding of IPC practices and increases the risk of cross-infections, as illustrated by the following participants:

ICN7: "There are some radiologists who are not compliant. I can see them leaving the radiology department with their gloves on."

ICN8: "Yes, some of them put on the PPE in the radiology department and then enter another department with the same PPE."

ICN7: "They feel that they can protect themselves better when they do it this way. They are not aware of the number of organisms they would carry and transfer from their department, the elevators, walls, and doors" (FG2).

Non-adherence to PPE use among these professionals could also be influenced by workload and time pressure, leading them to not changing PPE between patients or departments to save time.

4.4.4.2 Subtheme: A culture of feedback

This subtheme demonstrates the role of feedback in adherence to IPC practices. This includes feedback provided by infection control teams, senior members of staff, and peers. It also highlights the role of positive reinforcement in motivating HCWs to follow IPC practices.

Some participants commented that there is competition between the departments to achieve the highest percentage of HH adherence. The result of this comparison seems to encourage staff to be more adherent, particularly in hand hygiene. This transforms routine monitoring and feedback into a motivational tool that uses the natural human drive for achievement and recognition.

ICN4: "Then we calculate the percentage of the department's commitment to hand hygiene at the department level, not personally…."

ICN5: "When some departments get a low percentage, the necessary action is taken with them, so they always try to get a good percentage on HH" (FG1).

The infection control team talked about promoting a culture where infection control is viewed as a collective responsibility,

ICN4: "We also encourage employees to correct their colleagues because infection control is everyone's responsibility" (FG1).

However, implementing this ideal in practice is accompanied by challenges. While the infection control team advocates a culture of shared responsibility, the effectiveness of peer-to-peer feedback is often limited. Most of the infection control staff have prior experience working as nurses, which provides them with an understanding of peer dynamics in the clinical setting. They recognise that feedback between nurses may not always be well received, and interprofessional feedback can be influenced by hierarchical structures and personal relationships. This background gives them insights into how cultural and interpersonal factors affect the reception of feedback. For instance, some participants argued that accepting

feedback is restricted by HCWs' nationality, or culture. People from the same culture may accept receiving and providing feedback,

ICN6: "Look, this is really difficult. If I'm working with my friends or colleagues, it is not easy to correct or comment on the performance unless this is the task I should do, I mean if it is my job. But, if I don't have the authority, I can't tell my friend that this practice is wrong, this can affect our relationship…" (FG2).

Furthermore, a participant mentioned a challenge experienced when providing feedback to HCWs regarding their IPC practices, highlighting that some HCWs do not follow their advice and disrespect them when providing feedback. This behaviour could be influenced by hierarchical issues, especially considering that most of the members of the infection control teams are nurses. This resistance to feedback suggests that hierarchical structures within healthcare settings can undermine the authority of infection control teams, which hinders effective communication and adherence to IPC practices.

ICN7: "I got responses like 'even if you are an infection control member, I don't really care…'" (FG2).

A participant also highlighted the role of senior staff in shaping a culture that normalises feedback within the department. Leadership's endorsement and feedback practices can significantly influence how comfortably and frequently feedback is exchanged, thereby fostering a more open and supportive environment for IPC improvement.

ICN5: "I also feel that the head of department has a big role in that. When the head of the department tries to encourage and maintain feedback as a normal part of the work environment, the staff will be ok to give and receive colleagues' feedback" (FG1).

The above statement reflects a suggestion by a member of the infection control team rather than an example of current practice. It highlights the role of senior leadership in establishing a feedback culture. It suggests that when department

heads actively support feedback practices, this can positively impact the overall feedback culture and IPC improvement.

Additionally, some participants mentioned that some incentives, including thank you certificates, might motivate the HCWs to adhere to IPC practices. By acknowledging and rewarding good performance, healthcare facilities can enhance engagement and adherence among staff, but the evidence for the effectiveness of these incentives in improving actual practices is limited.

Moderator: "Were any facilitators used, and did you find them effective?"

ICN2: "Sometimes I send an email to thank the departments for their performance as a kind of motivation."

ICN1: "Sometimes I give them thank you certificates" (FG1).

This feedback reflects participants' perceptions that such incentives might be beneficial. However, it does not provide direct evidence that these practices lead to improved adherence to IPC practices. This is more about individual practices and perceptions rather than established policy or demonstrated effectiveness.

The infection control team highlighted the importance of implementing IPC practices. Participants at both sites stated that if nurses were not adherent to IPC, they were not able to continue working in the same unit. Thus, the fear of repercussions encourage adherence.

ICN8: "If we observe the same mistakes after that, we send her/him to another unit. She can't work in the dialysis unit if she is not fully compliant with infection control" (FG2).

The above method of reassigning nurses who repeatedly fail to adhere to IPC practices, including moving them to another unit, reflects an attempt by the infection control team to enforce adherence. However, the effectiveness of this method is not evident in this data. There is limited evidence on whether

reassignment of these nurses improved IPC adherence in their new departments. In addition, sending these nurses to other units as a corrective measure may have consequences, including creating a perception of punishment rather than support. It is important to address the root causes of non-adherence, such as inadequate training, since this punitive approach might not lead to long-term improvements.

4.4.4.3 Subtheme: Perceptions of adherence to each standard precaution

The majority of the participants stated that HCWs only perceive PPE and hand hygiene as necessary if they are having direct contact with someone or undertaking a procedure. This perception led to lapses in IPC practices, including failure to wear PPE when entering isolation rooms when no procedure was planned, as well as neglecting some moments of hand hygiene.

ICN2: "Do you know that one of the main problems we have is that some nurses do not apply the five moments of hand hygiene, and that the first moment, which is washing hands before entering the patient's room, is rarely adhered to or implemented. But they wash their hands after they are done…" (FG1).

ICN6: "So, the moment that doesn't include direct contact with patient is always missed or neglected…" (FG2).

ICN3: "One of the problems is when there is a patient in isolation and the staff have to wear PPE. Sometimes they don't wear it because they won't do a certain procedure with that patient, for example they will enter the patient's room to ask about something or to tell the patient some information" (FG1).

These perceptions suggest a potential gap in understanding of the importance of IPC practices. It also highlights a possible disconnection between the perceived and actual necessity of these practices. These behaviours could increase the risk of cross-infections and highlights a broader issue regarding the training and enforcement of IPC practices. This was highlighted when discussed under section 4.4.3.2 related to education, which indicates that the current efforts were insufficient. Furthermore, these lapse in IPC practices could be attributed to the workload, time constraints

and shortage of supplies that were reported as barriers to IPC adherence in this study.

Similarly, waste management practices, particularly separating the different types of waste, were not practised properly, as highlighted by some of the participants. A specific challenge highlighted was the frequent updates to these guidelines, particularly during the pandemic, which led to confusion and inconsistent practices among HCWs. This issue was exemplified by the following statement,

ICN8: "Not all the practices are done perfectly, particularly hand hygiene and waste management. For waste management, the staff are confused because of the regular updates regarding this matter" (FG2).

This inconsistency in waste management highlights a challenge in maintaining IPC practices. Although it is necessary to address emerging threats and incorporate new knowledge, frequent updates can lead to confusion if not communicated effectively. The use of visual aids and quick reference guides, as well as continuous support from the infection control team, can help to mitigate confusion and ensure consistent adherence to waste management practices. Additionally, it could also be important to provide adequate time for staff to adapt to new updates by possibly overlapping old and new guidelines during the transition period.

All the participants highlighted environmental cleaning and the overall cleanliness of the place as important in preventing the spread of infection. This suggests that despite the focus on direct practices such as hand hygiene, the environmental aspects of IPC carry equal weight in controlling infections,

Moderator: "What is the main reason for the transmission of any infection that occurs in the hospital?"

ICN5: "Environmental cleaning."

ICN4: "Environmental reasons related to the cleanliness of the place" (FG1).

ICN2: "Always when the focus is on hand hygiene and environmental cleaning, we can control any spread."

Moderator: Does everyone agree with this opinion?

Others: "Yes" (FG1).

Although the importance of environmental cleaning and hand hygiene is widely recognised, the practical application of these practices can be inconsistent. Environmental cleaning is typically often managed by different groups, with cleaning staff responsible for the majority of routine cleaning tasks, while HCWs are responsible for disinfecting shared equipment. This division of responsibilities may contribute to variations in adherence and effectiveness across different areas of infection control. To address this issue, it is essential to foster clear communication between different groups regarding their roles and responsibilities in infection control.

4.4.5 Theme 3: Barriers and facilitators:

This theme explores the various factors that either hinder or support the implementation and adherence to IPC practices from the point of view of infection control staff. These factors contain both organisational influences, such as environmental factors, and individual elements, such as HCWs' and patients' attitudes and behaviours.

4.4.5.1 Subtheme: Environmental factors

This subtheme discusses the influence of organisational factors on adherence. These are shortage of supplies, shortage of staff, workload, and the physical structure of the hospital rooms.

Shortage of supplies was reported as a challenge experienced by HCWs. Some participants consistently reported that a shortage of supplies was considered the

main cause of infection spreading. They also believed that the supplies issue was a common issue that could occur in any hospital.

ICN8: "Most of the time, the main cause is shortage of supplies, even before the pandemic."

ICN6: "Often, when we have shortage of supplies, the rate of infections will increase" (FG2).

The infection control teams also believed that some HCWs tended to not use some of the supplies when necessary due to fears of running out.

ICN6: "We also experienced shortages of gloves. HCWs knew that when they removed their gloves, they would not find another one. So, they had to use the same gloves with more than one patient…" (FG2).

As highlighted by the majority of participants, resource shortage, including shortage of staff and lack of supplies, are important organisational barriers that affect HCWs' adherence and contribute to spreading infections. These shortages are exacerbated during pandemics but are also a common issue during normal circumstances.

ICN7: "Regardless of the pandemic, we always have shortage of supplies or shortage of staff, which causes a spread of infection..." (FG2).

The participants also stated that when there is shortage of supplies, they provide the necessary teaching to HCWs to provide care and ensure patient safety. However, the focus groups did not provide specific examples of this advice. The infection control team's attempt to provide advice and support to HCWs illustrates the adaptive strategy adopted by them to maintain IPC practices in different situations.

ICN1: "Lack of resources. It is a problem that occurs in all hospitals and departments. We as an infection control team do not have a big role in terms of supplies, but we must follow up. Sometimes we can provide advice in order to help

the health staff in dealing with patients with a lack of some resources. For example, we teach them things that can be done in the absence of some supplies" (FG1).

In addition to resource constraints, the participants also emphasised the influence of workload on IPC practices. Specifically, the lack of assistant workers exacerbates the burden placed on nurses, as they are required to perform non-nursing tasks themselves. This increased workload can limit HCWs' time and divert their attention from strict adherence to IPC practices.

ICN4: " … we do not have assistant workers in the hospital to transport patients or bring medicines. Therefore, the nurse has many tasks that include transferring patients to other departments, sending samples to laboratories, going to the pharmacy to receive medicines, in addition to the documentation. This causes a working pressure on the nurses and must be relieved" (FG1).

Some participants suggested that having assistance or support from other staff could alleviate some of the workload on nurses and potentially improve IPC adherence. This was specifically illustrated in the case of when nurses in charge helped other nurses, who then effectively followed IPC practices and prevented cross-infections. This indicates that addressing staffing issues may be associated with enhancing IPC practices.

Some participants highlighted insights into the influences of staff-to-patient ratios on IPC adherence, particularly when comparing ICU and medical wards, stating:

ICN4: "In intensive care units, the ratio of patients to nurses is one to one, while in the medical departments, it is one to five. Therefore, it is natural for nurses in ICUs to be more careful than those in medical departments" (FG1).

In ICUs, the one-to-one staffing ratio allows nurses to dedicate substantial attention and care to each patient, facilitating adherence to IPC practices. Conversely, nurses in medical wards experience a higher patient load, which could compromise their ability to maintain optimal infection control standards due to time constraints and

increased workload. This difference suggests that a higher nurse-to-patient ratios may be associated with better IPC adherence.

A few participants also mentioned that one of the factors that affect HCWs' adherence is the presence of numerous doctors, specialists and trainees in one small area; this may unintentionally result in breaches in IPC practices. These breaches could include inadequate hand hygiene due to spatial constraints, difficulties in using PPE in crowded settings, and increased contact between individuals, which increase the risk of infections.

ICN7: "The number of doctors that deal with each patient is different. Sometimes a group of trainees enter the patient's room with consultants and specialties at the same time" (FG2).

This situation highlights a broader challenge in balancing educational needs with patient safety protocols. It also highlights an issue with the layout of the patients' rooms, which cannot accommodate a large group of people and limits the movement of HCWs when implementing IPC. The presence of inexperienced trainees may negatively influence adherence to IPC practices.

Addressing this issue may require organisational adjustments in hospital protocols, including limiting the number of people in a patient's room at any given time or improving the training of HCWs and trainees on the importance of IPC practices, even in challenging physical environments. These suggestions are derived from an analysis of the challenges identified in the data. Although the participants highlighted the problems related to overcrowding and training deficits, they did not explicitly propose these solutions.

Some participants also discussed redesigning the hospital to facilitate adherence to IPC, particularly during the pandemic. This included separating infected patients from those suspected of being infected by specifying different routes.

ICN2: "The hospital took strict measures and changed the design of many departments so that there were departments and a special path for COVID patients

and another path for suspected people and families in contact with infected patients. Some walls were demolished, and others built, so there was a major change to combat the pandemic. Therefore, no transmission of infection occurred between patients inside the hospital, but this did not include the staff" (FG1).

Although the above changes effectively managed the pandemic and reduced cross-infections, this study did not investigate whether these redesigns were maintained or reverted after the pandemic, as the study was conducted during the pandemic. Maintaining these redesigns post-pandemic could offer insights into their broader applicability for general HAIs.

The participants also highlighted the importance of managing human resources, including staff allocation, in improving adherence to IPC practices. The most qualified and adherent nurses were assigned to provide care for critical patients to ensure the patients' safety.

ICN1: "The nurse who is most committed to infection control precautions, most efficient and educated is assigned to patients with conditions that require more care" (FG1).

This practice utilises nurse expertise to reduce the risk of infections and enhance patient safety, which demonstrates a management approach to resource allocation.

ICN5: "When we are worried about one of the patients, the most qualified nurse is assigned to him …" (FG1).

The participants believed that this approach aimed to minimise the risk of infections among high-dependency patients. However, this approach suggests that it is less effective among low-dependency patients. Assigning less experienced or less adherent nurses to lower-risk patients could lead to increased infection rates in these populations. This indicates potential damage limitation rather than comprehensive prevention, suggesting that strategic staff allocation is an effective method for reducing the risk of HAIs in critical patients. However, it is important to

note that HAIs can also spread to low-dependency patients, which indicates the need for IPC practices across all patient care areas and levels.

Additionally, the participants reported that patients in the ICUs often required the use of life-supporting devices, including ventilators and central lines, which increase infection risks. The crucial nature of these patients required increased awareness and strict adherence to IPC practices. This highlights that patient acuity directly impacts the need for infection control, as high-acuity patients are at higher risk of infections and therefore require stricter IPC practices.

These insights suggest the need for hospital administration to consider adjustments in staffing policies, particularly in general medical wards, to increase IPC adherence and patient safety. However, deciding what constitutes safe staffing levels is important as this varies based on the specific healthcare context and needs in question. This suggestion is derived from the analysis of the data, and it aims to address the challenges of high patient load. Further training on implementing IPC practices under higher workload conditions may also help bridge the gap in adherence between different hospital environments.

On the other hand, some participants in the first focus group described medical departments as “quiet” and less critical than ICUs, allowing IPC practices to be maintained. This was exemplified by using single rooms for certain patients to minimise the risk of cross-infection:

ICN5: “This (ICU staff follow IPC) also happens in the medical departments. When we visit the departments, we see that they have put some patients in single rooms and put in place the appropriate precautions for them” (FG1).

ICN4: “Medical departments are considered quiet departments and are not critical like intensive care. They have a few emergency cases, so we can say that the employees are committed to the preventive measures” (FG1).

This perception suggests that both ICU and medical department staff implement IPC practices, including the use of single rooms for certain patients. This highlights how

similar practices are applied across different departments. However, it is important to evaluate whether this adherence is consistent across departments.

Although the use of single rooms is an important IPC practice, its effectiveness may vary between departments due to differences in patient acuity, staff-to-patient ratios, and the nature of each department. For instance, in medical wards, which are described as ‘quiet’ and less critical than ICUs, the implementation of IPC practices might be influenced by these contextual factors. This suggests that similar practices are observed. However, it does not necessarily mean that the level of adherence and overall infection control effectiveness are equally similar in each department.

However, some participants from the second focus group argued that comparing adherence between these two departments is complex. They believed that this complexity is because each department has its own capacity and procedures, which influence the level of workload and consequently IPC adherence. For instance, the types of routine procedures that are performed in the ICU are more intensive and different from those in a general medical ward, which influences the types of appropriate IPC. Furthermore, the patient admission rates in medical wards are higher than those in the ICU, which adds further challenges for HCWs in terms of managing and prioritising IPC practices during periods of high workload, as noted by the participants:

ICN7: “I think I can’t compare between these units. Each unit has its procedures and speciality.”

ICN8: “The patient conditions are different as well as the procedures …” (FG2).

The findings highlight the importance of considering departmental contextual factors when evaluating IPC adherence. Thus, it is essential to develop tailored IPC strategies that address the specific needs and challenges of each department for effective infection control.

Additionally, a few participants mentioned contextual factors in ICUs that could positively influence IPC adherence, such as the use of IPC as a routine, and having a minimum rate of staff turnover. For instance, one participant mentioned that the use of IPC practices in the ICU is considered routine work. The IPC practices become part of their routine which makes it easier for the staff to practise them. They also commented that adherence to IPC may not be habitual or consistent in departments where not all patients require strict precautions.

ICN6: "It [IPC in the ICU] became a routine because they used to do it all the time with all the patients. Thus, they do it involuntary. This is in contrast to the other departments where some precautions do not need to be implemented. Most of the patients do not need a specific precaution" (FG2).

In the ICU, the routine implementation of IPC practices is required due to the critical nature of the patients, who are often on invasive devices such as ventilators or central lines. For instance, specific precautions including protocols to prevent VAP and central line- associated blood stream infections are strictly followed to reduce the risk of device-associated infections.

There was agreement between the participants in the second focus group that in the ICU, the protocol is strict, which makes it obligatory for the HCWs to follow it. This could be attributed to the patients' critical condition, which necessitates strict IPC practices to prevent infections in these vulnerable population. This strict adherence is considered important in the intensive care environment.

ICN8: "There is a strict protocol for the ICU department. So, the staff are obligated to follow it. It is not optional. Whether they agree or disagree with that protocol, it should be followed" (FG2).

4.4.5.2 Subtheme: Patient-related factors

One of the factors that influence HCWs' adherence is the cultural background of patients, and patients' companions. The term "patient's watcher" is used by HCWs

to describe the relatives who accompany their patients throughout their hospital stay.

Some patients have insufficient awareness of the importance of IPC practices and thus contribute to spreading or acquiring infections.

ICN6: "Like when the patients visit each other without considering the IPC precautions. I have seen post-op patients who sit or visit others and they maybe haven't had a shower for 3 days. They can spread or get infections."

Another challenge experienced by a few participants in the second focus group was due to patients' companions. Despite the efforts spent teaching the patients' companions, their non-adherence to the recommended IPC practices often contributed to spreading infections within the hospital, which suggests that the current educational methods are insufficient. This non-adherence could be attributed to individual factors, including a lack of understanding or cultural habits that are difficult to change through the available educational efforts. Furthermore, at an organisational level, the patients' companions interact with their patients as well as others in close proximity. This interaction in shared rooms can lead to cross-infections between patients. This suggests the need for stricter supervision or policy changes within the hospital to reduce the potential transmission of infections in shared patient rooms.

ICN6: "Patients' watchers are a challenge in themselves, so that person goes to the hospital's supermarket and the cafeteria, then comes back to the patient's room. Whatever we tried to teach them, there are no benefits. Often, they will accompany patients in triple bedrooms with other patients. So, the environment of the hospital can contribute to infections and these things are out of our control" (FG2).

A few participants believed that a patient's age can act as a barrier to implementing IPC practices. This reflects an individual-level challenge as it can be challenging for HCWs to deal with the elderly and involve them in implementing IPC practices.

ICN7: "We can't force or convince an elderly woman to stay in her room …" (FG2).

This suggests that patient behaviour and demographics, particularly age, can influence adherence to IPC practices. Elder patients could be less adherent due to physical or cognitive limitations, which increases the risk of infections. Moreover, in some cases, cultural norms emphasise respect for older patients, which may make HCWs hesitant to enforce IPC advice or instructions. This contributes to increased infection risks.

4.4.5.3 Subtheme: Staff characteristics and their impacts on IPC practices

The participants noted a link between hiring new staff and infection outbreaks, which suggests potential challenges in integrating newly hired HCWs into the clinical environment. These outbreaks, which coincide with the arrival of new staff, could be associated with the level of supervision provided during their transitions. Assigning a large group of inexperienced staff to one department may overwhelm the existing team, strain supervisory resources, and increase the likelihood of lapses in IPC practices.

ICN8: "Also, when a new group of HCWs are hired at the same time and they assign all of them to one department, usually we experience outbreaks during that time" (FG2).

Furthermore, the participants referred to newly hired personnel as "foreigners", which may imply challenges related to cultural differences, due to variations in the nationalities of HCWs. These differences were linked to different approaches, including the use of PPE and cleaning practices. These differences could be influenced by cultural norms or prior professional training. However, generalisation about the adherence of HCWs based on nationality needs to be approached with caution and will be further discussed in the discussion section.

ICN2: "Almost a year before the pandemic, I had 14 patients with the same infection, Acinetobacter xdr, in the intensive care unit. In that period there was a new group of employees, and they were all foreigners from India. When they

arrived, I had only one case, but I noticed the same infection spread quickly until it reached 14 cases" (FG1).

This highlights the importance of considering cultural diversity and improving orientation programmes to address these potential barriers and support IPC adherence.

While a high number of new staff was associated with an increase in HAIs, some participants highlighted the significant impact of staffing stability (a stable group of HCWs with minimal turnover) on the effectiveness of IPC practices within healthcare departments. They believed that having a consistent team who becomes highly familiar with specific IPC practices can enhance adherence.

ICN8: "For us, in dialysis, it is the same staff and the same procedures. So, I think they are good in complying with infection control practices."

ICN7: "This is the same in the ICUs. The staff are the same. So, there is a focus on the same staff, and they do similar procedures" (FG2).

Staffing stability in hospital departments, including ICU and dialysis, benefitted from a consistent team that performed similar procedures regularly, which enhanced IPC adherence. This highlights the importance of staffing stability in maintaining effective IPC practices and reducing the risk of infections.

4.4.5.4 Subtheme: Communication skills

The participants highlighted the importance of communication style and techniques in influencing IPC adherence. There was a general agreement on the importance of understanding, and being approachable and respectful, which was perceived as a potential facilitator of IPC practices. However, the second focus group pointed out that despite using this approach, some had experienced challenges and resistance, which could indicate that one approach is not always effective for all HCWs. The following statement emphasises the importance of the approach taken by the infection control team.

ICN2: "This is a very important thing in dealing with people and everyone should use it. This was mentioned in the Qur'an, if a person's words were harsh, people would turn away from him. So, we must first give them clear information about the precautions and why we must apply them in a nice way" (FG1).

This approach is rooted in the cultural context that values gentle and effective communication, as noted in religious teachings. Such culturally relevant guidance implies that presenting information in a considerate and respectful manner can greatly improve the acceptability of IPC practices. The agreement among participants indicates a common understanding of the role of communication in IPC practices. However, the second focus group's perception that the friendly approach doesn't always work highlights a potential barrier related to the inconsistency in how communication techniques are received and implemented across different individuals and contexts.

ICN7: "I can't build a relationship with every HCW. But we are dealing with them politely, we greet them, we start with words like "Dear, I'm sure that you may forget or just missed wearing the gown...". We don't give the advice directly like "You have done this mistake, and I will report you to the head". Although we are really friendly, we get bad and rude responses sometimes." (FG2).

This suggests that while politeness and friendliness are culturally valued, they may not always be sufficient to maintain adherence. Variations in responses could be due to individual factors including resistance to feedback or organisational issues such as power hierarchies. This highlights the need for adaptable communication strategies to address individual and contextual differences.

4.4.5.5 Subtheme: Staff evaluation and upgrading staff

Staff evaluation refers to the formal assessment of HCWs' performance, which is typically conducted by the department head or supervisors. Staff are informed about their strengths and areas that need improvements. Some participants noted that staff evaluation also plays a role in their adherence. When a wrong practice is repeated, the head of the department should remind the staff of the possibility of

receiving a low evaluation. Thus, some nurses, particularly international nurses, will try to improve their practice as their evaluation is linked with their job contract,

ICN2: "From my point of view, employee evaluation plays a major role in accepting advice and correcting wrong behaviour. For example, when there is a nurse who is not good at washing her hands and always repeats the same mistake, we alert the head of the department and she, in turn, will take the appropriate action and will have to remind the nurse that her evaluation will be affected due to her lack of commitment to hand hygiene" (FG1).

ICN6: "This [resistance to change behaviours] rarely happens with international workers….they usually worry about their evaluation because it is associated with the job contract" (FG2)

The effectiveness of linking adherence to IPC practices with staff evaluation is evident among international nurses, which suggests that this approach could be effective among Saudi nurses. However, the influence of this approach on long-term adherence requires further exploration to ensure that it leads to sustained improvements rather than temporary adherence to secure the job.

Furthermore, a few participants commented that the heads of department take into consideration the nurses' adherence level. When the nurse is adherent with IPC practices, she will be upgraded to a higher position, which could be perceived as a motivator to carry out IPC practices. Thus, nurses may improve their IPC practices in order to be promoted to a higher position. This demonstrates the role of leadership within IPC practices, particularly how experienced and adherent nurses can become educators and role models to foster a culture of adherence and mentorship within healthcare settings.

ICN3: "Yes, when there is a professional nurse [experienced and adherent to IPC] in the department, she is given the role of a clinical resource nurse, an educator and is a role model for others. In addition, she can teach others and also become an infection control link nurse..." (FG1).

4.5 Discussion of the findings

The findings from this study highlight the important role of infection control teams in promoting IPC adherence through several strategics including regular monitoring, providing feedback, and education and training programmes. However, the study also identified communication challenges and hierarchical gaps that may limit the effectiveness of these strategies and hinder collaborative IPC efforts. One of the main strategies identified in this study is regular monitoring, mainly by direct observations. The infection control teams perceived that direct observations corrected behaviours related to IPC practices. However, it was noted that this impact was temporary. Similar findings are described by Agreli et al. (2019), who conducted a study using 59 hours of non-participant observations and 57 interviews to investigate how patients, families and HCWs use and understand IPC guidelines in four hospitals in Ireland. The authors found that an audit resulted in a change in practice, but that the change was quickly reversed when the audit was over, which demonstrates the Hawthorne effect (Agreli et al., 2019). This effect was minimised in the current study as there were some changes in the observation strategy. The participants highlighted that malpractices related to infection control were noted during unannounced rounds and when new observers visited the units. Malpractice was also noted when the infection control teams spent a longer time than usual in the unit or when practice was observed on camera. These strategies, which are covert methods of observation, are recommended strategies that reduce the Hawthorne effect (Chen et al., 2015). The temporary nature of behaviour correction observed in the current study reflects the broader challenge of sustaining long-term adherence to IPC practices, which has been identified in the literature. Therefore, it is essential to explore frontline staff perspectives to understand the reasons why these strategies are not effective in achieving sustained changes.

The study findings identified that adherence was perceived to vary based on individual and organisational factors. For instance, in the medical wards, adherence was perceived to be influenced by the less acute nature of patient care compared to ICUs. The infection control teams believed that HCWs in these departments may adjust their adherence to IPC based on perceived risks, workload and patient needs. Importantly, patient and family awareness was identified as an important barrier to

IPC adherence. The findings highlighted instances of insufficient awareness among high-risk patients who visited each other without applying the IPC practices. In addition, the participants discussed how some family members who accompanied hospitalised patients created a barrier to the prevention of HAIs, which highlights an organisational challenge related to visitor policies and engagement.

Although the Ministry of Health in Saudi Arabia has clearly outlined the responsibilities of patients, family members, and companions to adhere to healthcare regulations, including IPC practices (Ministry of Health, n.d), gaps in implementation appear to persist. For example, the MoH mandates adherence to safety and hygiene protocols, yet the current study suggests that these responsibilities are not always communicated effectively or consistently followed in practice. MacEwan et al. (2022) highlight the importance of patient education in reducing HAIs, emphasising that raising awareness and improving adherence are important. Moreover, despite the CDC recommendation that providing IPC education to patients and family members helps to prevent HAIs (Siegel et al., 2019), a recent review identified that the level of IPC education provided to hospitalised patients is low (Hammoud et al., 2020). The effectiveness of training programmes also depends on individual factors, such as personal motivation and HCWs' perception of risk. Similarly, the engagement of patients and families with IPC practices is influenced by their understanding and acceptance of the provided information. Therefore, it is important to consider these factors to foster a culture of adherence and safety in healthcare. To address these barriers effectively, it is important to understand frontline staff perceptions, as they are best positioned to identify patient- and visitor-related challenges in real time.

The findings of the current study reveal that some healthcare professionals, particularly physicians and surgeons, are perceived to have worse adherence than others. This finding is consistent with other studies, including those that compared adherence across different professionals and found that physicians had a lower adherence to IPC practices such as the use of PPE and hand hygiene (Lohiniva et al., 2015, Paul et al., 2020, Alhumaid et al., 2021). Although the findings of this phase on the adherence of nurses were not consistent, the literature that has compared multiple professions suggests that nurses typically show higher adherence (Nofal et

al., 2017, Bahegwa et al., 2022). Despite the Hippocratic Oath's commitment to doing no harm and ensuring the best possible care, this focus of physicians and surgeon on urgent medical outcomes can sometimes undermine adherence to IPC practices outside the operating room. In addition, these hierarchical issues may discourage peers and junior staff from advocating adherence, which further reinforces these inconsistencies. Hierarchical issues and their impact on IPC practices were further explored by frontline HCWs in the next phase.

To facilitate adherence to IPC practices, it is important to address these challenges; this requires targeted interventions aimed at surgeons as well as an organisation shift that fosters a culture of universal accountability for all staff, regardless of professional status (Shah et al., 2015). Tailored educational programmes, as highlighted in the previous phase, the systematic review, could provide a practical solution. These could be in different training formats, including simulation-based sessions or interdisciplinary workshops, which could address the specific needs of different professional groups while promoting mutual accountability. The WHO guidelines, as emphasised by Storr et al. (2017), highlight the importance of IPC education and training as a core component of effective IPC programmes. Studies have shown that hands-on IPC education involving frontline HCWs was effective in reducing HAIs and improving hand hygiene adherence. Therefore, the WHO panel recommends that all HCWs receive IPC education using interactive team and task-based approaches, including bedside and simulation training, to lower the risk of HAIs and Antimicrobial Resistance (AMR) (Storr et al., 2017).

At the organisational level, orientation programmes were perceived by the infection control team to be important in improving the IPC adherence of HCWs and this was also supported by a previous study (Karkar, Bouhaha and Dammang, 2014). In the current phase of the study, the infection control team believed that orientation programmes needed improvements, particularly as newly hired staff, especially international staff, were found to be inconsistent in their adherence. The effectiveness of these programmes may also be influenced by the diverse cultural backgrounds and nationalities of the HCWs, which appear to predict their level of adherence. In the current study, the participants commented that some nationalities were known to be more adherent than others, which highlights the individual

influences on adherence. This observation aligns with the finding by Brooks et al. (2021), who conducted a review to explore the factors that influence HCWs' adherence to IPC practices during infectious disease outbreaks. Brooks et al. (2021) noted that one study indicated that Saudi staff were significantly more likely to adhere to protective behaviours than non-Saudis working in the same city. However, it is important to highlight that this finding was based on a single study out of 56 reviewed, and only seven of these studies were conducted in Saudi Arabia, suggesting that this may not be a generalisable trend. Moreover, the review reported mixed findings regarding adherence across different countries. For instance, staff in Hong Kong and Singapore demonstrated higher adherence than UK staff (Chor et al., 2012), while other studies indicated varying levels of adherence among staff from Singapore, Indonesia, and Canada (Wong et al., 2005, Koh et al., 2009). Notably, a worldwide study found no significant differences in the use of preventive measures among nations (Kamate et al., 2020), which raises questions about the factors influencing the perceptions of the participants in the current study. The lack of significant differences in adherence across countries could be attributed to several factors, including the effectiveness of communication strategies, the uniformity of training received, and the shared understanding of risk perceptions among HCWs, regardless of their nationality. This suggests that while individual studies may highlight differences in adherence, the broader context of global practices may reflect a convergence in IPC behaviours due to standardised guidelines and training efforts (Brooks et al., 2021). Therefore, it is crucial to consider these factors when interpreting the findings related to nationality and adherence to IPC practices.

The findings of the current study identified a communication gap that can hinder IPC adherence. For instance, the inconsistency in reporting non-adherence by infection control link nurses was perceived to depend on the professional groups involved. This discrepancy in reporting behaviour may reflect the influence of interpersonal relationships within the nursing team, as trust or avoidance of conflict can lead to reluctance in reporting non-adherence among colleagues. In healthcare settings, a blame culture can impede effective communication and learning, which results in defensiveness and resistance to feedback. When feedback is perceived as criticism, it may discourage open discussions and impede attempts to address IPC

challenges. This aligns with the review conducted by van Buijtene and Foster (2019), which highlighted that adherence to IPC practices requires a culture of safety where mistakes are seen as opportunities for improvement rather than a fault. The review suggests that creating an environment of trust where criticism is seen as constructive rather than punitive is essential to move from a blame culture to a culture of safety. These changes can lead to better communication, increased accountability, and a more effective response to IPC challenges (van Buijtene and Foster, 2019).

Participants in this study also noted improvements in adherence to IPC practices such as hand hygiene and PPE during the COVID pandemic. However, this contrasts with the findings from Wong et al. (2021), who found that nurses' adherence to standard precautions during the pandemic was suboptimal and required improvement. Although adherence was reported to be suboptimal, Wong et al. (2021) did not provide a direct comparison with pre-pandemic levels, which makes it unclear whether adherence had improved or worsened compared to before the pandemic. The increase in adherence during COVID-19 in the current study could be due to the frequent educational training and increased fear of infections. While the current study indicates that the available training programmes are insufficient for enhancing IPC awareness among HCWs, the infection control teams believed that training programmes should be improved and extended to patients and relatives. Furthermore, the current study highlighted that a lack of managerial support during COVID-19, inadequate training programmes and the above-mentioned hierarchical barriers affected communication about IPC practices. This limited discussion highlights the need to investigate leaders' broader influence on organisational culture, which will be discussed further in the next phase.

4.6 Strengths and limitations

The study was conducted in two Saudi hospitals, so the findings may not be transferrable to other regions or healthcare systems with different cultural and organisational contexts. However, the findings of this study could be relevant to other regions in Saudi Arabia, particularly for MoH healthcare organisations with similar healthcare systems and workforce cultural diversity. Given that the MoH is

the primary provider of healthcare services, the study's insights could be beneficial for understanding the factors influencing IPC practices.

This study was conducted during the COVID-19 pandemic. To ensure the safety of the participants, the need for physical gatherings was eliminated, thereby reducing the risk of virus transmission. Furthermore, the study included infection control professionals with many years of experience from different backgrounds, including nursing and microbiology. Although a microbiology perspective was represented, it echoed similar views to those of other participants, which suggests a shared understanding of IPC practices across professional roles. The use of focus groups provided an opportunity for the participants to share and compare experiences in group settings to facilitate rich discussions and the exploration of diverse perspectives on IPC practices.

In total,10 individuals expressed an interest in participating, but the final number was 8 participants due to their availability and scheduling conflict. While the concept of information power (Malterud, Siersma and Guassora, 2016) suggests that the adequacy of a sample is not solely dependent on its size but rather on the richness and relevance of the data generated, this study did not reach the desire level of information power or data saturation due to the challenges faced. Multiple invitations were sent but work-related commitments, COVID-19 impacts, and the constraints of the study timeline limited the feasibility of conducting more focus groups or expanding participant numbers. The focus groups were scheduled during the participants' duty hours based on their preferences. However, some were unable to attend due to urgent tasks or pre-existing work responsibilities. Despite all the efforts made to accommodate all the potential participants by offering flexible scheduling options, it was difficult to align everyone's availability. The insights gathered from the available participants are valuable. However, the limited sample size may reduce the ability to draw broad conclusions about IPC practices across a more diverse population. The participants were infection control staff, including senior members, which might have introduced power dynamics into the focus groups. Participants may have felt hesitant to share information openly due to potential hierarchical relationships within their team. The focus groups were conducted in a neutral and supportive environment where confidentiality was

emphasised. Efforts were made to balance the power dynamics by encouraging equal participation, to engage all the participants. Moreover, the primary researcher was conducting interviews for the first time with no prior formal training, which may have influenced the quality of the data collection and the depth of the interviews. To mitigate this, the researcher sought guidance from experienced colleagues and read extensively about conducting qualitative interviews to enhance her skills.

While online focus groups ensured the participants' safety, they also presented potential limitations. These included technical issues that could disrupt the flow of the discussion. In addition, online responses could be shorter than when meeting face to-face. To address any technical issues, a pre-session technical check was provided and the participants were encouraged to use video to enhance visual cues.

4.7 Conclusion

This focus group study was conducted to explore infection control teams' perceptions and experiences of managing infection control practices. Specifically, the focus groups sought to identify factors influencing the implementation of IPC practices in Saudi healthcare settings. The focus groups revealed three main themes: the role of infection control teams, the perceptions of infection control teams of IPC adherence, and the barriers to and facilitators of this adherence. The data indicate that the current monitoring strategies used by infection control teams need some improvements, including enhancement of the current educational and training programmes. IPC adherence was also perceived to vary across professional groups and was influenced by different factors including environmental factors, staff awareness, and the strain caused by the COVID-19 pandemic, particularly in relation to staff shortages, supplies issues, and workload. Challenges including hierarchical barriers which influence communication and feedback were identified as important challenges to effective IPC adherence. Although the participants briefly mentioned managerial support during the pandemic, the role of leadership in sustaining adherence was not extensively explored. Interviews with frontline staff in the next phase will offer a more detailed understanding of the personal experiences and perceptions of those directly implementing IPC practices.

Chapter 5 Qualitative Findings from the semi-structured interviews (phase 3)

5.1 Introduction

This chapter presents the methods, findings, and discussion of phase 3 of the research: semi-structured interviews with HCWs from ICUs and medical wards from the study sites. This phase builds on the findings of phase 1, which was a systematic review, and phase 2, which involved focus groups with infection control teams, to probe for further explanation, and to provide a contextual understanding of the findings from frontline staff at different levels. Study 1 scoped the evidence across Middle Eastern countries, while study 2 adopted an in-depth approach to examine HCWs working in more strategic roles, to help implement and support policies on IPC practices that should be in place, and to support staff to do this. Although study 2 was focused on those in strategic roles, it still identified some important factors that acted as barriers and facilitators to IPC adherence. Study 3 complements this with an 'on the ground' perspective of the challenges faced by HCWs responsible for following or adhering to such IPC practices, exploring how they interpret the IPC practices and implement them at the study sites.

This chapter begins with a description of the methods, followed by the findings and a discussion in the context of the other phases of this study and the wider literature.

5.1.1 Background to study 3

As discussed in the previous chapter, infection control teams offer a managerial perspective, while frontline HCWs including nurses and other HCWs are directly involved in the daily implementation of IPC practices. Healthcare workers who have direct contact with patients play an important role in the prevention and control of HAIs. These workers, including nurses, doctors, and allied health professionals, are at the frontline of patient care and are often involved in procedures that increase the risk of infection transmission. In addition, HCWs with direct patient contact are

more likely to experience situations that require strict adherence to IPC practices and their adherence can directly influence patient outcomes (Al Sawafi, 2021). Therefore, it is important to focus on this group in order to better understand the difficulties they encounter in adhering to IPC practices and to be able to develop focused interventions that can enhance adherence and ultimately patient outcomes.

In the current phase, a qualitative study with frontline HCWs was conducted to help address the gap identified in the literature, particularly in the Middle Eastern context (Houghton et al., 2020, Alhumaid et al., 2021, AlJohani et al., 2021). Adherence to IPC practices in this region could be influenced by cultural values, religious beliefs, and the hierarchical structure. Although previous quantitative studies have examined IPC adherence across the region, they often lack in-depth insights into the factors influencing adherence and non-adherence. Therefore, the current phase used a qualitative method to fill this knowledge gap by focusing on the personal and professional experiences of HCWs in Saudi Arabia. By including both ICU and medical wards, this study allows for a comparison of IPC practices across these settings, which provides insights into how different environments might influence HCWs' adherence. Furthermore, this approach may help to identify whether IPC challenges are consistent across settings or if some areas require more targeted interventions. For a more detailed discussion on the justification for including both settings, see the methodology chapter, section 2.6.

5.1.2 Interviews aims and research questions

The aim of this phase was to gain an in-depth understanding of the factors that influenced IPC adherence from the perspective of frontline HCWs. To achieve this, semi-structured interviews were chosen as the primary data collection method as they allowed a detailed exploration of HCWs' individual perspectives on IPC adherence within their organisational context.

The current study aimed to answer the following research question:

What are the barriers to and facilitators of nurses' implementation of local/national infection prevention and control practices in medical and ICU settings in two selected hospitals in Saudi Arabia?

5.1.3 Population

The target population for the semi-structured interviews comprised HCWs, particularly those who had direct contact with patients in ICU and medical wards in two hospitals located in the Eastern province of Saudi Arabia. These participants were targeted in order to explore the unique challenges faced by HCWs in these specific departments. Studies have shown that patients in ICUs are more vulnerable to HAIs due to their advanced age, comorbidity, and immunocompromised status (Blot et al., 2022). In a recent report by the General Directorate of Infection Prevention & Control (GDIPC) in Saudi Arabia, the most common unit reporting HAIs outbreaks (73%) was the ICU (GDIPC, 2021). This was also supported by a large Saudi study which found that HCWs identified limitations in IPC within their institutions and suggested that both ICU and other departments, including inpatient areas, required improvements in awareness and adherence (Rabaan et al., 2017). Therefore, IPC challenges are not limited to ICUs; different types of departments may encounter unique barriers to adherence based on different factors, including patient population and staffing levels (McCauley, Kirwan and Matthews, 2021). Patients in medical wards are more diverse, and often present with a range of medical conditions at different stages of illness, each with different treatment requirements (Ojanperä et al., 2022). Moreover, medical wards tend to have more elderly patients who are vulnerable to infections (Luo et al., 2010, Ojanperä et al., 2022). Although the risk of HAIs may be lower compared to ICUs, adherence to IPC practices in medical wards remains important as patients are still at significant risk (Luo et al., 2010, Ojanperä et al., 2022).

Participant inclusion criteria:

- HCWs registered with the Saudi Commission for Health Specialties, with any level of experience. This criterion helped to ensure that all the participants were licensed and currently practising according to Saudi healthcare

regulations, which helped to ensure consistency and reliability in their knowledge.

- HCWs from any country as long as they were registered with the Saudi Commission for Health Specialties and working in Saudi hospitals. Since Saudi hospitals have a diverse workforce, this criterion allowed for a broader, more representative sample of HCWs that reflects the reality of IPC practices.

- HCWs employed in either the ICU or medical wards of the selected hospitals.

- Able to understand verbal and written English or Arabic sufficiently to complete the consent forms/understand the participant information sheet. This helped to maintain ethical standards.

Exclusion criteria:

Participants were excluded if they:

- Were unable to provide verbal informed consent.

- Did not have direct contact with patients, such as pharmacists, cleaners, laboratory staff, and administrators.

- Did not work at either of the two hospitals selected.

5.1.4 Sampling and sample size

A purposive sampling method, a non-probability sampling technique, was utilised to select potential participants from both hospital sites. This approach is widely recognised as effective in qualitative research because it targets individuals who are most likely to provide the information that addresses the research objectives (Patton, 2014, Creswell and Poth, 2016). This approach was used to select participants who met the above criteria, which are relevant to the research objectives. These included participants from a variety of HCW disciplines that engaged in direct patient care, with varying levels of experience. This was important

as it provided a broader perspective of the different factors influencing IPC adherence. For instance, experienced HCWs may offer insights into the long-term challenges and effectiveness of current IPC practices, while those less experienced might highlight different issues, including challenges with training and the implementation of IPC practices. Therefore, this diversity allowed the researcher to gain a comprehensive understanding of IPC adherence across different professional disciplines and career stages.

In qualitative research, sample sizes are typically smaller than those in quantitative studies, with the emphasis on gaining a deep understanding of the targeted population rather than generalising the findings to a broader group (Saunders et al., 2018). The sample size was informed by best practices in qualitative research and similar studies that explored HCWs' experiences with IPC practices. These often found that 10–23 participants are sufficient to capture the variety of experiences and make data analysis manageable (Dixit et al., 2012, Donati et al., 2019b, Henderson et al., 2020, Alshehri, 2023).

The anticipated qualitative sample size was thus 20-23 participants, which would provide a representative range of perspectives on IPC adherence. However, the actual sample size was determined in parallel with the data collection as the research design integrated data saturation. The final number of participants was determined by the achievement of data saturation, at which point no new information emerged from additional interviews (Saunders et al., 2018). Data saturation was achieved with 20 interviews with nurses from various roles.

The decision to use data saturation as the criterion for finalising the sample size is supported by qualitative research literature, which highlights that this approach helps to ensure the depth and breadth of the collected data to avoid unnecessary redundancy (Saunders et al., 2018). Saturation is generally recognised as an indicator of sample adequacy in qualitative research, since it allows the complexity and range of the phenomena under study to be fully explored (Morse, 2015). However, there are debates around the concept of saturation, particularly regarding how it is defined and when it is considered to be achieved. It has been argued that saturation is not a fixed point but rather a flexible guideline that varies based on

the study's complexity and the techniques utilised for the data collection (Saunders et al., 2018). In the current study, saturation was considered appropriate as it allowed for the exploration of diverse perspectives while preventing data redundancy. By continuously reviewing the emerging data and themes, the researcher could assess when new insights stopped emerging, which indicated that the sample size was adequate.

5.1.5 Recruitment and informed consent

Recruitment to the study was facilitated through the research department in each of the selected hospitals. A member of staff from the department communicated with the clinical department managers, including nursing managers, in both the ICUs and medical departments. Following this initial communication, the researcher visited these departments to present the study's details to the managers. This included information about potential participants, the inclusion and exclusion criteria, and the recruitment process. Subsequently, the managers agreed to assist with inviting potential participants to take part in the research. They were provided with an invitation letter, participant information sheet, and privacy notice. All the documents, including the consent form, were made available in both English and Arabic, ensuring accessibility for all the participants.

Participants were encouraged to contact the researcher for additional information or to make known their interest in participating in the study. During these interactions, the researcher verified the participants' eligibility against the inclusion criteria and discussed their preferences for conducting the interview via Zoom or telephone. An electronic consent form (Appendix 9) was then sent to potential participants who expressed interest in participating. As with the focus groups, potential participants were not required to return this form to the researcher, as consent was obtained and recorded verbally at the start of the interview. Since this study was conducted during the COVID-19 pandemic, this approach was employed based on the ethical approval guidelines, which permitted this method to restrict physical contact during the pandemic. For a detailed discussion on the ethical principles guiding this study, including informed consent, confidentiality,

anonymity, beneficence and non-maleficence, see the methodology chapter, Chapter 2, section 2.9.

Participants who consented were assigned a unique identification number for privacy. Following recruitment, the researcher scheduled interviews at convenient times for the participants. At the outset, before the interviews began, interviewees had the opportunity to ask any further questions about the study and the researcher reconfirmed verbal consent with them. They were reassured of their right to withdraw from the study at any time without affecting their workplace status. Participants were informed that data collected up to the point of withdrawal would still be included in the study's analysis.

This process ensured that consent was fully informed and given freely, without a penalty for non-participation. Verbal informed consent was secured from each participant at the start of each interview to simplify their involvement. This approach provided an accessible and comfortable environment for participants, which allowed them to confirm their willingness to participate under the outlined terms.

This consent procedure complied with the ethical standards outlined by the University of Glasgow and the local ethics committees, reinforcing the participants' rights to privacy, confidentiality, and the secure handling of their data throughout the study duration.

5.1.6 Data collection

5.1.6.1 Development of the interview guide

The topic guide for the semi-structured interviews (Appendix 6) was developed to facilitate a comprehensive exploration of HCWs' experiences and perceptions of IPC practices. This guide was informed by the systematic literature review (phase 1) as well as a review of the relevant literature and adjusted to incorporate insights from preliminary findings of the focus groups, so that these could be followed up through

the perspectives of HCWs in ICU and medical ward areas. The topic guide covered a range of thematic areas, including HCWs' understanding of HAIs, their direct experience with HAIs, and the IPC practices employed within their work environment. The guide aimed to capture the participants' perspectives on the level of adherence to IPC practices, including any barriers or facilitators they encountered, and to gather personal experiences and observations regarding adherence behaviours among colleagues and within the organisational context. Furthermore, due to the emergence of the COVID-19 pandemic during this study, the topic guide was contextualised with questions designed to prompt discussions about the impact of pandemics on IPC practices, exploring any changes in adherence or adjustments in practices resulting from the global health crisis.

The interview guide was initially developed in English and then translated into Arabic prior to use, allowing the Arab participants to express their views freely in their native language. The English version of the interview guide was refined for clarity and comprehensiveness after a pilot test with a HCW who was not included in the study. It was also revised after the first few interviews and discussed with the supervisory team to ensure its alignment with the study's aims and to enhance the validity of the research process. The revision of the interview guide after the initial interviews allowed it to be adapted to the insights gained early on in the data collection process. These revisions allowed the participants' experiences and perspectives to be better captured, and enhanced the depth and quality of the data obtained.

5.1.6.2 Conducting the semi-structured interviews

At the beginning of each interview, the researcher introduced herself, welcomed the participants, explained the aim of the interview along with the topics to be covered, and reaffirmed consent to proceed. Each interview was conducted one to one, with the researcher and a single participant, and lasted between 30 and 60 minutes. All the interviews were conducted in Arabic either via telephone or Zoom, to accommodate the participants' preferences and ensure their convenience and safety, particularly considering the constraints posed by the pandemic. This

flexibility in the mode of communication played a crucial role in facilitating the participation of HCWs from various departments.

During the interviews, the researcher built rapport with the participants by encouraging an open and relaxed atmosphere and actively listening to their concerns and opinions (Merriam and Tisdell, 2015). Probing questions and follow-up inquiries were utilised to encourage participants to expand on their responses, in order to achieve a depth of understanding and capture their experiences and perspectives on IPC practices (Knott et al., 2022). The researcher's approach was flexible, which allowed the conversation to flow naturally while ensuring that all the relevant topics were explored. This methodological flexibility was crucial for exploring issues and uncovering insights that might not have been anticipated at the onset of the study. This approach provided a more comprehensive understanding of the factors influencing adherence to IPC practices.

During the data collection process, notes were taken for each interview to capture emerging themes. The transcripts and notes were systematically reviewed to identify recurrent themes and patterns. When the 17th interview was completed, no new themes emerged, the data began to reinforce existing themes, which indicated that data saturation had been reached.

5.1.6.3 Justification for online semi-structured interviews

Semi-structured interviews are chosen to enable an in-depth exploration of individual perceptions because of their flexibility and adaptability (Knott et al., 2022). In contrast to focus groups, where social dynamics may inhibit some individuals from sharing their thoughts, one-to-one interviews encourage open and reflective responses, which allow participants to freely share experiences without being concerned about judgement or interruption. This privacy is important in healthcare research as it mitigates hierarchical influences that could restrict open communication (Merriam and Tisdell, 2015, Knott et al., 2022). For more details on the advantages and drawbacks for using online interviews, see chapter 4, section 4.2.3.

5.1.7 Study trustworthiness

This study adhered to the criteria of credibility, transferability, dependability, and confirmability, as discussed in the methodology chapter, section 2.7. The study's credibility was enhanced by providing a detailed description of data collection and analysis, which demonstrated a transparent approach. In addition, excerpts from the interview transcripts are presented to offer evidence of the participants' views directly. Transferability was supported by purposive sampling of HCWs from both ICUs and medical wards to provide diverse perspectives across various contexts, roles, and experience levels within the healthcare settings. Dependability was established by preserving all transcripts, and notes used throughout the data collection and analysis processes. Confirmability was maintained by employing a reflective journal after each interview, which helped to identify and manage researcher bias during data analysis.

5.1.8 Data management, storage and retention

Data were only accessible by the researcher and her supervisors. The Data Protection Act 2018 was followed throughout. All personal data obtained during the study were securely stored and processed in accordance with the General Data Protection Regulation (GDPR) (2018). No names of individuals or organisations participating in this study were used; instead, these were replaced by ID codes known only to the researcher, and only these codes were used in the study documentation. Because of the specialised nature of some participants' roles, additional caution was taken to avoid potential identification and any identifiable information was removed from the focus group and interview transcripts. To protect the privacy of the participants, their personal data were stored separately from the raw data. Personal information was retained until data collection was completed and no further focus groups/interviews were required. Following this, it was destroyed in accordance with the University of Glasgow's regulations, two months after the study's data collection was completed. All focus group discussions and semi-structured interviews were audio recorded and transcribed verbatim for analysis. The audio recordings were immediately destroyed after transcription, and then the transcripts were stored in a password-protected file on the University of Glasgow's OneDrive with

access only by the researcher. The transfer of audio files was strictly controlled and not done via email or a memory stick. The transcriptions from phases 2 and 3 of the research will be retained for 10 years following completion of the research, in accordance with University of Glasgow regulations.

5.1.9 Ethical considerations

5.1.9.3 Research ethics approval

See section 4.2.4.1.

5.1.9.4 Participant withdrawal

All participants were informed that they could leave the study at any point, without being obliged to give notice or provide any explanation. If a participant chose to withdraw, any data they had provided up to that point would be used as explained to them and as permitted by the ethics committee.

5.2 Data analysis

The interviews and focus groups were analysed using thematic analysis. This approach was selected because it offers both inductive and deductive approaches (Braun and Clarke, 2022). A codebook thematic analysis approach was employed, applying a deductive framework for its structure and systematic nature, which is important for analysing a phenomenon like IPC adherence. In the current study, the codebook approach involved developing a theoretical codebook from data gathered from the systematic review and the focus group discussion. This theoretical codebook served as a foundation for identifying and organising the key themes and subthemes relevant to IPC practices. Thus, the analysis was informed by the existing theoretical codebook and lived experiences of HCWs, which means that the findings were grounded in empirical evidence.

The codebook was iteratively refined throughout the analysis process, which allowed for adjustments based on emerging patterns in the data. This iterative approach facilitated a deeper understanding of the factors influencing IPC adherence while

ensuring that the analysis remained responsive to the complexities of the participants' experiences (Roberts, Dowell and Nie, 2019). Thus, the integration of a theoretical codebook, informed by both the literature and the qualitative data, enriched the thematic analysis by enabling a more in-depth exploration of the challenges and enablers of IPC adherence in the context of the current study.

The six steps involved in applying codebook thematic analysis to the qualitative data from the focus groups and interviews have been outlined in section 4.3, Chapter 4. These were applied in a similar way to the analysis of the interviews.

5.3 Findings

5.3.1 Demographics of healthcare worker participants

Despite the intention to seek the involvement of HCWs from different disciplinary backgrounds, the participants comprised of people in nursing roles only. The reasons for and implications of this for the data analysis and study recommendations are further discussed in section 5.5. Since nurses were the only disciplinary group represented in the study, the chapter refers to nurses synonymously with participants from this point onward.

A total of 20 nurses from across two hospital sites were interviewed between November 2021 and February 2022. The demographic details of the participants are shown in Table 5.1. To summarise briefly, the majority of the nurses had more than six years of experience and held a bachelor's degree or higher qualification in nurse education. In addition, all the participants were Saudi and only one was male. This aligned with the study population since the majority of the nurses working in the selected hospitals were Saudi and female. More people participated from hospital B (n = 13) than from hospital A (n = 7). Eleven nurses worked in an ICU setting and nine nurses worked in medical wards.

Table 5. 1: Demographic details of nurse interviewees

	Participant	Number	Percentages (%)
Current gender	Male	1	5%
	Female	19	95
Age group	20-29	7	35
	30-39	12	60
	>40	1	5
Qualification	Diploma	1	5
	Bachelor	16	80
	Master's	3	15
level of position	Nurses	14	70
	Clinical resource nurse	2	10
	Senior nurses	4	20
	Medical staff	0	0
	Other healthcare workers	0	0
Years of experience	1 to 5	7	35
	6 to 10	10	50
	>11	3	15
Hospital site	Hospital A	7	35
	Hospital B	13	65
Nurse allocation by unit	ICU	11	55
	Medical	9	45
Total		20	

5.3.2 Presentation of the findings

The findings from the analysis of the participants' transcripts are presented in this section. The participating nurses are identified by their participant number (RN1, RN2, etc.) followed by the clinical area (ICU or medical ward), and then by hospital site (A or B) and more generalised descriptors such as senior nurse.

The following table summarises the themes and subthemes from the interviews with nurses.

Table 5. 2: Summary of the themes and subthemes

Themes	Subthemes
Theme 1: Perceptions of adherence to IPC practices	Variations in adherence across different IPC practices Perceptions on adherence among professional groups Nurses' levels of experience and IPC adherence
Theme 2: Perceived barriers and facilitators	Workload Cultural aspects Environmental factors Challenges in infection detection Patients' awareness Impact of COVID-19 on perceptions of IPC adherence
Theme 3: Perceived role of managerial support and leadership	Leadership strategies: feedback and recognition of IPC adherence
Theme 4: Perceived role of the infection control team	Perceptions of monitoring of IPC practices Perceptions of the role of infection control team in communication Training programmes

5.3.3 Theme 1: Perceptions of adherence to IPC practices

This theme highlights the perceived variations in different IPC practices, including hand hygiene and glove use, as well as the perceived variations in IPC practices between various professional groups.

5.3.3.1 Subtheme: Variations in adherence across different IPC practices

Participants from both ICUs and medical wards reported different levels of adherence to various IPC practices. Certain practices, including hand hygiene and glove use, were frequently emphasised as more important or easier to implement but some HCWs reported challenges associated with these practices. All of the participants from both sites reported that they were aware of the importance of hand hygiene, therefore they considered themselves to be adherent. However, when discussing this further, particularly the 5 moments of hand hygiene, a few of the participants, including senior nurses, reported that there were moments of hand hygiene that were commonly overlooked. These included before touching a patient, especially when the patient was in a shared room as in the medical wards; after touching a patient's surroundings; and after touching a patient, particularly when more than one procedure was performed for the same patient. Non-adherence to hand hygiene practices was illustrated in the following example: a senior nurse reported that she sometimes forgot to practise hand hygiene when she had more than one patient in the same room. She believed that this practice was also influenced by the accessibility of supplies such as hand gel, which was discussed under the environmental factors section. While the practice of a senior nurse could be influenced by her higher responsibilities and multitasking demands that come with her role, non-adherence to hand hygiene was reported across participants regardless of their role or level, which suggests that non-adherence may be a common issue among staff in similar settings. This indicates that factors such as resource allocation and patient load influenced all staff.

"I forget to do hand hygiene and sometimes it is because of the supply, I mean alcohol hand rub, it is located at the door and I will for example move from A to C

which is near the window, and I say OK as I'm there I will also work and finish with bed B (laugh). Yes, I say this honestly" (RN15, Medical Ward, Site B, Senior Nurse).

Some participants from ICUs where patients were in single rooms also reported observing non-adherence to hand hygiene at some moments, particularly when two procedures were required, despite hand hygiene supplies being accessible. They believed that this could be due to different reasons, including workload, which is discussed further under the barriers and facilitators theme.

Furthermore, the participants perceived that their decision to use hand gel or to wash their hands after removing gloves was based on the nature of the procedure that they intended to do. For instance, when performing a simple procedure such as checking temperature, they preferred to use a hand rub over washing their hands.

"It depends on the procedure that I have done because sometimes I will not be wearing the gloves for a long period like if I want to check the temperature for example, so after that I will just do a hand rub" (RN13, ICU, Site A, Senior Nurse).

This decision-making process suggests that adherence to IPC practices is influenced by the perceived risk and duration of procedures. Some practices may reflect a pragmatic approach but could also lead to non-adherence if the perceived risk is not accurately assessed.

Similar to the findings related to hand hygiene, the majority of the participants discussed the importance of wearing gloves as a protective measure. However, a few participants reported some non-adherence to recommended practices with gloves, as some nurses, particularly those in the medical wards, found it difficult to change gloves between patients in the same room, primarily due to accessibility or a shortage of supplies. Furthermore, it was perceived by some nurses that gloves were misused among some professional groups such as lab technicians, who were observed using gloves outside the lab and when not involved in direct patient care, for example when using computers. Although the majority of the participants reported being adherent to glove use practices, they provided several examples of instances where gloves were used when not indicated. For instance, the

recommended WHO guidelines (which are also used in Saudi hospitals) state that gloves should not be worn during procedures that have no potential for exposure to blood or body fluids or contaminated surfaces (except for contact precautions). However, in the current study, the majority of the participants preferred to wear gloves at all times, including when taking blood pressure and other vital signs. This suggests a habitual preference or perceived necessity rather than adherence to evidence-based practice. Despite concerns about limited resources, particularly PPE, participants did not express awareness of the consequences of overusing PPE such as gloves.

Some of the nurses reported that they tended to be more cautious and adherent when providing care for patients who were considered critical. These included stable patients who were on the central line. For instance, the participants perceived these patients to be at higher risk of infection, which led to them changing their gloves when performing multiple procedures. This suggests that adherence is influenced by the criticality of the patient's condition, which is further discussed within the workload section.

"But If I have two other procedures like when I have a patient on the central line and I want to give him medication, I check the vital signs and will withdraw blood from the central line. For this patient, when I want to withdraw blood, I will change my gloves. But for other patients, I don't change the gloves. The patient who is on the central line, I need to be careful, so I don't transfer infections to them" (RN15, Medical Ward, Site B, Senior Nurse).

Furthermore, the habitual use of gloves could also be influenced by culture or religious beliefs, such as occasions of direct contact with patients who are not under isolation precautions including contact precautions but are from the opposite gender. This suggests that the current guidelines may not be culturally sensitive.

Interviewer: "But you know this (not wearing gloves) is possible because it is a clean procedure?"

"I know but because I deal with men, I don't like to touch them without gloves" (RN12, Medical ward, Site B).

However, other participants reported that they implemented IPC practices similarly with both genders.

"For me I use gloves and do hand hygiene when dealing with patients regardless of their gender" (RN15, Medical Ward, Site B, Senior Nurse).

The data showed that all the participants were able to discuss the importance of IPC practices, including PPE and the five moments of hand hygiene in preventing infections; some of them expressed honestly their non-adherence practices. This demonstrated the importance of monitoring hand hygiene by different methods from the ones used currently by infection control teams (as discussed in the focus groups chapter). The importance of senior nurses' perceptions is evident in their response to the current non-adherence issues. A few senior participants suggested that considering hand hygiene practices during the annual staff evaluation would be an important addition to the current evaluation criteria and could be effective in improving adherence.

"Because the evaluation contains some unnecessary things that do not affect the patient. It should contain things related to the practice of infection control which will affect the nurse's practice and improve herself and become more cautious with her patient" (RN17, ICU, Site A).

This insight highlights how senior nurses, with their understanding of both clinical practices and the operational aspects of nursing, can identify practical challenges that may be overlooked in standard evaluation processes.

5.3.3.2 Subthemes: Perceptions of adherence among professional groups

Some participants believed that adherence varied among different professional groups, including doctors, physiotherapists, lab technicians and radiologists. They perceived that these professionals were not fully aware of the IPC practices compared to nurses, which could influence their adherence to IPC practices

including separating waste and the use of PPE. For instance, lab technicians were observed misusing gloves and using them while handling documents and using computers, which could lead to cross-infections as illustrated in the following:

"I actually noticed something about the lab staff. So when they come to the patients … I also see them using gloves when they are using the computer, so I feel that the entire area is infected. I'm not sure why they use the gloves when they are using the computer …" (RN17, ICU, Site A).

Similarly, some participants reported that cleaners were perceived to have insufficient awareness of IPC practices, including those related to environmental cleaning. The participants highlighted the need for educational programmes specific to cleaners.

"The other thing is the cleaners. They have a big role in spreading infections …. Even when there is blood on the floor, it is known that they should use the spill kit but they do not …" (RN15, Medical Ward, Site B, Senior Nurse).

Perceived non-adherence among doctors was frequently reported and the participants believed that doctors were restricted by time and that their focus was finishing the work rather than maintaining IPC practices. This perception suggests that hierarchical issues might affect interdisciplinary communication and collaboration, which can affect adherence.

"The doctor comes and wants to finish his work and can't wait until we get things from other departments, he wants to finish quickly, even if I don't have sterile gloves or other things, he just works" (RN15, Medical Ward, Site B, Senior Nurse).

However, it is important to consider that all the participants in this study were nurses, which could introduce a biased perception of other professional groups. This should not be considered as a standard experience; as demonstrated in the following example, some nurses reported doctors who were adherent and requested the presence of infection control nurses to observe the sterile techniques during procedures and correct their practices directly.

"Some doctors like a member of the infection control team to accompany them and guide them. There is a doctor that we have, he said that he wants an infection control nurse with him to remind him and tell him when there is a mistake, other doctors feel like the infection control is trying to just give orders and put them under pressure" (RN6, ICU, Site B).

This indicates that the adherence of professional groups can be influenced by different factors, which highlights the need for improved communication and collaboration to understand and address these factors.

5.3.3.3 Subtheme: Nurses' levels of experience and IPC adherence

Some participants perceived that nurses with previous nursing roles, particularly those in high-risk departments and with more years of experience, were more adherent. However, a few participants highlighted that not all senior nurses were adherent.

A small number of senior staff compared to the number of new staff was also reported as a factor that negatively influenced adherence to IPC practices. It was noted that newly hired staff can expose patients to infections due to non-adherence to IPC practices.

"Five or 6 staff are senior. The others are all new around 15 so, I don't know what to say but we are struggling, we are trying to give them the idea that you are responsible now and you have to not harm the patient. The patient came without an infection, so try to not transfer any infection to him, by following the infection control guidelines like hand washing" (RN11, ICU, Site A, Charge nurse).

This statement highlights the important role of experienced staff in maintaining IPC practices. The difficulty in establishing a sense of responsibility and adherence to IPC practices among new staff indicated a lack of adequate training and mentoring for new hires. The shortage of senior staff means that the new hires may not receive the necessary supervision and guidance to completely understand and apply IPC practices, which increased the risk of infection transmission.

Some participants emphasised that although theoretical knowledge is important, real-world experiences enhance HCWs' adherence to IPC practices. They clarified that experienced nurses could avoid some mistakes associated with IPC practices because of their experience. For instance, an inexperienced nurse could miss an important item for a procedure and leave during the procedure, which compromises the sterility.

"Experience and education are very important and linked to each other. So for example, if the nurse is wearing PPE and is doing a sterile procedure and then find that there is something missing, she will leave the room and will break the sterility to bring that. And then she will avoid this in the future so, sometimes she has the knowledge but she needs more experience" (RN20, Medical ward, Site B, Senior Nurse).

The same senior nurse and others commented that not all senior nurses are adherent to IPC practices. Some of them may change their correct practices to a wrong one, which emphasises the need for education and training regardless of seniority.

"And the experience can be better among the relatively new staff compared to the seniors. I mean sometimes the seniors start to overlook some of the guidelines. Let's say that a nurse knows that she has to wear sterile gloves during a procedure but maybe with practice she will change that one day and wear just clean gloves" (RN20, Medical ward, Site B, Senior Nurse).

Furthermore, resistance to change among experienced staff was reported by some nurses, which indicates the preference for routine and familiarity over implementing new guidelines. This highlights the influence of ingrained behaviours on resistance to IPC changes.

"The experience of the nurse, you know some nurses say, 'I have been doing this procedure in this way for many years and nothing has happened', and she actually does it in a wrong way. And she will not accept advice from others. These people could have experience of 10 years and get used to that behaviour. They know it is wrong practice, but they do not want to correct it" (RN18, Medical ward, Site B).

A few senior participants also believed that nurses who have prior experience in an operation room (OR) tend to have better adherence to IPC practices as they are accustomed to a strict sterile environment and are likely to apply that to other settings. This suggests that a high-risk environment such as an OR could act as a facilitator for IPC adherence. Furthermore, the fact that only experienced senior nurses reported this perspective in the interviews highlights how different roles and levels of experience within the healthcare setting can shape perceptions of IPC practices.

"Um … for those who work in the OR for a specific period, they know that sterility is something very important. Yes, they will be stricter about sterility, they know that they are sterile, and their table is sterile and make sure that they maintain sterility, they become accurate. But for those who didn't work [in the OR], I feel they may need … um … more awareness although they teach us as nurses. I mean they focus on sterility, but they will not be like the nurse who works in the OR" (RN11, ICU, Site A, Senior nurse).

The influence of experience in high-risk environments on HCWs' adherence was also highlighted by another specialised nurse who perceived that the nature of work in ICUs and OR can act as a factor that encourages adherence. For instance, participants perceived that their regular involvement in specific clinical procedures, such as central line catheterisation, facilitated their adherence to IPC practices. The familiarity and repetition of these procedures contributed to their competence and carefulness in implementing IPC practices.

"It is normal for us and for those who work in these units to be more compliant and competent in infection control practices because of the work environment and we are doing the same practices every day … In the ICU, it is similar, almost every day we do central line catheters or arterial line … So, we are used to these things, and we are the most careful to implement the infection control practices" (RN3, ICU, Site A, Senior nurse).

5.3.4 Theme 2: Perceived barriers and facilitators

This theme examines the factors that were perceived as barriers or facilitators to IPC adherence, or a combination of both. These factors are: workload, cultural aspects, environmental factors, psychological and religious factors, challenges in infection detection, and patient awareness.

5.3.4.1 Subtheme: Workload

The majority of the participants in the current study reported that workload negatively influenced their adherence to IPC practices. This was due to several aspects, including staffing shortages, limited time, patient acuity, patient capacity, and additional tasks. This suggests that structural and resource limitations are main barriers to maintaining IPC practices, rather than individual difficulties, which reflects a systemic issue in healthcare management. It was also reported by some nurses that the workload was alleviated with the introduction of 12-hour shifts.

The majority of the participants in both clinical areas were affected by staffing shortages. In the ICUs, the number of critical patients intensified the workload for the existing staff, whereas in the medical wards, the staff encountered difficulties when providing care for bedridden and obese patients. The following example from the ICUs demonstrates that providing care for multiple critical patients increased workload and compromised nurses' ability to follow IPC practices due to time constraints:

"The night nurse is busy, she has two patients and they both are critical and need a lot of medications and procedures, she doesn't have time to maintain infection control precautions. Now, we want to have one patient. If we have double patients, how are we going to maintain?" (RN7, ICU, Site B).

Similarly, in medical wards, some nurses reported that the multiple demands of bedridden and obese patients affected their adherence to IPC practices. Bedridden patients are often dependent on nurses for their basic needs and need to be repositioned frequently to prevent pressure ulcers. This task requires a significant

amount of time and physical effort, constituting an additional workload and leaving limited time for strict adherence to IPC practices, as shown in the following:

"If the nurse is assigned to 10 patients and 3 or 4 are bedridden at the same time, of course she will be under pressure and cannot follow the infection control recommendations properly. The work with bedridden patients is not easy" (RN18, Medical Ward, Site B).

This challenge is compounded when providing care for obese patients, as the nurse who is performing a procedure will not be able to follow the IPC practices properly. For instance, it is difficult for one nurse to maintain sterility when changing a dressing for an obese patient. Thus, they believed that patients' needs and staffing levels could influence HCWs' adherence.

"Sometimes the patient is heavy, and it is hard to handle and do the dressing alone um-ah so some of the sterility will be broken here …." (RN16, ICU, site B)

This suggests that patients' characteristics, such as patient acuity and capacity, in addition to staffing limitations, influence how HCWs balance their responsibilities for multiple patients. In such circumstances, essential care tasks could be prioritised over strict IPC adherence, suggesting that staffing levels and workload can impact infection prevention efforts.

Furthermore, one of the challenges that influences nurses' adherence is emergency situations. Some participants in both clinical areas highlighted that when they had patients in a critical condition and needed to take action to save their lives, they would not follow the IPC practices as they prioritised emergency care over IPC practices. For instance, when doing a central line for a critical patient, a break in sterility could occur as it should be inserted quickly to give medications. However, in these situations, IPC practices remain important due to the increased risk of infection for critically ill patients.

"Sometimes we know that the patient has COVID or something else but he is in a critical situation and there is no time to put on the PPE" (RN10, Medical ward, Site B).

"I think it can happen during the time of insertion if the patient is critical, they want to insert quickly, like the folly's catheter and the central line. There could be a break of the sterility during that time as they could be in a hurry and lifesaving and they need the line to give, for example, inotropes …" (RN16, ICU, site B).

This suggests that the urgency of patient care conflicts with maintaining IPC practices, as reported by the participants. Although patient safety is important, the urgency of care often leads HCWs to prioritise immediate clinical interventions over IPC practices, regardless of the increased risk of infections in critically ill patients.

Some nurses also articulated that the scheduled workforce is usually sufficient, but staff shortages could arise due to absenteeism, which results in an increased workload for the remaining staff, subsequently impacting their adherence to IPC practices.

Interviewer: "What makes following the guidelines more difficult or easier for you?"

"... Also sometimes we face challenges because of staff shortages, like when someone has sick leave or other issues and didn't come [to work]" (RN14, ICU, site A).

A participant further expressed her concerns regarding the issue of absenteeism without a valid reason, which was perceived as a continuous issue and not limited to COVID. The issue of absenteeism was perceived as a challenge that increased workload for the remaining staff. This indicates that the hospitals need stronger policies in place to manage staff absences and maintain patient care standards.

"But as I said we experience a number of absentees and sometimes there is even not a good excuse for that. But at the end they would say this is not your business

as our salary will be cut. This will create pressure on others but still some of them do not care" (RN6, ICU, Site B).

Participants reported that COVID-19 increased the workload because of the above challenges, including staffing issues and patient characteristics, which negatively influenced adherence to IPC practices.

RN16: "With the crisis [COVID-19], we have more patients with staff shortages. With this crisis, I can't focus on the care and precautions.

There is no time even to change my gown. Sometimes, I have had to leave the room with my gown on to bring something because there is no time. I want to finish my work" (RN16, ICU, site B).

Regardless of COVID-19, a heavy workload also restricts the time available for following IPC practices such as putting on PPE when providing care for patients, including newly admitted patients. This was reported by nurses in both departments at both sites.

"Here in the medical ward we are sometimes assigned to 7 to 8 patients. This will consume a lot of time if we put on PPE every time we go to the patient [new patients who are not tested for infections], and then you know we may deal with that patient with just gloves if the patient is in contact and then wash our hands. So we have a heavy workload, we cannot follow all the guidelines" (RN10, Medical ward, Site B).

Some nurses in the medical wards added that doing other tasks in addition to patient care tasks, including sending or receiving reports or patients to different departments, is time-consuming and leads to more workload on the nurses and then affects their adherence. These tasks were described by the participants as 'non-nursing tasks' and were perceived to detract from the time and focus required for IPC adherence.

"We also go sometimes to bring a report from another building, get medications, send patients when they are discharged, we also send them to MRI, CT scan,

ultrasound, … all these things are time-consuming and put more pressure on us and affect our focus on the precautions" (RN12, Medical ward, Site B).

Some participants believed that longer shifts were a facilitator for following infection control practices, as they allowed more staff to be present and fewer patients to be assigned to each nurse, which alleviated the workload. For instance, a participant said:

Interviewer: "What are the facilitators and things that support you to be able to follow the infection control guidelines?"

"I also think that the 8-hour shift was more challenging and now the workload is lower. Because more staff will be on the shift and the assigned patients can be 5 or even 4 not like before when we get even 8 patients" (RN19, Medical ward, Site B).

Despite the potential benefits of the longer shifts, it is also important to consider the potential drawbacks. Extended work hours can lead to fatigue and burnout, which might undermine adherence to IPC practices due to decreased alertness and increased potential errors. Participant nurses from both clinical areas identified some factors that they perceived made them physically exhausted and compromised their adherence to the IPC practices. These included doing procedures that took a long time to complete, as noted in the following quotations from both departments.

"Sometimes it is hard because of the duration, at the beginning, you will be able to keep sterile, but if the procedure is long, you will get tired" (RN10, Medical ward, Site B).

"I think when the procedure takes long time, so at the start of the procedure you can see everyone is compliant but then little bit not much break in sterility will happen" (RN4, ICU, Site B).

The influence of long working hours, particularly without the ability to request an annual leave, could lead to staff fatigue and burnout. However, this was only

observed during the COVID-19 pandemic where nurses tended to not come to work due to tiredness, which increased the workload on the remaining staff.

"We experienced like 5 absentees most of the days [during the pandemic], and every day there were absentees, and this increased the pressure on the staff and they became tired" (RN5, ICU, site B).

The staffing shortages highlight the need for additional staff support to allow nurses to focus on nursing care and improve IPC practices, as was suggested by nurses in the current study.

"As I mentioned, they can bring more staff to help us and do other things so we can focus only on patients' care. If they want us to provide better care for patients, they should minimise the tasks for us" (RN12, Medical ward, Site B).

The need for additional staff was further explained by many nurses, particularly the staff on the medical wards, who mentioned that the managers must make more effort, particularly during a staff shortage, to solve this issue. It was suggested to bring in more nurses, assistant nurses, or male nurses to allow them to focus on implementing the practices. They also believed that they were usually neglected by hospital management, which was reflected in inadequate resource allocation.

Interviewer: "Is there support that you get to implement infection control guidelines in your department?"

"No, we don't get support from the nursing office. In our department, we cooperate with each other. But if we have a shortage of staff and we need someone, they never bring nurses for us. We are the last department in the hospital that they think about. They think that we are perfect, and we can do everything" (RN2, Medical Ward, Site A).

A few participants also reported that having some male nurses in the department would positively impact adherence to IPC practices. The data highlight that the availability of male nurses is perceived to save time since it is time-consuming to

find male nurses from other departments. This was described by the participants as additional tasks that could lead to delays in patient care and increase the workload.

Male nurses are preferred for certain tasks such as inserting an urinary catheter for male patients, based on cultural and religious beliefs that prevent interpersonal contact between people of opposite genders in Saudi Arabia. Female participants highlighted the relief and reduced pressure experienced when a male trainee was present in the department, as this allowed them to maintain IPC practices without delays. This delay is also likely to influence IPC practices since postponed care can increase the risk of IPC lapses such as missed hand hygiene or other IPC practices. For instance, if nurses feel pressured to complete tasks quickly due to delays, they may skip essential steps in IPC practices, which increases the risk of infection.

Furthermore, transferring male nurses between departments may increase the risk of cross-contamination because moving between different wards could expose nurses to different pathogens. A strict adherence to hand hygiene and other IPC practices is required during transitions to avoid infection transmission from one area to another. Despite this risk, male nurses could be perceived as an important support to allow more time for implementing IPC practices and respecting cultural and religious needs. This analysis highlights the influence of cultural and religious factors on nursing practices in Saudi Arabia.

"I had a male trainee two weeks ago and he relieved me a lot of work. There was a difference, not just for me but for all the nurses because he was the only male nurse here. He was doing things that we used to go around different departments to find an available male nurse to do certain things for us…." (RN12, Medical ward, Site B).

5.3.4.2 Subtheme: Cultural aspects

This subtheme discusses the influence of cultural aspects, including the organisational culture and ethnicity or cultural background of nurses, as well as religious beliefs and psychological factors. In the Saudi context, cultural values and religious practices play a key role in shaping HCWs' adherence to IPC practices.

Psychological factors, including fears of contamination and personal beliefs about accountability, further contribute to their behaviours, particularly when these beliefs are rooted in religious motivations.

Teamwork was identified as cooperation between nurses on the same shift to provide patient care considering the implementation of IPC practices. The cooperation between nurses was described by a few participants as a factor that helped nurses, particularly when the workload was heavy due to a shortage of staff. More participants from the medical wards than from ICU mentioned that working in self-arranged teams was important for them to accomplish their work effectively. They explained that these teams are arranged based on their preferences when selecting shift schedules to ensure they work with colleagues they trust and prefer. They perceived that this grouping allowed them to help each other during times of a high workload, especially when a nurse in the team is assigned to a patient who is critical or bedridden.

"We do our schedules similar to the other members of the group. Then we can work together as a team. When any of us have overload or a critical case, the others will help that nurse, so she can finish her work and do it perfectly. I find this is really helpful and excellent" (RN1, Medical ward, site A).

The teamwork perceptions highlight the importance of interpersonal relationships and collaboration among nursing staff in maintaining adherence to IPC practices. The preference of self-arranged teams based on interpersonal relationships highlights the importance of a supportive work environment. This analysis suggests that teamwork and staff scheduling strategies may enhance IPC practices whereas some perceived that the lack of teamwork among staff could negatively affect their adherence to IPC practices.

A few participants from the ICU pointed out the importance of teamwork and believed that working individually would not allow them to complete the work due to the heavy workload. With cooperation, however, they could ensure effective implementation of IPC practices.

"As I said, the workload that we have can affect our compliance but one of the good things is teamwork. The staff cooperate with each other. If one is busy, and there is another one that can help, she is going to help with a procedure or documentation. And this is one of the things that relieves the pressure because sometimes it is impossible to finish your work alone" (RN5, ICU, site B).

Another participant from the medical ward further emphasised the importance of cooperation and working in teams by reporting the challenge of adhering to IPC practices without colleagues' support. She expressed her frustration when some nurses preferred to work individually and focused solely on providing care for their own patients.

Interviewer: "What other things make applying the precautions more difficult for you?"

"Um-ah … when the team is not cooperating during the shift, so if some of the nurses only working with their patients, so my patients are my patients" (RN19, Medical ward, Site B).

Some of the participants reported that spending break time together as well as cultural food-sharing practices contributed to cross- infections, particularly during the COVID pandemic. In Saudi Arabia, sharing meals is not only a form of hospitality but also a cultural expectation, where it is considered impolite to eat alone without inviting other to join. This tradition is common across various settings, including workplaces, which makes it challenging to maintain social distancing and proper infection control during break times. Social interactions in these departments could also be influenced by the size of the staff room, which does not allow for social distancing and exposes the staff to infection risks. A participant reflected on this issue:

"Actually, I can say that I'm 100% wrong because we should do social distancing and we must not do a group shared lunch. We were supposed to stop these things [sharing food and spending break time together] but unfortunately, we continued practising these. So, I think that I didn't implement all the precautions, especially

the social distance. This is the reason for getting infected" (RN3, ICU, Site A, Critical care nurse).

The analysis suggests that teamwork is important for effective patient care and support among staff. However, informal social interactions during break times can lead to breaches in IPC practices, especially in the context of the COVID pandemic. This cultural practice of food sharing and the physical constraints of staff rooms suggest that deeply ingrained cultural practices and the physical environment can influence behaviours such as IPC practices. It highlights the need to balance social support and teamwork while considering IPC practices.

The following example illustrates that social interactions, communal activities, and shared spaces can contribute to infections and are perceived as barriers to IPC practices. The participants also highlighted that regardless of adherence to IPC practices, acquiring infections is perceived as predestined, which means that while they are responsible for adhering to IPC practices, they can be infected, and they should accept this as it occurs under Allah's will. Thus, although the faith in predestination may provide comfort, it does not undermine the importance of IPC practices.

"Even if we implement all the precautions when dealing with patients, in the end we sit with each other in the same room. We eat together, we touch the same things. In the end it is predestination, thank Allah (God) anyway" (RN2, Medical ward, Site A).

In addition, some senior staff, particularly those working in ICUs, highlighted that they could predict adherence levels from the nationality of nurses. They believed that some nationalities had insufficient awareness and were careless as they focused on completing their work rather than following the IPC practices. This was reported by the ICU participants only, which could be because the majority of the staff in medical wards were Saudi.

"There are some who are aware, but they are careless and neglect it. I mean … um they do not bother themselves, they just want to finish their work. These include

… um I do not want to be biased but some nationalities I do not know if you get it, but they do not care, they leave with their isolation gown and go and touch even things in the nursing station. This is their nature ..." (RN11, ICU, Site A, Charge nurse).

However, linking adherence levels to nationality could lead to potential biases and the risk of reinforcing stereotypes. This perception could lead to divisions among HCWs, which undermine the collaborative efforts required to ensure patient safety. In addition, this perception might overlook other factors that contribute to adherence, including variations in training. This suggests the need for more tailored and culturally sensitive approaches to training and evaluation to ensure that all staff, regardless of their background, are equipped and motivated to follow IPC practices.

Some participants from both sites reported that they were afraid of acquiring infections and transferring them to their families. These personal motivations generally appeared to be a factor that encouraged professionals' adherence. However, personal fears as a motivator may not be consistent across all healthcare staff and settings. For instance, factors including varying levels of perceived risk, trust in infection control practices, and some mental health conditions can influence the fears that motivate adherence. Therefore, fears may not motivate all HCWs.

"Um-ah … actually for me I have fears and always try to protect myself, especially because I have young kids and do not want to transfer any infection" (RN14, ICU, Site A).

A few nurses also explained that their adherence to IPC practices was influenced by their trust in the quality of the PPE such as gloves and was mainly influenced by their mental health, including obsession related to contamination. These HCWs were driven by these thoughts when following IPC practices and believed that they were always adherent. However, the reliance on obsessive thoughts as a motivator for IPC adherence suggests a need for mental health support in healthcare facilities. Hospitals should ensure the availability of high-quality PPE and support mental well-being among their staff for better adherence.

"I don't trust the quality of the gloves and I wash my hands before and after I use it especially because I have obsession" (RN2. Medical Ward, Site A).

Some participants also believed that people's moral sense guides their behaviours, which in turn increases their adherence to IPC practices. The belief in Allah (God) influenced their morals as they were aware that they were responsible and accountable because Allah was witnessing their behaviours, and it is expected from everyone to be adherent to protect patients and themselves. While moral or religious beliefs can be strong personal motivator, adherence can vary across individuals and contexts. Therefore, it is important to consider combining personal beliefs with professional guidelines to maintain adherence to IPC practices.

"Everyone acts according to his conscience …. If your conscience works, you are going to do the right thing in front of your God and others and even if there is no one is watching you" (RN12, Medical ward, Site B).

5.3.4.3 Subtheme: Impact of COVID-19 on perceptions of IPC adherence

Adherence to IPC practices could be influenced by COVID-19 since the majority of participants reported heightened awareness related to the importance of IPC practices, as demonstrated by a nurse from a medical ward:

"I see the staff is better after COVID and there is like obsession, we are just missing the supplies. I think the staff are better now even compared to the period before COVID" (RN10, Medical ward, Site B).

Although awareness was heightened, in practice many participants reported that they were not able to adhere to IPC practices because of challenges including increased workload and resource shortages, which acted as a barrier to adherence to IPC practices such as changing gowns between patients. This reflects that heightened IPC awareness alone may be insufficient in contexts with systemic barriers, emphasising the importance of supplies availability across various units. The following example illustrated the challenges faced by ICU nurses during COVID-19.

RN16: "I mean before COVID, patients are fewer, and staff is enough. With the crisis, more patients with staff shortages. With this crisis, I can't focus on the care and precautions.

There is no time even to change my gown sometimes, I had to leave the room with my gown on to bring something because there is no time. I want to finish my work" (RN16, ICU, site B).

5.3.4.4 Subtheme: Environmental factors

Many environmental factors appeared to influence adherence, including set-up of care tasks, availability of supplies, and the quality of these. This subtheme also includes the challenges that HCWs encountered because of hot weather and the strategies described by the participants to mitigate a shortage of supplies.

In medical departments, the location of sinks, ABHR, and waste management supplies influenced adherence to IPC practices. For instance, participants noted that sinks were not located in the patients' rooms. This suggests that there is a need to improve the physical structure of the hospital to facilitate adherence to IPC practices.

"Also, for hand hygiene, I can't wash my hands when I'm in the patient's room. There is no sink, the only sink there is in the patient toilet so (laugh) I'm not able to touch the patient without gloves, how I'm going to use their sinks. But we have the hand gel available at the door" (RN8, medical ward, site B).

As discussed earlier, participants from both clinical areas reported that hand hygiene practices were not consistently applied, with some moments overlooked. Non-adherence to hand hygiene was particularly more common in shared rooms, which could be due to issues in the ward's layout. For instance, the participants reported that although hand gels were available in medical wards, they were not located near the patients' beds, particularly in the shared rooms. Some nurses admitted that they did not clean their hands before providing care for a second patient in a shared room

because the hand gel was only available at the room's entrance, as illustrated in the following example.

"For me, If I evaluate myself [for hand hygiene] I will give myself a score of 4 out of 5, or 3 out of 5. I always do hand rub before I go to the patient, but sometimes when I finish from one patient and I will go to another one, I forget to do hand hygiene and sometimes it is because of the supply. I mean alcohol hand rub, it is located at the door and I will for example move from A to C which is near the window, and I say OK as I'm there I will also work and finish with bed B (laugh). Yes, I say this honestly" (RN15, Medical ward, Site B, Senior Nurse).

Some staff in the medical wards reported that general, non-hazardous waste bags were available in every room whereas biohazardous waste were not. Consequently, they were required to transport biohazardous waste, such as dressing soiled with body fluids, from the patient's room to a communal area for disposal, which could increase the risk of infection transmission.

"We have a yellow bag and black bag, but sometimes they are not available. Um-ah one time I entered isolation and I wanted to use a yellow bag and there was no yellow bag, only a black bag. So there was no way to separate the waste" (RN12, Medical ward, Site B).

In addition, many participants in ICUs and some in the medical wards reported that the patients' rooms were small, which limited their ability to adhere to the practices. For instance, during the sterilisation technique, a breach of the guidelines may occur if there are a few staff attending the same procedure in one room, as stated by a participant:

"Yes, our rooms are small, so when they move they may break the sterility" (RN7, ICU, Site B).

Similarly, many nurses from the medical departments also commented that the size of the rooms was inadequate for more than two patients with their relatives, particularly when they are doing a sterile procedure. This was perceived as a barrier

to IPC practices. The inability to maintain sterility due to limited space can lead to higher infection rates, which undermine patient safety and quality of care. This highlights the need to redesign patient rooms or consider limiting the number of people present in the room during procedures.

"Yes, the size of the room is really small for three patients and there are watchers with them. So, there is no space to follow all the rules for the aseptic technique, for example" (RN15, Medical ward, Site B, Charge Nurse).

Another participant highlighted that hot weather makes adherence more challenging, especially when wearing PPE during procedures that require more than an hour, such as central line insertion. The nurse also believed that hot weather affected their physical and psychological well-being and how they accepted comments from others, including feedback related to IPC practices.

"And we were working during the hot weather and wearing PPE and sometimes we do a procedure like the central line for an hour or two inside the patient room so of course we become exhausted. Another important point is that a lot of the staff had to take sick leaves to have some rest even if she is not sick but she is physically tired, she takes sick leave then there will be more workload at work and sure there will be shortcomings in compliance. The hot weather even affects a person's psychological status and the acceptance of things" (RN17, ICU, Site A).

The challenges associated with hot weather, as described by a few participants, show how environmental conditions can significantly influence IPC practices. The data reveal how the physical challenges contribute to increased absenteeism among staff, which leads to a heavier workload for the remaining personnel and potential lapses in IPC adherence. The participants also highlighted that the hot weather impacted psychological well-being, which affects how staff handle feedback and stress. These examples illustrate that environmental conditions are important factors in understanding and addressing barriers to effective IPC practices.

Some nurses from the medical wards reported that with the nature of the ward environment and the number of patients on it, patients with suspected infections

may be placed alongside patients who are vulnerable to infection, which increases the risk of acquiring or transmitting infections. Patients could acquire infections due to some lapses in IPC practices among HCWs or from other patients in the same room. The proximity of patients in a crowded ward exacerbates the risk of cross-infections, particularly when vulnerable patients, such as those with sickle cell disease, are placed next to patients with airborne infections. Thus, nurses suggested arranging the patients in shared rooms based on their medical conditions to facilitate implementing IPC practices and minimise the risk of cross-infections as illustrated in the following:

"I also think that the arrangement of the patients is not good. I mean like a patient who has sickle cell should not be placed with someone who has an infection. They know that he is vulnerable to infections why did they put him with others? They should sort the patients according to their medical condition" (RN8, Medical ward, site B).

Reports of a shortage of supplies of PPE, hand hygiene products, and waste management supplies were consistent across the interviews. However, participants in medical departments stated that this was a chronic issue while participants from ICUs believed that the shortage of supplies was often linked to specific occasions such as religious seasons and the COVID pandemic.

"Yes. Sure. Sometimes we do not have all the supplies. Sometimes we don't have sterile gloves or gauze. So you know what I mean, we can't do a proper aseptic technique without these. Limited resources are out of our hands" (RN1, Medical department, Site A).

ICU nurses also reported a shortage of supplies and staff during religious seasons such as Ramadan and Hajj due to operational challenges. This suggests the need for improvements in managing resource allocation to ensure that the delivery of healthcare is not affected by these seasons.

"Sometimes the problem is because of the supplies, um-ah we have some days that we have like during Ramadan or Hajj, these days we have limited supplies even in

the hand gel …. You know that we have a shortage of staff during these seasons as they go to Makkah, and this includes the staff who work in the supplies department" (RN20, Medical ward, Site B, Senior Nurse).

Some participants also highlighted that the COVID pandemic exacerbated the shortage of essential supplies.

"I also have another point that we face these days with the pandemic, which is the shortage of supplies, so it is normal to have some days without soap. So the nurse will only have one option which is the hand rub and you know that hand rub doesn't get rid of all the microbes" (RN17, ICU, Site A).

Additionally, some participants from site A reported that some supplies were available but of bad quality, for example gloves that can be teared easily and must be replaced during procedures. This extends the time required to perform a procedure and results in greater use of PPE supplies. It also increases the risk of acquiring infections and restricts HCWs' adherence to IPC.

Interviewer: "Are there any other factors that affect your compliance?"

"Yes almost but we have another issue like with the gloves, now they are low quality so they can tear in the mid of the procedure so this is considered a source of infection. The quality of the equipment really affects us like the gloves and the gowns" (RN17, ICU, Site A).

The compromised quality of essential supplies such as gloves can also undermine HCWs' confidence in the protective measures, which potentially leads to lapses in IPC practices.

The majority of the participants from all the included areas mentioned that they had to buy some supplies including gloves and masks to be able to follow the IPC practices, particularly during the COVID-19 pandemic. Otherwise, they had to reuse some supplies or bring them from other departments. Furthermore, some of the

supplies were perceived to be insufficient most of the time and improvements were required in the resource allocation systems to improve the quality of patient care.

Interviewer: "I see, so you will need to find them from other departments."

RN4: "Yes, for example the drape, I need to go to the OR to get them. And sometimes they provide us with 6 kits in the morning and they finished because we did 6 procedures and then we will try to find the things again" (RN4, ICU, Site B).

The constant shortage of supplies in some hospital departments could indicate the need for better resource management. This could expose HCWs to more challenges and increase their workload, which in turn negatively influences their IPC adherence. Furthermore, during the COVID pandemic, a shortage of supplies was perceived as a barrier to implementing IPC practices at both clinical sites, and HCWs made efforts to buy some essential supplies. This highlights the need for better preparation to ensure that HCWs are adequately equipped, especially during a crisis, as noted:

"The things that we can bring from outside, we can buy on our expense but there are things that is difficult for us to bring as staff so we try to work without that thing" (RN13, ICU, Site A, Senior Nurse).

5.3.4.5 Subtheme: Challenges in infection detection

Some of the participants highlighted that they faced challenges with identifying some infections among patients, particularly those with no clear symptoms in their early stages, such as TB, hepatitis, MRSA, or COVID. HCWs should use specific IPC practices with patients who have these infections. Therefore, the delayed or missed identification of infections can contribute to the spreading of infections among staff and patients. Many participants felt anxious and concerned about their own safety and the safety of patients because of this uncertainty. Uncertainty about infection detection may also lead to lapses in adherence to IPC practices, as HCWs may not perceive the need for strict adherence to IPC practices in the absence of a confirmed

infection. This challenge highlights the importance of infection detection protocols and timely communication of infection status.

"Sometimes we do not even know that the patient has the infection. Sometimes the patient has MRSA and we do not know that he has it until they do swab from him" (RN10, Medical ward, Site B).

5.3.4.6 Subtheme: Patients' awareness

It was perceived by the majority of participants that HCWs' adherence to IPC practices can be influenced by the awareness and behaviours of patients, their relatives and visitors. A few participants believed that when patients have good hygiene, it reflects their awareness level, and this encourages HCWs to be more adherent to meet the patients' expectations. However, the participants also believed that patients' hygiene practices varied because of their cultural differences and backgrounds. For instance, they perceived that when the patient had a background in health, they were more aware of the importance of infection control practices. Many participants believed that patients' awareness played a role in infection prevention, particularly if patients were aware of IPC practices and well enough to make comments. Thus, educating patients can set expectations and foster a collaborative environment where patients are empowered to be informed and engaged in their care. This is illustrated in the following example, where an experienced nurse believed that increasing patients' knowledge could indirectly encourage HCWs to maintain IPC practices.

"I feel that the patient should know that the nurse has to do hand hygiene before she deals with him and can ask her to do hand rub so I think this is really important, the patient should be educated about that…" (RN20, Medical ward, Site B, Senior Nurse).

The participant further clarified that some patients became more aware of some IPC practices, such as hand hygiene practices and the use of PPE, after the emergence of COVID-19, which subsequently enhanced nurses' adherence to IPC practices.

"We really wish that all patients know their rights in relation to infection control and can tell the nurses if they noticed any mistakes. Actually, I can tell you that now after COVID, we have more aware patients, they ask us sometimes to change our gloves for example, you got it. Not all the patients are doing that but I can say that they are more aware than before" (RN20, Medical ward, Site B, Senior Nurse).

This observation suggests an increase in patients' awareness and involvement in IPC practices. However, this could be influenced by different factors such as cultural factors, the power dynamic between HCWs and patients, and the specific healthcare setting. The confidence and willingness of patients to question or correct HCWs in Saudi Arabia could be influenced by cultural norms and social hierarchies, which often emphasise respect for authority figures, including HCWs. However, this is not a universal experience and may vary based on specific healthcare settings and patients' awareness and level of education. Even in the medical wards, where patients are less critically ill, power dynamics may still discourage them from speaking up. However, the COVID pandemic increased public awareness of infection control practices, which could make some patients feel more confident about challenging healthcare staff.

Additionally, many participants believed that patients often compromised IPC practices by sharing food with one another or visiting other patients' rooms without seeking permission from the nursing staff. Nurses acknowledged that some patients were unaware of their medical diagnosis, or that they may have an asymptomatic infection that could be transferred to others if they overlooked IPC practices.

"When they [patients] sit with each other and are in a shared room. They even share their food. When one of them gets food from her family, she shares it with the others in the room. Sometimes she is infected [any asymptomatic infection] but still doesn't know about herself. Also, when they stay for a long time, they get bored, and they move to other rooms to see different people" (RN1, Medical department, Site A).

This issue highlights the importance of communication and the monitoring process in healthcare settings. Nurses and other HCWs should become more proactive in

educating patients about IPC practices. However, this could be challenging in environments with staff shortages and high patient turnover, as highlighted by the participants.

Some nurses also mentioned that patient behaviour can impact their adherence to IPC practices, including patients refusing to wear masks or disregarding isolation measures, which made it difficult for the nurses to maintain a safe environment.

"Yes, we also had an elderly patient who was suspected [to be infected by COVID-19], and we asked her to stay in her room but she come to us without a mask. I asked her to put the mask on and explain that to her, but no benefit, she fights with us …. The management didn't have the ability to convince the patient to stay in her room and say that she is elderly? So, we can't do anything" (RN15, Medical Ward, Site B, Charge Nurse).

Some participants from the medical wards reported that patients' companions (patients' relatives who accompanied them during hospitalisation) act as a barrier to implementing IPC practices. These relatives interact with other patients and visit other hospital areas. In addition, some nurses expressed their frustration over the relatives' negative attitudes, which included disrespect and sexual harassment. They also felt rushed by relatives and visitors, which compromised their ability to complete their work safely, including adherence to IPC practices. It is important to address these challenges in order to maintain IPC practices and ensure a safe and respectful work environment for HCWs.

"The watcher is a source of infection, patients do not just get infections from the hospital. The watchers maybe change every day and leave and go everywhere and then come back, these people bring us infections like coronavirus. … There was one watcher who was calling his nurse (housekeeper) … this is in addition to the men [patients' companions] who sexually harass us, I'm not going to talk about that. So I just want to finish my work, no need to do it perfectly" (RN12, Medical ward, Site B).

Additionally, similar challenges were reported by ICU nurses during the early stages of COVID-19 when visitors were still allowed into ICU settings under certain conditions. The nurses described different situations where visitors transmitted COVID-19 to patients and exposed HCWs to infections. For instance, some visitors refused to use PPE, citing their personal cleanliness as an adequate precaution. This made it difficult for nurses to maintain a safe and monitored environment. It also negatively affected their health and well-being, which ultimately led to absenteeism, increasing the workload for other staff. Thus, these challenges created stress and anxiety among nurses, impacting their motivation to adhere to IPC practices. This highlights the need for increasing awareness among visitors to address cultural misunderstandings about infection transmission and hygiene, and to encourage visitors' adherence to IPC practices.

"Yes, we actually have difficulties because of the visitors, you know that the visitors in the ICU are different from others. I mean the patient is infected and they come from outside and want to enter the patient's room, we ask them to wear PPE, some of them are OK but others refuse, so the patients are immunocompromised, and they would say that I'm clean I just had a shower and washed my hands and so on …" (RN16, ICU, hospital B).

5.3.5 Theme 3: Perceived role of managerial support and leadership

This theme highlights the importance of leadership in enhancing adherence to IPC practices through effective role modelling, providing constructive and consistent feedback, and recognising staff contributions.

5.3.5.1 Subtheme: Leadership strategies: feedback and recognition of IPC adherence

This subtheme identified different leadership strategies that can positively impact adherence to IPC practices, including role modelling, feedback and recognition.

Some nurses suggested that nursing managers should be role models for their staff and encourage them to implement the IPC practices in different ways. These could include discussing infection control practices with their staff, personally

implementing these practices by themselves, and ensuring that the required supplies are available in their departments. This perception highlights the importance of leadership in enhancing adherence to IPC practices, as noted by the following:

"The head of the department is a role model in everything, not just in the infection control practices. If the head of the department is interested in implementing infection control practices, the others will be interested in them …" (RN3, ICU, Site A, Critical care nurse).

Another participant suggested that the creation of an environment that welcomed active participation in supervision and reminders from colleagues would be an effective strategy to encourage adherence to IPC practices. For instance, using a special hand gesture to remind each other of the 5 moments of hand hygiene proved to be an effective method to reinforce IPC practices in the participant's experience. This participation in supervision highlights the role of a supportive environment in promoting IPC practices.

"There was always a word that is common between the staff, which is 5 hands, and in here they mean that this is reminder if you did the 5 moments of hand hygiene, so this is one thing related to infection control that I miss in here and maybe because we don't like someone to ask us to do things like wash your hands and so on but the manager can create a language in the environment between the staff" (RN20, Medical ward, Site B, senior Nurse).

This analysis demonstrates the importance of fostering a culture where peer feedback is normalised and encouraged. It also highlights the role of leadership in creating a culture of IPC practices. However, there were mixed views regarding sharing and accepting feedback among staff. While a few participants perceived that accepting feedback from their colleagues can enhance adherence to IPC practices, some participants highlighted that accepting feedback from colleagues is not always possible and can be affected by hierarchy in healthcare settings, particularly between junior nurses and more experienced staff, and between doctors and nurses. This suggests a power imbalance where seniority and professional status affect open communication. The perceptions that doctors possess a "superego" reflects a

cultural and professional barrier where authority takes priority over cooperative attempts to uphold IPC practices. The data show that acceptance of feedback can also be influenced by the ethnicity and cultural backgrounds of HCWs, which is discussed further under the cultural aspects' subtheme.

"It [accepting feedback] depends on the person itself and the position, like some doctors do not accept our comments, but we have the authority to prevent him from continuing the practice if he is not compliant" (RN13, ICU, Site A, Senior Nurse).

A participant stressed the importance of managers assessing staff adherence to IPC practices and providing regular feedback, as shown in the following:

"The manager should focus on the movement of the nurse, whether she leaves her area to bring something or not. If the manager keeps her eyes on the nurses and says like "I saw you walking wearing your gown, I think you didn't finish your procedure and maybe you didn't wash your hands" (RN20, Medical ward, Site B, Senior Nurse).

A senior nurse further explained that their feedback on infection control practices was continuous and important, particularly with regard to correcting their IPC practices and improving staff adherence.

"There are some people who come here and know the infection control guidelines and we just need to guide them. For example, they have some defects in some points, and we advise them" (RN11, ICU, Site A, Senior nurse).

However, a nurse mentioned that infection control teams provided more feedback than the charge nurses and believed that charge nurses should always correct the behaviours of HCWs when implementing IPC practices. Although some nurses agreed that infection control teams provided regular feedback, some participants also believed that the infection control nurses needed to provide more feedback during their rounds, particularly on the medical wards.

"I think if the infection control come to see the practices and mistakes and talk with nurses more often, it would help" (RN18, Medical ward, Site B).

This highlights the disparity in the perceived effectiveness of supervision within clinical settings. The nurse's belief that charge nurses should provide continuous feedback reflects the necessity for proactive involvement from individuals in leadership positions. Charge nurses are in a unique position to influence day-to-day practices and maintain IPC practices due to their close proximity to clinical activities and their responsibility to supervise staff. A few nurses mentioned the example of receiving immediate feedback from charge nurses regarding overfilled waste bins which demonstrates a practical situation where the need for immediate correction is required. This highlights the importance of charge nurses as supervisors, as well as role models who demonstrate a commitment to IPC practices.

Many participants reported that recognition and appreciation would encourage them to be more adherent. From the perspective of the participants, appreciation can come in different forms, such as thank-you certificates and financial incentives. It was perceived that nurses' motivations and participation in IPC practices were positively affected when their efforts were valued. This suggests that recognition reinforces a sense of accountability and ownership over IPC adherence. On the other hand, the participants highlighted that not receiving any form of appreciation, particularly during COVID, negatively affected their enthusiasm to work in general and this may have affected their adherence to IPC practices, as noted by the following:

Interviewer: "Is there anything that promotes the staff to be more compliant?"

"I think, yes, if there is staff recognition. If the hospital supports them to work better. This period, they gave the staff thank you certificates, and I felt that the staff were more enthusiastic. Because someone appreciates their work" (RN5, ICU, site B).

Some participants, including senior nurses, further emphasised the importance of financial incentives in creating a sense of ownership among staff regarding outcomes of adherence to IPC practices.

"Why don't they give rewards to the staff when the rates of infections become lower after having a high rate of infection in the same department? When the staff are known to be able to implement PPE, hand hygiene or any infection precaution perfectly, they should be given a suitable thing as a reward. It can be a thank you certificate or financial rewards. These things will enable the staff to feel that they are part of the process and when the rates of infections become high or low, it will affect them negatively or positively. Therefore, they will feel that they are part of this" (RN3, ICU, Site A, Critical care nurse).

Some participants also commented that seniors should identify the good practices performed by the staff and thank them. The participants also believed that commenting on small mistakes without paying attention to the right practices is a form of unappreciation. The focus on failures rather than achievements can create a negative culture that can discourage staff from their commitment to IPC practices.

Interviewer: "Is there anything else that supports you to be more compliant?

"The appreciation, for example, the head nurse wants you to do everything but sometimes doesn't appreciate what you did, and once you did a small mistake you are going to receive bad comments, whereas when you do something good, she doesn't come and thank you or show that you have done something good, …. So, she is focusing on the negative things. And I saw that in different situations with different staff. But, we get used to that" (RN5, ICU, site B)

This analysis suggests that financial incentives and formal recognition can foster a culture of accountability and adherence. Therefore, the management could potentially influence staff motivation by implementing a reward system, which might enhance adherence to IPC practice.

A senior nurse in the medical ward expressed concern about the lack of career development, which frustrated them and has the potential to result in non-adherence to IPC practices.

"Why there are no promotions for these [senior nurses] or send them to other departments to do other tasks? This is unlike the other departments, we can see that some staff became supervisors and others were sent to other departments like the infection control or to the management. For us, in the medical, they stay the same …" (RN15, Medical Ward, Site B, Senior Nurse).

The data showed that adherent staff in the medical wards were not typically promoted to higher positions. This lack of recognition and advancement may lead to non-adherence behaviours as staff perceived career development as a reward for their efforts. This highlights the need for promotion and recognition strategies across all departments. Furthermore, the disparity in professional development opportunities, which was reported by the experienced senior nurses, could be a sensitive topic for junior nurses to discuss. Therefore, the inclusion of these senior nurses was important in exploring this perceived barrier.

5.3.6 Theme 4: Perceived role of the infection control team

This theme highlights the role of the infection control team in nurses' adherence to IPC practices. There are three subthemes within this theme: perceptions of monitoring IPC practices, perceptions of the role of infection control team in communication, and training programmes.

5.3.6.1 Subtheme: Perceptions of monitoring IPC practices

This subtheme focuses on the different tasks performed by infection control teams, including direct observations and monitoring IPC practices.

Many participants mentioned that the comments and supervision carried out by infection control nurses during direct observations have an important role in improving staff adherence to IPC practices. The nurse reported that the presence of

the infection control nurse during procedures provided practical and real-time learning, which was perceived as more effective than theoretical discussion alone.

"When there is someone that can observe our practice, for instance when we had the infection control nurse in the department, she showed me one time how to insert a folly's catheter, and I was assisting her, so when you see the practice and you do it is different from when they just talk about it. Then I felt I'm competent to do it in the correct way" (RN16, ICU, site B).

The data suggest that the consistent presence of an infection control nurse within a department can improve adherence to IPC practices. The immediate feedback and demonstration of proper techniques enhance learning and adherence more effectively than verbal instruction alone. This could also lead to more sustainable long-term adherence and higher confidence in applying IPC practices independently.

A minority of the staff also highlighted the role of the infection control team in improving adherence to IPC practices by using Key Performance Indicators (KPIs) to assess hand hygiene adherence rates, as well as the rates of other infections including MRSA.

"Um-ah the KPI from infection control when they do rating for hand hygiene and the number of patients who have MRSA or Acinetobacter, this will result in actions taken by infection control department that aim to improve the practices, especially if there is an outbreak in a department, they will receive specific education for them. So when the staff see that the hospital are doing the KPI, they will be motivated to be compliant" (RN20, Medical ward, Site B, Senior Nurse).

However, another participant believed that KPIs were not sufficient and suggested more improvements, suggesting providing lectures and education. The data suggest that the current monitoring strategies used by infection control teams is inadequate for long-term improvements in adherence and should involve more strategies such as supervision and education, as shown in the following:

"From my experience, I found that the role of the infection control team was only focused on statistics and doing the KPI (key performance indicator) rather than supervising the staff and providing lectures, advice, and courses" (RN3, ICU, Site A, Critical care nurse).

5.3.6.2 Subtheme: Perceptions of the role of infection control team in communication

For updates or any clarification regarding IPC practices, the majority of the participants preferred asking the infection control team or other authorised HCWs such as the clinical resource nurse, the head nurse, or the charge nurse. This highlights the important role of infection control teams in communicating IPC practices effectively to staff.

"We have CRN [clinical resource nurse] in our department. If we have any question related to infection control, we ask her and she communicates with the infection control department" (RN1, Medical ward, Site A).

Some of the nurses reported that they could also access updates through the groups created for nurses on social media or through emails.

"And for the updated policies the manager sends us that in the group from time to time" (RN11, ICU, Site A, Senior nurse).

In addition, it was more feasible to receive the updated practices directly from the infection control department, as nurses reported that they usually had a heavy workload and were not able to sit at the computer to check for updates. Furthermore, it was not always possible to access computers because of their limited number.

"We also have very limited numbers of computers and doctors access these more than us when they are around, and we the nurses are a huge number … and have a lot of pressure and work, especially during the last period, we have a lot of orders, procedures and so on" (RN6, ICU, Site B).

The data also showed that there is a need for further improvements when communicating updates, particularly those related to waste management. Some participants in the ICUs felt overwhelmed and regularly had difficulty keeping up with the most recent IPC practices due to the frequent changes. They commented that they could change frequently and that this could occur on their days off, and they did not receive any notification. This was seen as a barrier to following correct IPC practices.

"Oh this is really one of the things that we suffer from, we are tired from this issue. One day they ask to put a specific thing in the yellow bag and then on the other day they ask us to put it in the black one as the yellow bag is expensive now so we have to change" (RN6, ICU, Site B).

This analysis shows that both the constant changes to IPC practices and the lack of clear communication regarding these changes can lead to confusion and frustration among staff. Consistent and clear communication about changes in IPC practices are important to keep the staff informed of recent IPC updates. The frequent changes in IPC practices, including those related to waste management, were reported as a barrier to IPC practices. The data further indicate that the ongoing changes, such as shifting from using medical waste bags to general waste bags was perceived to be related to cost considerations.

The infection control team communicated updates on IPC practices during a shortage of supplies, particularly during the COVID-19 pandemic. For instance, some participants acknowledged that the infection control team clarified the guidance during COVID-19, particularly those related to shortages of PPE such as masks and gowns, and advised to reuse them. This reflects the infection control team's role in helping staff adapt to the constraints of supplies.

"… they asked to use the same N95 we just put it back in its bag. The same thing with the yellow gown, they asked us to use and then hang it to reuse it again, and this could be for one or two patients and we used to have all COVID patients as we were one to one or one to two" (RN6, ICU, Site B).

However, some participants on medical wards reported that the infection control team provided education on IPC practices without considering finding alternatives for the supplies that were not available. The staff expressed their frustration, stating that they could only buy some supplies such as gloves, otherwise, they would have to work without the missing items.

"The infection control department knows about that [specific supplies not available] and they are responsible for these and aware that we do not have them and they should find the alternative and give us education. We have one educator in the department …. They teach us. For example, last time, how we get a culture from the folly's catheter and we know that we should use sterile gloves, but there is no sterile gloves and they know that (laugh)" (RN12, Medical ward, Site B).

The controversy related to guidance during a shortage of supplies varies between different departments and situations. The data showed that participants from medical wards required more guidance from infection control during a shortage of supplies, whereas staff in the ICU believed that the advice offered by the infection control team was sufficient. This could also be due to the availability in the ICU of infection control link nurses, who are readily available to provide advice.

5.3.6.3 Subtheme: Training programmes

This subtheme focusses on nurses' experiences and their perceptions of the available training and their capacity to engage with this.

All the participants reported that attending infection control training (basic infection control skills licence) is important and is mandatory. It is provided by the infection control team and contains all the basic elements of infection control. It should also be renewed annually.

"Yes, I attended BICSL (basic infection control skills licence) almost 3 weeks ago. BICSL includes a set of lectures and the requirements from the infection control that are required by the Ministry of Health. Then the person will be given a card or

certificate of attendance. It briefly includes everything on infection control. It has a test about the fit test, PPE and isolation" (RN3, ICU, Site A, Critical care nurse).

However, some participants stated that attending the training was challenging for them as it had to be during their working hours. This highlights how the pressure of daily responsibilities limits learning opportunities, which could negatively impact adherence to IPC practices.

"The education is continuing but sometimes they do that during the work hours and not everyone can attend. They do not give us time for learning because of the shortage in staff" (RN18, Medical ward, Site B).

For this reason, the participants reported that the transition to digital platforms enhances accessibility and convenience, particularly for HCWs at site B.

"Now, we can do it online, I just did it a few months ago to renew my licence. We can do it at any time and there is a test at the end" (RN4, ICU, Site B).

Interviewer: "What are the available infection control training and courses?"

RN20: "We have infection control training available online which contains videos and questions and then they will receive a certificate, so it is not difficult" (RN20, Medical ward, Site B, Senior Nurse).

The data indicate that essential IPC training is available in both hospitals. However, infection control teams should take into account the challenges experienced by staff when delivering this training using traditional methods, as it overlaps with working hours and the existing staff shortage. For this reason, in-person training had been replaced by online training in hospital B to offer flexibility and allow HCWs to attend the training at their convenience. This transition could mitigate some of the challenges highlighted by nurses, but the data also suggest the need for more training.

In addition to the mandatory infection control training, most of the participants stated that there were regular lectures provided by the infection control team. However, they reported that these lectures were not enough, particularly for new staff who required more education to improve their adherence to IPC practices.

"No, it is not enough. We need something more intensive. We need to know more about the types of microbes and their impacts on patients, some staff maybe don't have the knowledge that the microbe may affect the patient and that will lead her to be less compliant" (RN17, ICU, Site A).

A few participants also believed that senior staff may benefit from these training courses. For instance, senior staff may still experience situations where a lack of appropriate supplies forces them to use the available alternatives, which potentially leads to errors.

"… they should also increase the teaching even for the staff. This is for me as a new staff but even for nurses who worked for 11 years, if they do not have the required equipment, they will use the available ones and then there will be a mistake" (RN8, medical ward, site B).

In addition, an experienced participant suggested that providing these lectures in a more interactive way in workshops would be more effective.

"They actually do that but as lectures not workshops and my suggestion is to make this as workshops" (RN20, Medical ward, Site B, Senior Nurse).

The analysis suggests that workshops that involve active involvement in the learning process can offer immediate feedback, which is important in enhancing adherence to IPC practices during different procedures. A nurse added that the education on infection control should not be limited to HCWs and should include patients and visitors, as they should be aware of their role in preventing infections.

"Infection control should not just include healthcare workers, there should be infection control guidelines for the patients, including patients who come for

outpatient clinics and for visitors. They should understand the guidelines and be aware of infection control, so they do not transfer any infections. The infection control team should teach them …" (RN8, medical ward, site B).

The inclusion of patient and visitors in infection control education represents a holistic approach to infection prevention. This approach can emphasise that infection control is a collective responsibility, and that educating patients and visitors can reduce the risk of cross- infections within healthcare settings.

Participants from the ICU at site B noted that establishing projects intended to reduce specific infections was very effective in improving adherence to IPC. These included projects that aimed to reduce Central Line-associated Bloodstream Infection (CLABSI) by dedicating staff to monitor adherence to IPC practices during central line insertions. The effectiveness of this project highlights the potential for replicating such approaches for other procedures to reduce HAIs. For instance, tailored approaches could be applied in other clinical settings such as medical wards where adherence to IPC might focus more on preventing infection transmission during routine care. Tailoring interventions to the specific procedures and contexts within each clinical unit can improve adherence to IPC practices and can be focused on the unique risks present in each clinical area.

"Yes, now the ministry uses a programme to prevent CLABSI. So, we have a team who is working on this project, so these staff assist the doctors when doing the insertion of a central line to ensure sterilisation. Once this was implemented, almost after 2 months, we had zero CLABSI, so this is something they are now working on. The rate of infections became low because someone is monitoring all of the central lines and checking if there is an indication for them or not" (RN7, ICU, Site B).

5.4 Discussion

The findings of this phase showed perceived variations in IPC adherence in ICUs and medical wards, as well as between professional groups. Adherence was also

influenced by the nurses' level of experience and previous nursing roles, which highlights the importance of providing training based on these factors.

Workload was identified as a major barrier and it was perceived that a heavy workload negatively affected HCWs' adherence and could lead to non-adherence due to fatigue. Adherence was also compromised by environmental factors such as a shortage of supplies, particularly during specific religious seasons such as Ramadan and Hajj, as well as pandemics such as the recent COVID-19 pandemic. Leadership and managerial support were perceived as important for improving IPC practices. Participants emphasised the need for better staffing, better and consistent communication about changes in IPC practices, consistent feedback, and more training that took into account cultural and religious considerations.

5.4.1 Discussion of findings in light of existing literature

A key insight from this study is the need for improved managerial support and leadership to address different issues, including balancing staff gender distribution, facilitating feedback sharing, recognising staff contributions, and providing training. Increasing the number of staff was recommended by previous studies as a way to improve adherence and mitigate the risk of HAIs in healthcare (McLaws et al., 2015, Salem and Youssef, 2017). This is similar to the current study where nurses, particularly those in medical wards, suggested having more staff and assistant nurses to enable them to focus more on implementing IPC practices. In addition, some female nurses reported cultural or religious sensitivities that made them reluctant to provide care for male patients. This reluctance could lead to delayed or rushed procedures, which could result in some lapses in IPC practices. The current study also found that these gender differences led to the use of gloves when they were not indicated, which could lead to a waste of supplies or missing IPC opportunities. Therefore, it is important to establish an appropriate gender balance in staffing and to consider cultural sensitivity to enhance the overall adherence to IPC practices.

Moreover, the current study's contribution lies in its exploration of feedback mechanisms. The findings showed that consistent feedback provided in real time during procedures was seen as more effective than feedback given after events as it allowed HCWs to correct their practices immediately, which reinforced IPC adherence. Therefore, it was suggested that the consistent presence of an infection control nurse in the department would be beneficial. Consistent feedback could contribute to a culture of continuous improvement where HCWs are encouraged to reflect on their practices and make necessary adjustments. In addition, feedback from peers was identified as important. However, the effectiveness of feedback can be compromised by hierarchical issues where junior staff might be hesitant to provide suggestions or feedback to senior colleagues. This was similar to the findings of a previous study by Henderson et al. (2020) that aimed to determine the factors influencing adherence to IPC practices among HCWs. They employed a qualitative design with semi-structured interviews involving 11 nurses experienced in infection control in Australia. The study found that effective feedback on IPC practices was important for the immediate correction of IPC practices. However, the study also highlighted that hierarchical structures within healthcare settings can create barriers to open communication. For instance, Henderson et al. (2020) found that hierarchical structures can create power imbalances, which makes it difficult for nurses to challenge or provide feedback to doctors regarding IPC practices. The authors also found that the management of interprofessional relationships can create a challenge, particularly when nurses are responsible for monitoring the practices of other HCWs. This can lead to a reluctance to address non-adherence among other HCWs like doctors. Despite geographical differences, there are many similarities in healthcare provision and hierarchy that contribute to these challenges across contexts. Thus, effective leadership is important for promoting a culture of open communication and support that encourages collaboration among HCWs and reduces the impact of perceived hierarchies (McCauley, Kirwan and Matthews, 2021).

In addition to the role of feedback, the current study found that recognition and support from leadership could be an important factor in reinforcing IPC adherence. While immediate feedback is often considered effective for changing practice,

recognition after the event also plays a role in maintaining motivation and reinforcing positive behaviour. The importance of leaders' recognition and support aligns well with the Transformational Leadership Theory (Bycio, Hackett and Allen, 1995). This theory emphasises the role of leaders in inspiring and motivating followers to achieve a higher level of performance and commitment. The theory posits that leaders can influence followers through four key components: idealised influence, inspirational motivation, intellectual stimulation, and individualised consideration. In the context of IPC adherence, these components can be applied as follows: 1) idealised influence: leaders who prioritise and model IPC practices themselves serve as role models, which enhances their credibility and influence on staff behaviour; 2) inspirational motivation: by recognising and supporting staff efforts in IPC adherence, leaders can inspire and motivate HCWs to maintain high standards of practice; 3) intellectual stimulation: leaders can encourage innovative approaches to IPC challenges to foster a culture of continuous improvement; and 4) individualised consideration: providing personalised feedback and recognition demonstrates that leaders value individual contributions to IPC efforts. Therefore, the current study's findings on the role of recognition in maintaining motivation suggest that if staff feel valued for their efforts, this could increase their IPC adherence (Bycio, Hackett and Allen, 1995). The current study makes a contribution to the field in the context of healthcare in Saudi Arabia by offering an understanding of how leadership strategies, staffing challenges, and cultural sensitivities interact with IPC practices.

The current study highlighted that the IPC training programmes provided for HCWs are available and regular. However, staff on the medical wards, particularly those at site A, found it difficult to attend these training sessions during working hours because of the shortage of staff in their department. This issue could be present in both settings but only hospital B addressed the attendance issue by making these training sessions available online for HCWs. Despite these efforts, the analysis suggests a need for additional IPC educational programmes, particularly ones specifically tailored to meet the needs of diverse staff groups and experience levels, including newly hired nurses, senior nurses, and staff from various cultural backgrounds. Nurses and other professional groups such as cleaners would benefit

from training approaches to effectively enhance IPC adherence. This finding is consistent with a review by Alhumaid et al. (2021), which assessed HCWs' knowledge of IPC and identified factors influencing IPC adherence. The review included 30 studies from different countries including but not limited to Italy, Saudi Arabia, India, Ethiopia, and the United States. Alhumaid et al. (2021) highlighted that effective education and training are important for improving adherence to IPC. The review found that a lack of knowledge is a main barrier to adherence and emphasised that education and training should be prioritised as core components of IPC programmes in accordance with the WHO guidelines. Similarly, the current study supports the importance of arranging training sessions for all HCWs, as highlighted by both Alhumaid et al. (2021) and the WHO guidelines, to enhance understanding and adherence to IPC practices (World Health Organization, 2016). The findings of the current study contribute to the literature by highlighting the practical challenges faced by HCWs in accessing IPC training and by emphasising the importance of adapting training formats to address staffing shortages and involve all HCWs in these programmes.

One of key findings in this study is the influence of increased workload on the adherence of HCWs. A heavy workload was caused by different factors, including shortage of staff, high patient-to-nurse ratio, limited time, additional tasks, patients' characteristics, and patients' relatives. Furthermore, supplies were sometimes insufficient or inaccessible, as commonly reported in the literature, which can increase the workload for the staff and hinder adherence to IPC practices (Houghton et al., 2020, Alhumaid et al., 2021). However, in the current study, the challenges associated with supplies were primarily observed during specific events in Saudi Arabia such as Hajj, when local demand surges, in addition to the global strain caused by the COVID-19 pandemic. Furthermore, while a large workload was reported in both departments, each department had its own challenges that exacerbated the workload, often leading to fatigue and compromised adherence. The findings from the current study are consistent with the results from a Cochrane review conducted by Houghton et al. (2020) which included 20 studies to identify factors influencing HCWs' adherence to IPC guidelines for respiratory infectious diseases. The study concluded that workload and HCWs' fatigue can also be

exacerbated by the ward temperature, which could affect staff members' ability to adhere to IPC practices. Houghton et al. (2020) also highlighted that visitors created additional challenges, especially with respiratory infections. In the current study, visitors and patient companions were reported as an important barrier to IPC practices and they impacted the daily workflow beyond the effect of COVID-19. One suggestion to address this was to increase the awareness of patients' relatives. Houghton et al. (2020) also suggested increasing staffing levels, which is consistent with the recommendations from the current study. However, there was a key difference regarding working hours. While the Cochrane review suggested reducing staff working hours to mitigate workload, the current study reported that 12-hour shifts decreased workload as more staff were present during each shift. This discrepancy highlights the need to consider specific departmental and hospital contexts when searching for solutions.

Another important finding in the current study is that adherence to IPC practices can be influenced by nurses' level of experience and previous nursing roles. Some senior nurses perceived that work experience in some departments such as operation theatres and ICUs could help to improve adherence because of the high risk of infections and the high patient vulnerability. This finding is consistent with a previous review conducted by McCauley, Kirwan and Matthews (2021), which focused on identifying the factors influencing nurses' adherence to IPC practices across 17 studies from different countries including Jordan, the Netherlands, England, Switzerland, the United States, South Korea, China, Australia, and Italy. McCauley, Kirwan and Matthews (2021) found that nurses with prior experience in departments such as ICUs showed stronger IPC adherence because of the critical nature of these environments. It was also noted in the review that nurses may rely on their personal experiences to justify not following established IPC practices. Both the current study and McCauley, Kirwan and Matthews (2021) found that some nurses might take shortcuts or make decisions based on their immediate assessment of patients, which means that they may prioritise urgency over strict adherence to IPC practices, which can lead to potential risks for infections. This highlights the importance of continuous training and reinforcement of IPC practices, even for experienced nurses.

5.5 Strengths and limitations

The current study employed semi-structured interviews to obtain rich and in-depth information from HCWs and to gain a thorough grasp of their perspectives of IPC practices.

A strength of this study is the inclusion of nurses from various roles and settings, including ICU nurses, medical ward nurses, charge nurses, deputy department heads, and clinical resource nurses. This promotes a diversity of perspectives and a wide range of experiences and insights. These frontline nurses work directly with patients, which offers a different viewpoint from that of infection control teams. This combination allowed for a comparison to be made between the perspectives of those implementing IPC practices daily and those supervising them, which uncovered potential gaps in IPC perceptions and adherence strategies.

Moreover, the findings gained depth and richness through the inclusion of participants with different levels of experience, with over fifty per cent having more than six years of experience. The representation of experienced professionals improves the credibility and relevance of the study's findings and helps to reflect a broad range of expertise and knowledge (Patton, 2014). These HCWs shared their understanding of IPC practices, challenges, and solutions from the perspective of their varied roles and experiences.

One of the strengths of this study was its ability to foster an atmosphere that encouraged open and honest communication among the participants. This approach allowed honest answers to be gathered, regardless of cultural norms that might prevent such openness. For instance, the respect for hierarchy is highly valued in many cultures, which may discourage individuals from openly criticising their organisations. The ability to foster an environment where participants felt comfortable to discuss sensitive topics without fear of repercussions demonstrated the effectiveness of the methodological flexibility used.

While these interviews were instrumental in capturing in-depth information, the data were at times relatively thin, particularly in certain areas where the

participants may not have provided as many details as anticipated. This limitation may have been influenced by the researcher's limited experience in conducting qualitative interviews, which could have affected the depth of probing and follow-up questions. Despite this limitation, the use of thematic analysis was still an appropriate and effective approach, as it allowed for a systematic exploration of the data. However, it is important to note that the insights gained could have been stronger with more robust and detailed responses from the participants. Thus, future research could benefit from a more extensive training on interviewing, as well as a more comprehensive data collection process or additional probing during interviews.

There are also some limitations of the current study that should be taken into consideration. Despite attempts to recruit participants from different disciplines, this was not achieved. This might be due to some biases in recruitment as senior nurses were more cooperative with regard to inviting people to participate. This led to the inclusion of only nurses, which might overlook the viewpoints of other key HCWs in the healthcare system, such as physicians. To mitigate this limitation in future studies, more targeted recruitment strategies could be employed, including directly reaching out to other HCWs such as doctors. To offer transparency about the findings, this limitation was explicitly acknowledged.

A potential limitation of this study is the inclusion of only Saudi healthcare workers. Saudi nurses tend to prefer working in urban areas while non-Saudi nurses predominately staff rural facilities. Since this study was conducted in urban hospitals where Saudi nurses form the majority of the workforce, the participants were exclusively Saudi nationals.

While the findings of the study provide insights into IPC practices within the selected hospitals, it is important to note that the findings may not be generalised to other healthcare settings across Saudi Arabia. However, the researcher believes that the study's findings could be applicable to other hospitals in different regions in Saudi Arabia, particularly MoH institutions, which share a similar healthcare system and standardised guidelines. However, variability across healthcare settings in Saudi Arabia must be considered since differences in resource allocation, staffing levels, and organisational practices can influence IPC adherence. Regardless of these

differences, the findings of this study may still be valuable for improving adherence to IPC practices in various healthcare settings as the MoH is the primary healthcare provider in Saudi Arabia and it regulates a significant number of hospitals. This means that many healthcare settings in Saudi Arabia follow similar care practices, organisational structures, and IPC guidelines, which are standardised and enforced by the MoH. Therefore, the study's recommendations could be implemented by several hospitals under MoH regulations, which could improve the general consistency of IPC practices across the country.

Furthermore, the study entailed translating the transcripts from Arabic to English, which could potentially lead to a loss in the meanings of the participants' responses. To overcome this limitation, careful measures were taken to ensure the accuracy of the translation. A bilingual expert fluent in both Arabic and English cross-validated the translated transcripts and agreed on the final translation. Subsequently, the data were back-translated from English to Arabic to verify the maintained meanings and nuanced expressions in order to further validate the accuracy (Chen and Boore, 2010). Despite the mentioned limitations, the mitigation strategies used helped to enhance the trustworthiness of the study. This was achieved by acknowledging the limitations, using methodological strategies, and validating findings through comparisons with the wider literature. This approach strengthens the study's credibility, transferability, and dependability.

5.6 Conclusion

This chapter presented the findings of phase 3, which explored the factors influencing the implementation of infection control practices on medical wards and ICUs in two selected hospitals in Saudi Arabia. By using thematic analysis, several factors were identified, including environmental factors, workload, and nurses' levels of experience and previous nursing roles. Furthermore, the study highlighted the importance of improving managerial support, leaders' involvement in balancing staffing levels with cultural or religious considerations, staff recognition, providing different forms of IPC training to involve all groups of HCWs, and improving communication about changes in IPC practices.

In the next chapter, the overall discussion will synthesise the findings from all the study phases, along with a comparison with the existing literature and their wider implications. Important directions for further study as well as practical recommendations for enhancing IPC practices in Saudi Arabia will be examined.

Chapter 6 Discussion and conclusion

6.1 Introduction to the Chapter

This chapter synthesises and discusses the key findings from the thesis, focusing on identifying consistent themes across the three phases in relation to the wider context of the current literature in order to provide an overall picture of the factors influencing HCWs' adherence to IPC practices in Saudi Arabia. The discussion focuses on three main areas identified across the findings: the role of leadership, the influence of religious and cultural factors, and the influence of environmental factors. In addition, this chapter details the strengths and limitations of the study and offers conclusions and recommendations for improving the implementation of IPC practices within Saudi healthcare, addressing the dimensions of practices, policy, and research. A personal reflection on the researcher's PhD journey is also included.

6.2 Leadership's role in IPC adherence

Leadership plays an important role in promoting adherence to IPC practices by promoting good practice and creating an important environment that prioritise safety and adherence. The findings of this study highlight ineffective leadership; leaders failed to recognise HCWs' good practices during their interactions with them and they provided inadequate training, which can hinder IPC adherence.

The findings of this study highlighted staff perceptions that adherence to IPC practices could potentially influence career development opportunities, including promotion to roles like an infection control nurse. Although the participants in phase 2 stated that staff career development is used as a reward for adherent staff, the participants in phase 3 stated that adherent staff expected career advancement but were disappointed when it did not occur; this highlighted the lack of a structured reward system. The study found that there was no evidence of rewards for continued good practice. This discrepancy may stem from differences in expectations: infection control teams may assume that adherence would naturally contribute to promotions or development opportunities, whereas frontline staff felt that their

efforts were not being recognised. Notably, no explicit criteria for progression or promotions linked to IPC adherence were identified in the data, which suggests that adherence alone is insufficient for career development. For instance, infection control practitioners typically require specific qualifications, certifications, and competences as emphasised by the GDIPC (GDIPC, 2022). Healthcare organisations should establish formal mechanisms for recognising and rewarding IPC adherence. While adherence is a fundamental responsibility, incorporating recognition reinforces positive behaviours. These mechanisms complement existing strategies for addressing non-adherence to ensure patient safety without replacing accountability measures. Research suggests that the lack of a recognition and reward system reflects a broader issue within the organisation (Alahiane et al., 2023).

The wider literature supports the importance of rewards in motivating HCWs. Afolabi, Fernando and Bottiglieri (2018) conducted a systematic review to explore the impact of organisational factors on the motivation and performance of HCWs in various settings in the UK, Europe, Africa, and Asia. The review included 30 studies and found that promotions, recognition, appreciation and tangible rewards contributed significantly to increased commitment and job satisfaction. On the other hand, a lack of recognition was linked to feelings of demotivation and undervaluation, particularly if HCWs perceived that their contributions were being overlooked.

The review by Afolabi, Fernando and Bottiglieri (2018) also emphasised that motivation is influenced by factors such as staffing levels, work environment and support from supervisors. These were also identified in the current thesis and will be further discussed in the following sections as influential factors in IPC adherence. Studies have shown that recognising HCWs' success in preventing HAIs through tangible rewards such as parties and intangible rewards such as email acknowledgements enhance adherence to IPC practices and align with recommendations from the WHO (Gaughan et al., 2021, Wang et al., 2023). These initiatives motivate staff and support a culture of recognition and support for adherence to IPC practices (Gaughan et al., 2021, Wang et al., 2023). However, evidence linking rewards directly to IPC adherence remains limited, particularly in

the Middle East. While structured mechanisms for recognising IPC adherence are discussed in the international literature, their application in Saudi Arabia has not been well explored. This study provides context-specific insights that can contribute to understanding the effects of reward systems on IPC practices in this region.

The suggestion of rewards aligns with the concept of reward power. French and Raven (1959), as discussed by Elliott, Storr and Jeanes (2023), highlight reward power as a mechanism that incentivises adherence through tangible or intangible benefits, which can be effective in the short term but have limitations. As Elliott, Storr and Jeanes (2023) point out, rewards may become counterproductive if perceived as unfair or if they fail to materialise, which could undermine trust and long-term motivations. Thus, although this approach holds promise, its sustainability and fairness must be critically assessed to promote sustainable adherence. These findings highlight the need for leaders to develop fair, transparent and sustainable reward systems to incentivise IPC adherence. These systems should balance tangible benefits such as career advancement with intangible forms or recognition to promote trust and sustained motivation among HCWs. Further research is needed to evaluate the feasibility and effectiveness of reward systems tailored to IPC practices in Saudi Arabia.

Phase 1 of the study identified a need for training provisions. Both phases 2 and 3 identified a number of training opportunities and the participants agreed overall with the findings of phase 1, noting that these opportunities were inadequate because of their infrequency, inaccessibility, and irrelevance for diverse HCWs as well as for patients and visitors. For instance, participants in phases 2 and 3 highlighted the need for more interactive and diverse training approaches, including online options and sessions tailored for a range of HCW groups, as well as patients and visitors. This suggests that while training programmes are available, they are not always accessible or sufficient to meet needs. These findings align with the World Health Organization (2016) recommendations, which advocate hands-on, task-oriented education including interactive training methods such as simulations and workshops. In addition, both phase 2 and 3 highlighted that targeted projects for specific infections were effective. Such projects were identified as playing a key role in improving adherence and decreasing infection rates. An example includes

adherence to preventive care bundles designed for CLABSI, which was identified as impactful in reducing infections. This study and the WHO have highlighted that targeted interventions, including infection-specific projects such as those aimed at preventing VAP or blood stream infections, are effective in improving IPC adherence and reducing the risk of infections (World Health Organisation, 2022).

The findings from phase 2 and 3 also highlighted the need for additional IPC training for specific groups such as cleaners, newly hired nurses, patients and families. While training sessions were available, they did not sufficiently meet the needs of all HCWs. These findings are consistent with the WHO guidelines on IPC education, which emphasise the importance of including all HCWs, regardless of their level of experience, in ongoing IPC training (World Health Organization, 2016). Importantly, phase 2 revealed that the current training and education efforts were insufficient and needed to be improved, but no more details were given. A possible explanation for this limited discussion is the lack of structured staff consultation mechanisms within the organisation, which can discourage team members from expressing concerns or offering suggestions. Without a formal channel for providing feedback on training programmes, staff may feel less empowered to address the gaps that they perceive. Although this study did not explore the use of evaluation sheets or similar mechanisms after IPC induction training, the absence of structured feedback does not align with the WHO's recommendations to establish clear and consistent communication channels for feedback on training effectiveness and programme development. Actively involving HCWs in forming the training programmes is important for better adherence and to improve practice (World Health Organization, 2016).

6.3 Factors related to cultural and religious considerations

The systematic review conducted in phase 1 noted references to cultural sensitivity but little evidence was found of the specific sensitivities relevant to the healthcare context in Saudi Arabia or how these may be accommodated or addressed. For instance, it highlighted challenges related to beards and face coverings, which affect

adherence. In phase 3, a more comprehensive picture emerged with a range of specific cultural considerations offered across the study sites. These included traditional Muslim views of modesty and the challenge this presents in physical contact between male and female HCWs in the administration or receipt of care. Nurses reported using PPE, particularly gloves, when it was not clinically necessary as they considered that it maintained modesty. However, the role of cultural factors did not appear to be a central theme within the phase 2 data. The cultural factors surrounding gender interactions are discussed in a recent review of 24 studies by Alsadaan et al. (2021), which explored the challenges experienced by nursing professionals in Saudi Arabia. The review noted that cultural restrictions on female nurses providing care for male patients could discourage women from entering the nursing profession because of societal pressure and the need for gender interactions within healthcare.

Several reasons can explain this absence of discussion about specific cultural considerations in the focus groups. This absence might indicate the reluctance of the infection control team staff to discuss culturally specific matters in a focus group setting, possibly due to cultural norms in Saudi Arabia that make discussing sensitive topics among peers uncomfortable. Although the groups involved only female participants, views on such topics can vary between individuals and some may feel more comfortable discussing these issues than others. Alternatively, the absence of discussions about face coverings might indicate that issues related to face coverings are simply not prevalent in the hospitals where the data were collected. However, given the diversity of healthcare settings in Saudi Arabia, this might not reflect broader trends across the country.

Another explanation could be a gap in knowledge or that these topics are not widely addressed in IPC training, which was a large part of the context for the infection control team staff's discussions. The WHO highlights the need for culturally adapted training programmes to enhance IPC adherence in diverse healthcare settings (World Health Organization, 2016). Previous studies, including that by Brooks et al. (2021), have highlighted the role of cultural awareness in improving adherence to IPC practices and suggested that this gap could undermine IPC efforts among staff from diverse backgrounds. This study contributes uniquely by identifying the differences

between infection control teams and frontline staff regarding the consideration of cultural factors in IPC practices in Saudi Arabia.

These findings highlight the need for IPC policies to accommodate cultural considerations, particularly socio-religious contexts, to ensure that adherence is both feasible and culturally acceptable. While the use of supplies such as gloves may sometimes be seen as unnecessary in certain contexts, it could also reflect a positive effort by HCWs to adhere to cultural norms that enhance both their comfort and the patient experience.

The findings of this study revealed a consistent perception across the participants in both phase 2 and phase 3 that IPC adherence varied among international nurses according to their national or cultural backgrounds. Interestingly, the findings highlighted that nurses from some nationalities were associated with higher adherence to IPC practices, while others were perceived to have lower adherence. However, the underlying reasons for these differences were not explicitly explored in this study.

The perception that IPC adherence varied among international nurses based on their national or cultural backgrounds could reflect underlying discrimination. The recent review by Alsadaan et al. (2021) found that international nurses often face challenges, including cultural misunderstanding, language barriers, difficulties in professional relationships and discrimination, that make them feel marginalised and can lead to high turnover rates. (High turnover rates can impact adherence to IPC practices and will be further discussed in the following section). While discrimination was identified as an issue in only one study among the 24 studies in the review, it remains important to explore this issue and its impact on healthcare delivery in Saudi Arabia.

Another explanation for the perception that IPC adherence varied among international nurses could be variations in the training and healthcare systems of nurses' countries of origin. Many may have had prior experience of resource-limited healthcare systems (Saudi Health Council, 2019). In such settings, IPC practices may not be consistently implemented due to systemic challenges, including insufficient

staffing, limited access to essential supplies, or inadequate training (World Health Organization, 2016). According to the WHO, healthcare settings with limited resources often need to prioritise basic interventions, which may lead to gaps in comprehensive IPC education and practices (World Health Organization, 2016). This discrepancy in exposure and experience may contribute to different levels of IPC adherence among nurses when they transition to the Saudi healthcare context where resources and expectations differ. In the Saudi context, some recent studies have provided evidence of these differences and identified nationality as a predictor of IPC knowledge and adherence among HCWs (Colet et al., 2018, Aljaffary et al., 2024). The implications of workforce diversity and distribution on staffing challenges in Saudi Arabia are discussed further in the following section. Incorporating culturally sensitive training into IPC programmes could help to bridge the gaps in understanding and improving adherence among HCWs, which would contribute to safer, more effective healthcare practices (World Health Organization, 2020).

There is a gap in our understanding of how cultural aspects affect IPC practices and the broader work environment for international nurses; understanding these factors is essential for developing more inclusive and supportive healthcare environments. Further research could examine how discrimination affects IPC adherence, particularly in multicultural healthcare teams, to promote better integration and performance.

6.4 Environmental factors

Insufficient numbers or quotas of staff was consistently reported as a barrier to IPC adherence throughout all the phases of this study. In the systematic review in phase 1, the overall findings highlighted that staff shortages were a persistent challenge to IPC adherence across healthcare settings in the Middle East. Among the two Saudi studies included in the review, one specifically identified a challenge related to staff absenteeism, which exacerbated the workload of the remaining staff (Alshehri, 2023). This finding was not reported in the other Saudi study or across the broader review. It was theorised that this issue was related to the consequences of the COVID-19 pandemic. However, phase 3 of the study revealed that a shortage of staff and absenteeism among nurses were persistent challenges even before the

pandemic. Globally, staffing issues have been widely recognised as a significant challenge in healthcare systems (Alsadaan et al., 2021, McCauley, Kirwan and Matthews, 2021). According to the World Health Organization (2024) statistics published for 2022, Saudi Arabia (55.1/10,000) has the second highest nurse-to-population ratio among Gulf countries, following the United Arab Emirates (63.9/10,000). However, the nurse-to-patient ratio in Saudi Arabia remains low compared to international standards. In 2022, Saudi Arabia's ratio was significantly lower than those of the United Kingdom (92.5/10,000), Canada (103/10,000), Australia (137/10,000) and the United States (119/10,000) (World Health Organization, 2024).

The nursing workforce in Saudi Arabia faces unique challenges compared to the global trends (Saudi Health Council, 2019). Staffing shortages directly impact IPC adherence as limited personnel can increase workload, reduce the time for proper IPC practices, and increase the likelihood of errors (McCauley, Kirwan and Matthews, 2021). Only 38% of nurses are Saudi citizens, which poses risks to workforce stability due to the heavy reliance on foreign nurses. In addition, the nursing turnover rate in Saudi Arabia is approximately 20%, which is double the turnover rate in countries like the United Kingdom (Saudi Health Council, 2019). Another challenge is the unequal distribution of nurses between urban and rural areas, with Saudi nurses working primarily in urban centres and foreign nurses staffing rural healthcare facilities (Saudi Health Council, 2019). These workforce challenges provide important context for understanding some of the perceptions identified in this study, including the perceived variations in IPC adherence among nurses based on their national or cultural background, as discussed above.

Recent reviews highlighted that a shortage of staff remains a challenge in Saudi Arabia (Alsadaan et al., 2021, Albalawi et al., 2024). This is consistent with the findings from Alhindi et al. (2024), who investigated the prevalence of nursing staff shortages in government hospitals. A total of 279 nursing directors were surveyed across all regions of Saudi Arabia (Alhindi et al., 2024). Interestingly, the study identified variations in the methods used to estimate staffing shortages, with the majority of leaders preferring to use a professional judgement approach over acuity-based staffing or evidence-based guidelines (Alhindi et al., 2024). Phase 3 findings

presented a picture of consistent staff shortages (section 5.3.4.1) which reflects broader staffing concerns identified in phase 1. Various approaches for planning staff requirements have been discussed in the literature (Butler et al., 2019, Stafford, 2021); however, exploring the calculation and planning of nursing provision in the study sites was beyond the scope of this study. Staffing challenges are also compounded by high turnover rates, which could affect access to training and development opportunities for staff, further exacerbating the issue (Saudi Health Council, 2019, Albalawi et al., 2024).

Importantly, this study contributes to understanding how staffing shortages in Saudi Arabia influence IPC adherence by highlighting the persistent challenges exacerbated by absenteeism and a lack of sufficient support staff. Contrary to common assumptions, the employment of more nurses was not the priority for the participants in this study; rather, they identified the potential to better utilise nurses' time by providing greater support through nursing assistants and considering the gender composition of staff on each shift as important factors. The findings also highlighted the need to employ strategies that reduce absenteeism and its impacts on adherence.

Other environmental factors were also highlighted across the study phases, including the shortage and inaccessibility of supplies. Interestingly, there were some discrepancies between the perspectives of infection control teams and frontline staff regarding resource challenges. For instance, while infection control teams in phase 2 reported that they actively addressed resources shortages, frontline staff in phase 3 expressed that support during these shortages was inadequate. Similarly, the accessibility of IPC resources such as hand washing facilities was not highlighted in phase 2 but it was described in phase 3 as a common barrier to IPC adherence. This discrepancy highlights one of the strengths of the research approach used in this study, as it enabled the identification of different perceptions of staff groups.

These discrepancies between the perspectives of infection control teams and frontline staff may reflect differences in their roles, priorities and levels of awareness about the supply chain. Infection control teams, who often operate at a managerial level, may focus on broader resource planning and assume that shortages

have been addressed effectively. However, frontline staff may experience these shortages firsthand, particularly in terms of immediate access to PPE or handwashing facilities. This suggests a potential misalignment between organisational resource allocation and the operational realities faced by HCWs.

The discrepancy regarding resource challenges could also be due to the variability of resources across departments or shifts. Recent studies from Saudi Arabia have noted variations in IPC adherence and resource availability across the country (Abukhelaif, 2019, Sagar et al., 2023, Alshagrawi and Alhodaithy, 2024). Supply shortages could also occur during specific periods such as high workloads or during a pandemic, as noted in the study and the wider literature (Houghton et al., 2020, Alhumaid et al., 2021).

The contrasting perspectives of infection control staff and frontline HCWs may also indicate gaps in communication between them. Infection control teams may not always receive feedback from frontline staff about issues, which leads to assumptions of adequacy. According to the World Health Organization (2016), effective communication channels are essential for consistent implementation of IPC practices as they facilitate feedback, clarify expectations and support collaboration across different professional groups.

6.5 Strengths and limitations

With regard to phase 1 (the systematic review), to the best of the author's knowledge, this study represents the first qualitative systematic review in the Middle East that specifically examines the factors influencing IPC adherence among HCWs. This review makes an important contribution by synthesising the available evidence, highlighting consistent themes in IPC adherence, and identifying important gaps in qualitative research within the region. While some factors influencing IPC adherence appear to be universal, such as the availability of resources and training, others are context specific, such as cultural considerations like the use of face coverings. Although the review broadly indicated a need for some cultural sensitivity, it did not clearly articulate how such sensitivities should be addressed, identifying a gap in the current understanding of IPC practices within this region.

Another strength of this study was that it involved perspectives from two participant groups: infection control staff and frontline staff. Involving both infection control teams and nurses in the study allowed for a comparative analysis between those who directly provide patient care and those who oversee IPC adherence. Nurses who were directly involved in patient care experienced specific challenges that impacted their daily IPC adherence. On the other hand, the infection control team offered a perspective on monitoring and training strategies, which reflect specific organisational approaches to IPC. Both groups highlighted similar challenges, but each presented unique perspectives and narratives shaped by their roles in patient care and IPC management. This design revealed important contrasts in the perceptions of IPC challenges and solutions, showing the value of including diverse participant groups in order to understand IPC adherence. For instance, the study identified gaps in communication and alignment between strategic and operational levels of IPC management when addressing the issue of resource shortages.

Another important strength of this study is the inclusion of participants from two distinct clinical settings, ICUs and medical wards. This allowed for a more comprehensive exploration of IPC adherence across different healthcare environments and provided context for understanding how different clinical settings and clinical tasks or responsibilities may impact and shape adherence to IPC practices. Furthermore, since this study was conducted during the COVID-19 pandemic, it adds another layer of relevance. Although some of the challenges identified in this study predate the pandemic, the crisis exacerbated these issues, including staff shortages and increased workload. While these challenges are not unique to pandemics, the crisis highlighted their urgency and the strain they place on the healthcare system. This makes the study's findings particularly relevant for understanding how IPC practices are impacted during times of crisis. Exploring the influence of these factors during the pandemic offered lessons for preparing healthcare systems for future crises and highlighted the need to improve IPC strategies during non-crisis periods as well. Specific recommendations from this study include improving the physical infrastructure of hospitals, enhancing training, ensuring sufficient staffing and resource management during emergencies, and

disseminating updates in a timely and comprehensive manner. These are detailed in the recommendations section.

A potential limitation of this study is the inclusion of only Saudi nurses, as discussed in the interview chapter, particularly given the suggestions by the participants that international nurses' adherence to IPC practices was less than ideal. The inclusion of a wider range of nurses from different countries and cultural backgrounds would have been valuable to offer a more comprehensive understanding of the effect of culture on adherence to IPC practices.

In addition, this study focused exclusively on nurses and did not incorporate an observational component to directly assess the implementation of IPC practices in clinical settings. Including an observational element could have provided a more accurate representation of how IPC practices are implemented in real time. However, due to the constraints of the COVID-19 pandemic, as explained in the methodology chapter, this was not feasible.

6.6 Conclusion

This study explored the factors influencing HCWs' adherence to IPC practices in Saudi hospitals, focusing on ICUs and medical wards. The key facilitators of IPC adherence include direct observations, immediate feedback, and religious and psychological factors, including the moral obligation felt by HCWs to protect themselves and others. Nurses' level of experience and the communication of IPC updates were also identified as important factors that can encourage adherence.

However, the study also identified barriers to IPC adherence, which included environmental factors (e.g., inadequate access to essential supplies), limited patient and family awareness, staff characteristics including the challenges associated with new staff, hierarchical challenges, and difficulties with infection detection. The absence of reward and recognition among staff, particularly when career advancements expectations were not met, was also identified as an important barrier.

Overall, the factors influencing HCWs' adherence to IPC practices are not unique to Saudi Arabia and have been observed in other healthcare settings globally, as identified in the wider literature. However, this study contributes to existing evidence by highlighting specific cultural considerations that may affect IPC adherence, such as traditional views on modesty-created gender-related challenges related to physical contact between male and female HCWs. These cultural challenges highlighted the need for IPC policies that are both evidence-based and culturally sensitive. These factors should be addressed to enhance staff motivation and promote safer healthcare delivery.

6.7 Recommendations

The findings of the three phases of the study highlight the importance of creating a work environment that enhances the implementation of effective IPC practices and overcomes the challenges faced by Saudi healthcare organisations. The study highlights that enhancing IPC adherence requires an approach that includes improvements in the implementation of policies, resource management, and training programmes. Based on the findings, the following recommendations are made:

6.7.1.1 Recommendations for practice

- Infection control teams should enhance dialogue and collaboration with frontline staff to promote transparency and shared responsibility in IPC practices. This could involve establishing regular opportunities for staff to provide feedback, share their experiences, and discuss concerns about IPC strategies. Encouraging frontline staff involvement in the development and review of IPC strategies may also foster greater engagement and ownership, which would ultimately strengthen adherence to IPC practices.

- Provide IPC training programmes that are tailored to the organisational and professional needs of different professional groups including nurses, doctors, and support staff, as well as the unique requirements of various clinical units. While the study primarily included nurses, the perceptions they shared suggest that

some groups may need additional awareness and guidance to adhere to IPC practices. These training sessions should emphasise the role that each staff member plays in maintaining a safe environment. The programmes should use interactive learning methods including workshops, case study scenarios, and digital platforms, which enhance flexibility and accessibility. This approach would encourage the active participation and engagement of HCWs.

- Improve and support the involvement of family members in IPC practices by introducing mandatory visitor orientation sessions as part of the admission process in Saudi healthcare settings. While the findings suggested that educating visitors and companions could improve IPC awareness, the effectiveness of this was not demonstrated. These sessions should provide concise, culturally appropriate IPC education to ensure that visitors and patients' companions understand their role in maintaining a safe healthcare environment. Healthcare organisations should develop standardised educational materials including videos, brochures, or interactive sessions that are tailored to the diverse cultural backgrounds and educational levels of the family members and provide accessible and relevant information. Furthermore, clear protocols should be enforced for how visitors and patients' companions can interact within the patient care area to reduce the risk of infection. This approach will ensure that all individuals within healthcare setting are aligned with IPC guidelines. This will contribute to a safer and more controlled environment for both patients and HCWs.

6.7.1.2 Recommendations for policy and management

- Develop comprehensive IPC programmes for newly hired staff incorporating a detailed learning needs assessment to adapt training to individual experiences and backgrounds. These programmes should address potential IPC differences, including variations in adherence to protocols and different perceptions of risk. These are shaped by previous workplace norms or training experiences and cultural practices that may influence adherence, including gender-specific concerns. Flexible training methods should accommodate diverse learning needs, and mentorship programmes can provide ongoing support and help staff to adapt

to the organisation's IPC practices. This approach aims to reduce the risk of outbreaks associated with newly hired staff as identified in this study.

- Review the existing feedback mechanisms within IPC policies to ensure timely and comprehensive communication of updates. A structured review should identify strength and areas for improvement to enable better alignment of staff practices with updated guidelines and enhance collaborative efforts for IPC adherence.

- Saudi healthcare organisations could implement leadership recognition programmes that reward HCWs who consistently demonstrate excellence in key aspects of patient care, including IPC practices. IPC is fundamental to patient safety, and effectively modelling these practices can enhance adherence across teams, which promotes a culture of adherence and collaboration. Recognised leaders could take on roles such as clinical resources nurses or infection control nurses where they can further influence their peers, resolve patient safety concerns, and create a culture of excellence across various dimensions of care.

- Saudi healthcare organisations should initiate a review of staffing levels and the staffing issues and absenteeism in the healthcare system to identify areas requiring improvement. A review can help establish evidence-based staffing standards, refine the recruitment process, and determine the optimal nurse-to-patient ratio needed to provide effective and safe care. In addition, strategies should be implemented to reduce absenteeism, which exacerbates staff shortages and increases the workload of the remaining staff. By improving staffing levels and addressing absenteeism, healthcare facilities can create a more supportive environment that enables HCWs to prioritise patient safety and maintain high standards of infection control.

- Healthcare organisations should prioritise improvements to the physical work environment to better support IPC practices and patient safety. This includes auditing and assessing the current physical environment to identify areas for improvements. In addition, sufficient equipment and supplies, including hand hygiene stations and properly designed patient rooms must be provided. It is also important to incorporate IPC considerations into the design of clinical areas to

help mitigate potential infection risks, even in non-crisis situations. For example, well-organised workspaces can reduce overcrowding, which can occur during routine operations due to high patient turnover or staff shortages. Addressing overcrowding can maintain high IPC standards under both normal and emergency conditions.

6.7.1.3 Recommendations for future research

Taking into account the findings of this study, several important areas warrant further exploration. Future research should focus on addressing the barriers and facilitators identified, particularly in practice. Building on the qualitative insights gained, interventions should be developed and tested to determine their effectiveness in improving IPC adherence.

This study identified several contextual challenges and enablers that require deeper investigation to inform culturally tailored IPC interventions. For instance, future studies could examine specific cultural and religious factors affecting IPC adherence, including the challenges of caring for patients of the opposite gender or using IPC equipment with facial coverings or beards, which present unique barriers within this context. These areas warrant mixed-methods studies that combine qualitative methods with observational studies to offer a more comprehensive view of adherence and the cultural and contextual factors that impact IPC adherence. Broader inclusion of diverse international nurses' perceptions could also uncover the influence of cultural backgrounds on IPC adherence, which would provide valuable perspectives for more inclusive interventions. There is also a need to investigate IPC adherence during emergency situations, including pandemics or mass gathering like Hajj, as these contexts often exacerbate challenges.

Future research could also explore the impact of engaging family members in IPC education and practices and assess whether such interventions improve adherence among patients and families and lead to a subsequent reduction in HAIs. Outcomes such as hand hygiene adherence, infection rates, and staff feedback on family involvement can provide an understanding of the potential benefits of involving family members in promoting IPC efforts.

Future research should also extend beyond the current focus to include various healthcare settings including primary care, outpatient departments, emergency departments, and hospitals not run by the MoH, such as private hospitals. Comparing the factors that influence IPC adherence across these diverse settings could reveal contextual variations that impact the main facilitators of and barriers to adherence. Despite global challenges being similar, some circumstances such as the distinction between private sector and MoH hospitals may present different challenges or solutions worth investigating.

Furthermore, future research should encompass a broader range of HCWs from diverse disciplines including nurses, doctors, and allied health professionals. Although IPC practices are universal, each professional group may face distinct challenges based on their specific responsibilities, frequency of patient contact, and exposure to infection risks. The level of IPC knowledge and training also varies across roles. Adherence and attitudes towards IPC also differ between groups, demonstrating resistance or a lack of adherence that can be influenced by interprofessional communication and collaboration.

6.8 Reflection on my PhD journey

When I began my PhD, my initial focus was on the psychological aspects of coping mechanisms and pain perception, particularly exploring the interaction of sickle cell crisis pain and psychoeducational models. Over time, I recognised the importance of grounding my work in a clinical context given my background as a nursing professional. This shift allowed me to focus on another interest, which was the need for a deeper understanding of the specific factors influencing IPC adherence. I developed a greater appreciation of the importance of a theoretical foundation and expertise to guide impactful research.

My PhD journey, particularly during the COVID-19 pandemic, was a transformative experience that affected my research approach and personal growth. Once the lockdown was enforced and COVID-19 spread globally, the closure of ethics committees made it impossible to proceed with my original plans. During this time, I was working on expanding my understanding of IPC and became aware of the issue

of IPC adherence among HCWs worldwide and in the Middle East. I also had to re-evaluate my research approach and shifted my focus to conducting a systematic review, which posed its own challenges. Working from home with limited access to librarians who were also adapting to deliver a service remotely pushed me to develop higher level of independence and adaptability in conducting research.

I also needed to adjust my data collection methods to align with COVID-19 restrictions, which was another challenge. This process developed my critical thinking and research skills. Conducting interviews was a research skill that I had little experience with before. At the beginning, it was a challenging process, especially when conducting interviews online. Over time, I became more confident and could develop better strategies for managing interviews and improving communication to engage participants more effectively.

Pursuing this PhD has also enhanced my personal development. Balancing academic work with family responsibilities during a global health crisis required time management, perseverance, and a commitment to well-being for myself and my children. I learned to prioritise, manage competing demands, and stay focused on long-term goals despite personal and professional challenges. This period reinforced my resilience, patience, and capacity for self-reflection, which I believe are essential qualities for a researcher.

My PhD journey also improved my academic writing skills. Through academic writing workshops, critically engaging with the literature and constructive feedback from my supervisors, I learned to synthesise information, critique ideas and adopt a more analytical approach. These developments enhanced the depth of my thesis and boosted my confidence as a researcher, which equipped me with skills that will continue to benefit my future endeavours. Overall, research is not a straightforward process. It requires adaptability and resilience. This journey taught me to remain focused on long- term goals even when immediate progress seemed uncertain.

Appendices

Appendix 1: PROSPRO International prospective register of systematic reviews CRD42020223257

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

Barriers and facilitators to healthcare workers' adherence to infection prevention and control measures in the Middle East

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Citation

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Review question

What are the factors that influence healthcare workers' adherence to recommended infection prevention and control measures for healthcare-associated infections (HAIs) in the Middle East?

Searches

A search will be carried out for relevant published literature in the MEDLINE, EMBASE, the Cochrane Library and CINAHL databases.

The database search strategy will be based on the use of search keywords with their associated synonyms: healthcare workers (e.g. health personnel), healthcare-associated infections (e.g. cross infection), infection prevention (e.g. hand hygiene, Personal Protective Equipment (PPE)), guideline adherence (e.g. compliance), and the Middle East (e.g. Qatar, Emirates, etc.).

Studies for inclusion will be limited to those published between 2010 and 2020. This time period has been selected as the most relevant literature has been published within this time period. No language restrictions will be implemented in the search - any studies published in a language other than English will be translated.

Searching other resources:

Hand searching of the reference lists of eligible studies will also be undertaken.

The grey literature will be searched through several sources, including EThOS, Google and the CADTH grey literature search list.

The search terms "healthcare associated infections AND adherence AND Middle East" will be used to search the grey literature.

Studies will be included if they meet the inclusion criteria and they will be excluded if they were published before 2010 or are not related to healthcare workers' adherence to infection prevention measures in the Middle East.

Additional search strategy information can be found in the attached PDF document (link provided below).

Types of study to be included

Qualitative and mixed-method studies (where the qualitative findings can be clearly extrapolated) will be included with the primary focus on qualitative findings that identified the barriers or facilitators to infection prevention and control measures for healthcare workers to prevent HAIs.

Appendix 2: Ovid MEDLINE Search strategy

Ovid MEDLINE(R) ALL <1946 to March 08, 2024>

1 Nursing Assistants/ 4428
2 exp Health Personnel/ 628432
3 (health personnel or healthcare personnel or health care personnel or health worker$ or healthcare worker$ or health care worker$ or health care practitioner$ healthcare provider$ or health care provider$ or health practitioner$ or healthcare practitioner$ or health care practitioner$ or health employee$).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 313117
4 exp Medical Staff/ 29093
5 (doctor$ or physician$).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 768849
6 (allied health adj (staff or personnel)).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 13680
7 Allied Health Personnel/ 13254
8 Nursing Staff/ 22218
9 exp Nurses/ 100133
10 (hospital staff or hospital worker$).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 7954
11 (physician? or doctor? or practitioner? or clinician? or nurse? or nurs* assistant? or midwife or midwives? or dentist? or pharmacist? or physiotherapist? or occupational therapist? or technician? or radiographer? or health manager? or health care manager? or healthcare manager? or clinical officer? or medical personnel? or medical professional? or medical worker? or medical provider? or medical staff or health personnel? or health care personnel? or healthcare personnel? or health professional? or health care professional? or healthcare professional? or health worker? or health care worker? or healthcare worker? or health provider? or health care provider? or healthcare provider? or health staff or health care staff or healthcare staff).mp. [mp=title, book title, abstract, original title, name of

substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 1925836

12 (infection prevention or infection control).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 57850

13 exp Infection Control/ 71424

14 (protective clothing or gown* or coverall* or protective layer* or surgical toga or apron or smock or hazmat or glove* or respiratory protective devices or mask* or face mask* or facemask* or respiratory protection or eye protection or personal protective equipment or PPE or goggles or safety spectacles or glasses or donning or doffing or respiratory hygiene or clean* or disinfect* or waste management or respiratory hygiene or environmental control*).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 350205

15 (Universal Precaution* or standard precaution*).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 3418

16 exp Universal Precautions/ 1683

17 ((Droplet* or contact or isolation) adj3 precaution*).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 1797

18 ((infectio* adj3 battl*) or (infectio* adj3 control*) or (infectio* adj3 fight*)).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 91076

19 (control adj3 measure*).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 53917

20 or/12-19 500749

21 (guideline* or protocol* or guidance).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 1506365
22 exp Guideline Adherence/ 35208
23 IPC guideline*.mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 106
24 ("adhere to" or adherence or barrier* or challeng* or compliance or comply$ or facilitat*).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 2619247
25 or/21-24 3867296
26 20 or 25 4270044
27 (aerosol or surface or environment or contaminat* or spatial or aerodynamic or disinfectant or cross infection or infection prevent* or infection control or viability or inactivation or indirect transmission or indirect virus transmission or indirect viral transmission or hand rub or hand rubbing or hand rubs or alcohol or hand hygiene or ethanol or hand disinfection).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 3706263
28 exp Cross Infection/ 65554
29 healthcare-associated infection*.mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 5360
30 (hospital-acquired infection* or nosocomial infection*).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 23249
31 exp Disease Transmission, Infectious/ 82071
32 or/27-31 3786894
33 exp Middle East/ 165854
34 (Bahrain or Bahrain$ or Kuwait or Kuwait$ or Saudi or Qatar or qatar$ or UAE or United Arab Emirates or Emirat$ or Oman or oman$ or Iran or Iran$ or iraq or iraq$, Egypt or eygpt$ or israel or israel$ or Palestine or palestin$ or Lebanon or

laban$ or jordan or jordan$ or syria or syri$ or yemen or yemen$ or turkey or turk$ or cyprus or cyprus$ or middle east or middle eastern or middle east$).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 380408
35 33 or 34 380408
36 or/1-11 2076885
37 26 and 32 and 35 and 36 2280
38 limit 37 to yr="2010 -Current" 1808
39 limit 38 to yr="2021 -Current" 707

Appendix 3 : Participants information sheet (Phase II) focus groups

University of Glasgow | College of Medical, Veterinary & Life Sciences

Nursing & Health care School

1. **Study title.**

Implementation of infection prevention and control (IPC) guidelines in Saudi Arabia

2. **Invitation**

You are being invited to take part in a research study that will be conducted by Zainab Awal, PhD candidate at the college of Medicine, Dentistry and Nursing at the University of Glasgow. Before you make a decision, you should know why the research is being conducted and what it will involve. Please take the time to read the following information and if you wish, discuss it with others. If there is anything that is not clear or if you want additional information, please contact us.

3. **What is the purpose of the study?**

This study aims to find out about the views and experiences of staff working in infection control teams to understand more about infection control polices and how these are put into practice and followed across hospitals.

4. **Why have I been invited to participate?**

You have been invited because we would like to talk to infection control members to hear their views and experiences on IPC guidelines and how these are implemented. Your views will help us know things that you think they help staff and things that stop them from practising infection control polices.

5. Do I have to take part?

No, it is up to you to decide whether or not to take part. If you decide to take part, please take the time to read this information sheet and we will ask for your consent before commencing discussions. Please note that you have the right to withdraw from the study at any time and without giving a reason. If you decide to withdraw, data collected up to the point of withdrawal will be included in the study analysis.

6. What will happen to me if I take part?

If you decide to participate in the study, you will be invited to take part in a focus group discussion with the researcher and other members of the infection control team working in your hospital. The discussion will be scheduled at a convenient time and date for you using an online platform, such as MS Teams. The discussion will focus on your views and experiences on IPC guidelines and the implementation of these guidelines. At the start of the focus group discussion, you will be asked to give a verbal consent expressing your willingness to take part and will be asked for some information including years of experience, and your professional group. This information will only be used to describe people who will participate in the study. It will not be possible to be identified.

7. What do I have to do?

You should give yourself enough time before deciding to participate. If you do want to participate, the researcher can be reached at the email/phone number listed below. After that, the researcher will contact you to discuss this information sheet and answer any questions you may have. You will be interviewed once, and the session will last for 60–90 minutes. There will be around 6 other people from the infection control team as well as the researcher and a note taker in each session. During the discussion, you will be asked about your perceptions and experiences of IPC guidelines and how these are implemented. There are no right or wrong answers. The session will be audio recorded, which will allow the researcher to transcribe (type up) what you have said so that the researcher can accurately capture your views and experiences. The audio recording will be destroyed after it has been typed up and checked for accuracy. It will be impossible to identify you in any reports or publications about the information provided.

8. What are the possible disadvantages and risks of taking part?

There are no expected drawbacks or risks associated with participating in this study. However, if you feel uncomfortable during the discussion and do not want to discuss something, please let the researcher know and will discuss whether you want to withdraw or continue.

9. What are the possible benefits of taking part?

There may be no direct benefits to you from this study. However, your views may help in maintaining compliance with IPC guidelines in hospitals.

10. Will my taking part in this study be kept confidential?

Yes, in accordance with the General Data Protection Regulation (GDPR) (2018), all information obtained during the study will be kept confidential. You will be given a unique identification number and won't be possible to identify you from this. we will ask you to keep everything that is said confidential.

11. What will happen to my data?

Only the researcher and the supervisors will have access to the data. The Data Protection Act 2018 will be followed. In accordance with the General Data Protection Regulation (GDPR) (2018), all information obtained during the study will be kept confidential. The names of the individuals or organisations involved in this study will not be mentioned; these will be replaced by ID codes identifiable only by the researcher. The discussions will be audio recorded and transcribed verbatim, any identifiable information (names) will be replaced by ID codes in the transcripts. Transcripts (typed copies of the discussion) will be kept electronically in a secure password-protected folder on a computer at the University of Glasgow that can be accessed only by the researcher. Your personal data will only be collected for the purposes of arranging the focus group and to send you a copy of the results if you wish one. Your personal data will be stored separately from other data to protect your privacy and will be retained until the completion of data collection when there is no need for further interviews or discussions. Personal data will be destroyed within two months of the study completion date as per the University of Glasgow's regulations.

All discussions will be audio recorded and transcribed for analysis. When the audio recordings have been transcribed, they will be destroyed, and the transcriptions will be kept in a secure password-protected folder on a computer that can be accessed only by the researcher. Audio files and transcriptions will not be transferred via email or a memory stick.

12. What will happen to the results of the research study?

The findings of this study will be written up as part of the researcher's PhD thesis and may be published in journals and presented at conferences. Your names will not be mentioned in any publication.

13. Who is organising and funding the research?

The research is organised by Zainab Awal, PhD student at University of Glasgow. The funding of this project is based on the researcher's scholarship from the Royal Embassy of Saudi Arabia's Cultural Bureau in London.

14. Who has reviewed the study?

The research has been reviewed by the local committee for research ethics at King Fahd Hospital in the eastern region and the University of Glasgow, College of Medical & Veterinary and Life Sciences Ethics Committee for none- clinical research.

15. Contact for further information

For further information please contact: Zainab Awal

Email: xxxxxxxx@student.gla.ac.uk Phone:

You can also contact: Clare Mcfeely (student supervisor)

Email: Clare.McFeely@glasgow.ac.uk

"Thank you for reading this information sheet"

Appendix 4: Participant information sheet (Phase III) Semi-structure interview

Nursing & Health care School

16. Study title.

Implementation of infection prevention and control (IPC) guidelines in Saudi Arabia

17. Invitation

You are being invited to take part in a research study that will be conducted by Zainab Awal, PhD candidate at the college of Medicine, Dentistry and Nursing at the University of Glasgow. Before you make a decision, you should know why the research is being conducted and what it will involve. Please take the time to read the following information and if you wish, discuss it with others. If there is anything that is not clear or if you want additional information, please contact us.

18. What is the purpose of the study?

This study aims to find out about the views and experiences of staff working in ICU and medical departments to understand more about infection control policies and how these are put into practice and followed across hospitals.

19. Why have I been invited to participate?

You have been invited because we would like to talk to healthcare workers who are working in ICU and medical departments to hear their views and experiences on IPC guidelines. Your views will help us know things that you think they help you and things that stop you from practising infection control polices.

20. Do I have to take part?

No, it is up to you to decide whether or not to take part. If you decide to take part, please take the time to read this information sheet and we will ask for your consent before commencing interviews. Please note that you have the right to withdraw from the study at any time and without giving a reason. If you decide to withdraw, data collected up to the point of withdrawal will be included in the study analysis.

21. What will happen to me if I take part?

If you decide to participate in the study, you will be invited to take part in an interview with the researcher. The interview will be scheduled at a convenient time and date for you. you will have the chance to choose between face-to-face interviews and telephone/online interviews. The interview will focus on your views and experiences on IPC guidelines. At the start of the interview, you will be asked to give a verbal consent expressing your willingness to take part and will be asked for some information including your clinical area that you work in (medical / ICU), and your professional group. This information will only be used to describe people who will participate in the study. It will not be possible to be identified.

22. What do I have to do?

You should give yourself enough time before deciding to participate. If you do want to participate, the researcher can be reached at the email/phone number listed below. After that, the researcher will contact you to discuss this information sheet and answer any questions you may have. The interview will then be scheduled at a time and date that is convenient for you. You will be interviewed once for no more than one hour, and each interview will be one to one between the participant and the researcher. During the interview, you will be asked about your perceptions and experiences of IPC guidelines and putting these into practice. There are no right or wrong answers. The interview will be audio recorded, which will allow the researcher to transcribe (type up) what you have said so that the researcher can accurately capture your views and experiences. The audio recording will be destroyed after it has been typed up and checked for accuracy. It will be impossible to identify you.

23. What are the possible disadvantages and risks of taking part?

There are no expected drawbacks or risks associated with participating in this study. However, if you feel uncomfortable and do not want to discuss something, please let the researcher know and will discuss whether you want to stop the interview or continue.

24. What are the possible benefits of taking part?

There may be no direct benefits to you from this study. However, your views may help in maintaining compliance with IPC guidelines in hospitals.

25. Will my taking part in this study be kept confidential?

Yes, in accordance with the General Data Protection Regulation (GDPR) (2018), all information obtained during the study will be kept confidential. You will be given a unique identification number and won't be possible to identify you from this.

26. What will happen to my data?

Only the researcher and the supervisors will have access to the data. The Data Protection Act 2018 will be followed. In accordance with the General Data Protection Regulation (GDPR) (2018), all information obtained during the study will be kept confidential. The names of the individuals or organisations involved in this study will not be mentioned; these will be replaced by ID codes identifiable only by the researcher. The discussions/interviews will be audio recorded and transcribed verbatim, any identifiable information (names) will be replaced by ID codes in the transcripts. Transcripts (typed copies of the discussion) will be kept electronically in a secure password-protected folder on a computer at the University of Glasgow that can be accessed only by the researcher. Your personal data will only be collected for the purposes of arranging the focus group and to send you a copy of the results if you wish one. Your personal data will be stored separately from other data to protect your privacy and will be retained until the completion of data collection when there is no need for further interviews or discussions. Personal data will be destroyed within two months of the study completion date as per the University of Glasgow's regulations.

All discussions will be audio recorded and transcribed for analysis. When the audio recordings have been transcribed, they will be destroyed, and the transcriptions will be kept in a secure password-protected folder on a computer that can be accessed only by the researcher. Audio files and transcriptions will not be transferred via email or a memory stick.

27. What will happen to the results of the research study?

The findings of this study will be written up as part of the researcher's PhD thesis and may be published in journals and presented at conferences. Your names will not be mentioned in any publication.

28. Who is organising and funding the research?

The research is organised by Zainab Awal, PhD student at University of Glasgow. The funding of this project is based on the researcher's scholarship from the Royal Embassy of Saudi Arabia's Cultural Bureau in London.

29. Who has reviewed the study?

The research has been reviewed by the local committee for research ethics at King Fahd Hospital in the Eastern region and the University of Glasgow, College of Medical & Veterinary and Life Science ethics committee for none- clinical research.

30. Contact for further information

For further information please contact: Zainab Awal

Email: xxxxxxxx@student.gla.ac.uk Phone:

You can also contact: Clare Mcfeely (student supervisor)

Email: Clare.McFeely@glasgow.ac.uk

"Thank you for reading this information sheet"

Appendix 5: (Phase II) Focus group guide for infection control teams

Nursing & Health care School

Title of project: Implementation of infection prevention and control guidelines in Saudi Arabia

Name of researcher(s): Zainab Awal

introduction

Good mooring/ afternoon and thank you for your time today. I am Zainab Awal and the interview today is to understand more about IPC guidelines and how these are implemented and adhered to at your hospital. The focus groups will also provide further insight into the barriers and facilitators to the implementation of IPC guidelines

Before we begin, can I check that you received the information about this study? Have you had time to read it? Would you like to ask any questions about the research? I would like to record the discussion today. This will help me to accurately record the information. The recording will only be available to myself and my supervisors. Are you happy for me to record this? I will start with recording your consent.

The information you share today is confidential. Your responses will be stored separately from any information about you and we will not share the information with anyone. When I report the information, we will take care to anonymise any quotes we use.

Perceptions

- Can you tell me about your role in the infection control team?
    - (Prompts - developing guidance, providing advice, supporting practice. Potential follow up questions - do staff engage with the guidance, do they request advice and if so, what is the nature of this?)

- Can you outline some of the infection control practices you expect to see in medical and ICU units?

- Should / do infection control practices differ between professional groups? (If difference, why do you think this is?)

Practice

- You regularly monitor infection control practice - how effective are your monitoring methods? (follow up: How do ensure you gain an accurate picture of practice?)

• What are the factors that contribute to the spread of infection in medical and ICU settings in your hospital? (follow up: Why do you think so?)

• What are the barriers to implementation of infection control guidelines?
o (prompts- What prevents or makes it difficult for employees to implement IPC measures such as hand hygiene/PPE/respiratory hygiene?)

- How compliant are health professionals working in medical and ICU settings in your hospital?

- Do you think compliance changes as a result of pandemics e.g SARS, MERS. COVID-19?

Do you think there is a difference in compliance between clinical areas? If yes, why do you think so and in which IPC measures?)

- Do you think there is a difference in compliance between clinical areas? If yes, why do you think that is?

- Can you tell me about the education and training (staff development) that takes place here to support infection prevention and control? (Prompts: Do HCWs receive appropriate training in the use of PPE and how often?)

- In relation to infection control, do you think there is anything else that I should include in my questions in future interviews?

- Is there anything you would like to add?

Closure

Thank you for your time today. Would you like to know about the study findings? If yes, how can we get that to you?

Appendix 6: (Phase III) Semi-structured interview guide for healthcare workers

University of Glasgow | College of Medical, Veterinary & Life Sciences
Nursing & Health care School

Title of project: Implementation of infection prevention and control guidelines in Saudi Arabia

Name of researcher(s): Zainab Awal

Healthcare workers (one to one interviews)

Introduction

Good morning/ afternoon and thank you for your time today. I am Zainab Awal and the interview today is to hear about your experiences and views towards IPC guidelines and it will help to provide further insights into any potential barriers to and facilitators of the implementation of these in medical and ICU settings in Saudi hospitals.

Before we begin, can I check that you received the information about this study? Have you had time to read it? Would you like to ask any questions about the research? I would like to record the interview today. This will help me to accurately record the information. The recording will only be available to myself and my supervisors. Are you happy for me to record this? I will start with recording your consent.

The information you share today is confidential. Your responses will be stored separately from any information about you, and we will not share the information with anyone. When I report the information, we will take care to anonymise any quotes we use so that it will not be possible to identify anyone from the quotes used.

Perceptions

- can you tell me about your experiences of healthcare-associated infections'?
  - (prompt - did they include staff becoming infected in this?
  - if yes, can you mention an example, did you get involved?)

- What do you think are the major infection problems in your department?
  (Prompts – how frequent is this, what factors do you think spread this?)

- What factors contribute to the spread of infection in your ward / department?

- (Prompt - What do you think caused that?) e.g *invasive procedures, VAP, Central line,,*
- *Medical ward: folly's catheter?*

- Can you tell me about what guidance you have here on infection control?

    - (Prompts – is it national/local guidance? How evidence based it is? How do you learn about or find out about what guidance is available? How do you access this? How often you access this?)

Is there a link nurse in your department? Do you get any guidance related to IPC from her?

Lets talk about hand washing, when is this necessary?
There are mixed views about washing hands after you remove gloves – what do you think of that?"

- Can you tell me about other infection control practices (standard precautions) in the area you work in?
    - (Prompts - do you think that HCWs have a good understanding of the importance of hand hygiene- the importance of PPE? respiratory hygiene and safe disposal of sharps/ waste?

Can you tell me about managing waste? Are there any specific practices there?" Prompt if needed "What about separating waste?"

"There is an expectation that you will establish a sterile field for catheterisation, wound dressing etc – is that always necessary? Why? Why not? Can you maintain a sterile field in the clinical area? Why / why not?
(Prompts: is there anything that makes it difficult for you?)

Did you receive any training on infection control? Was this useful / adequate?

- Can you tell me what your thoughts are on compliance with these practices from your experience?
    - (Prompts - what makes you say this? Are some measures/guidelines easier to comply with than others? Why is this? (or why not?) what are the advantages of performing these measures/ Are there disadvantages of preforming some of these)

- What prevents or make it difficult for you to perform IPC measures?
    - (Prompts- what prevents or make it difficult for you to perform hand hygiene/ PPE/ respiratory hygiene/ safe disposal of sharps and waste/ sterilisation or disinfection)

- What helps or motivates you to perform IPC measures?

  - (Prompts- What helps or motivates you to perform hand hygiene/ PPE/ respiratory hygiene/ safe disposal of sharps and waste/ sterilisation or disinfection

- What is the influence of other colleagues' perceptions and practices, what is the influence of adequate training, is there support for implementing guidelines across the hospital and department or is this lacking, what about time, workload and staff shortages etc?

- Have you worked during a pandemic (MERS, SARS, Covid19)? If yes, do you think that had any impact on infection control practice in your area?
  - (prompts- how did this affect your practice?)

- In relation to infection control, do you think there is anything else that I should include in my questions in future interviews Is there anything you would like to add?

- Thank you for your time today. Would you like to know about the study findings? If yes, how can we get that to you?

Closure

Thank you for your time today. Would you like to know about the study findings? If yes, how can we get that to you?

Appendix 7: Privacy notice

Privacy notice for project

Implementation of infection prevention and control guidelines in Saudi Arabia

Your personal data

The University of Glasgow will be the 'data controller' of your personal information processed from the interviews and any further personal data divulged during our research with you. This privacy notice will describe how the University of Glasgow will process your personal information.

Why we need it

Your basic personal data will be collected such as name, email address in order to contact you and arrange a suitable time and date for the interview/discussion. Thereafter, through interviews, additional personal information will be collected such e.g. years of experience nationality, age, gender, highest educational level and your professional group. The participants will have the chance to choose between face-to-face interviews and telephone interviews/online interviews (via Zoom /Teams). All of the interviews will be audio recorded.

Legal basis for processing your data

The lawful bases for research processing are generally Article 6(1)(e) for personal data and Article 9(2)(j) for special category.

What we do with it and who we share it with.

The staff at the University of Glasgow in the United Kingdom will process all of the personal data we gather for/from you (i.e. name, email address, telephone numbers). Your personal data will be kept electronically in a secure password-protected folder on a computer at the University of Glasgow. Your personal data will be stored separately from data you provide in the interviews/focus groups. Only members of the research team will have access to your personal data. Your personal data will not be shared with anyone outside the research team.

How long do we keep it for?

Your personal data (i.e. name, email address, telephone number) will be retained by the University for two months after your last contact with the researcher, data will be securely deleted after this time. Additional anonymised personal data including years of experience and your professional group collected during the study will be treated as research data and will be retained for a minimum of 10 years after the end of the study as per University policy.

What are your rights?

You can request access to the information we process about you at any time. If at any point you believe that the information we process relating to you is incorrect, you can request to see this information and may in some instances request to have it restricted, corrected or, erased. You may also have the right to object to the processing of data and the right to data portability. If you wish to exercise any of these rights, please submit your request via the webform or contact dp@gla.ac.uk.

Complaints

If you have a concern about how we treated your personal data, please contact the University Data protection Officer who will investigate the matter. Our Data Protection Officer can be contacted at dataprotectionofficer@glasgow.ac.uk

If you are not satisfied with our response or believe we are not processing your personal data in accordance with the law, you can complain to the Information Commissioner's Office (ICO) https://ico.org.uk/.

Appendix 8: Consent Form for focus groups

University of Glasgow | College of Medical, Veterinary & Life Sciences

Participant Identification Number for this trial:

Title of Project: Implementation of infection prevention and control guidelines in Saudi Arabia

Name of Researcher(s): Zainab Awal

CONSENT FORM

	Please initial box
I confirm that I have read and understood the Participant Information Sheet version 1 dated 25/05/2021.	☐
I confirm that I have read and understood the Privacy Notice version 1 dated 25/05/2021	☐
I have had the opportunity to think about the information and ask questions, and understand the answers I have been given.	☐
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected.	☐
I confirm that I agree to the way my data will be collected and processed and that data will be stored for up to 10 years in University archiving facilities in accordance with relevant Data Protection policies and regulations.	☐
I understand that all data and information I provide will be kept confidential and will be seen only by study researchers and regulators whose job it is to check the work of researchers.	☐

I agree that my name, contact details and data described in the information sheet will be kept for the purposes of this research project. ☐

I understand that if I withdraw from the study, my data collected up to that point will be retained and used for the remainder of the study. ☐

I agree to take part in the study. ☐

I agree to my focus group being audio recorded. ☐

I understand that my information and things that I say in a focus group may be quoted in reports and articles that are published about the study, but my name or anything else that could tell people who I am will not be revealed. ☐

I understand that I should respect the privacy and maintain confidentiality of the others in the group and that I should not disclose any of the discussion outwith the group itself. ☐

I agree for the data I provide to be anonymously archived in the UK data archive or other approved archiving facilities, and that other researchers can have access to this data only if they have scientific and ethical approval, and agree to preserve the confidentiality of this information as set out in this form. ☐

_____ _____ _____

Name of participant Date Signature

_____ _____ _____

Name of Person taking consent Date Signature

(if different from researcher)

_____ _____ _____

Researcher Date Signature

(1 copy for participant; 1 copy for researcher)

Appendix 9: Consent Form for healthcare workers

University of Glasgow | College of Medical, Veterinary & Life Sciences

Participant Identification Number for this trial:

Title of Project:
Implementation of infection prevention and control guidelines in Saudi Arabia

Name of Researcher(s): Zainab Awal

CONSENT FORM

	Please initial box
I confirm that I have read and understood the Participant Information Sheet version 1 dated 25/05/2021.	☐
I confirm that I have read and understood the Privacy Notice version 1 dated 25/05/2021.	☐
I have had the opportunity to think about the information and ask questions, and understand the answers I have been given.	☐
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected.	☐
I confirm that I agree to the way my data will be collected and processed and that data will be stored for up to 10 years in University archiving facilities in accordance with relevant Data Protection policies and regulations.	☐
I understand that all data and information I provide will be kept confidential and will be seen only by study researchers and regulators whose job it is to check the work of researchers.	☐

I agree that my name, contact details and data described in the information sheet will be kept for the purposes of this research project. ☐

I understand that if I withdraw from the study, my data collected up to that point will be retained and used for the remainder of the study. ☐

I agree to take part in the study. ☐

I agree to my interview being audio recorded. ☐

I understand that my information and things that I say in an interview or focus group may be quoted in reports and articles that are published about the study, but my name or anything else that could tell people who I am will not be revealed. ☐

I agree for the data I provide to be anonymously archived in the UK data archive or other approved archiving facilities, and that other researchers can have access to this data only if they have scientific and ethical approval, and agree to preserve the confidentiality of this information as set out in this form. ☐

Name of participant Date Signature

Name of Person taking consent Date Signature

(if different from researcher)

_____ _____ _____

Researcher Date Signature

(1 copy for participant; 1 copy for researcher)

Appendix 10: Ethical Approval from IRB in Saudi Arabia

IRB KFHH No. (H-05-HS-065)
اللجنة المحلية لأخلاقيات البحث العلمي بمستشفى الملك فهد بالهفوف
مستشفى الملك فهد بالهفوف
King Fahad Hospital Hofuf
التجمع الصحي بالأحساء
Al-Ahsa Health Cluster

Date: **04-04-2021 / 22-08-1442**

Subject: **Exempted Approval of Research Proposal**

KFHH RCA NO: **07-E-2021**

Research Title: "**Implementation of infection prevention and control guidelines in Saudi Arabia**"

To:

Principal Investigator	Title/Position	Organization
ZAINAB ABDUALLH AWAL [redacted]829	Nursing, PhD student	University of Glasgow

Referring letter of Dr. CLARE MCFEELY, Lecturer, Nursing & Health Care, University of Glasgow, IRB-KFHH **APPROVES** your application study with title: (**Implementation of infection prevention and control guidelines in Saudi Arabia**), for data collection: Secondary data analysis, focus groups and Interviews in [redacted], Mixed method (qualitative and quantitative).

keeping in view that, it is for the purpose of completion of your PhD degree, not as purpose of publication in research journals.

It is to be informed, that this collected information will not be used for any publication purpose, in any print media.

This is for your kind information and necessary action please.

MOHD Y.AL-YOUSEF

Dr. FATIMA HUZAM AL OTAIBI
Consultant, Rheumatologist
Head of IRB
Director of Academic Affairs & Research Administration
King Fahad Hospital Hofuf, Al Ahsa, Kingdom of Saudi Arabia

HASA-KFHH-RESEARCH@MOH.GOV.SA
013/5753121 - EX: 2973

IRB KFHH No. (H-05-HS-065)
اللجنة المحلية لأخلاقيات البحث العلمي بمستشفى الملك فهد بالهفوف
مستشفى الملك فهد بالهفوف
King Fahad Hospital Hofuf
التجمع الصحي بالأحساء
Al-Ahsa Health Cluster

Date: **31-05-2021**

Subject:**RESEARCH PROPOSAL APPROVAL LETTER (Expedited Review Process)**

KFHH RCA NO: **10-EP-2021**

Research Title: **"Implementation of infection prevention and control guidelines in Saudi Arabia".**

Principal Investigator	Title/Position	Organization
ZAINAB ABDUALLAH AWAL	PhD student - Nursing	University of Glasgow

Type of Research	Purpose of Research	Research Specialty	Sites of Research
Epidemiological research	Health Research Purpose For Publication	Infection Control	[redacted]

Sample Size	Study Design
• First phase (anonymized documents from the hospitals) (200 docs) • Second phase (online focus groups) 14 participants • Third phase (healthcare workers) 24 participants	Retrospective review of the file & medical records

It is my pleasure to bring to your benign notice that above said research proposal was reviewed through expedited review process and has been **APPROVED** for future proceedings.

Government hospitals involved in this research will not provide any financial support in your research.

This is for your kind information and necessary action, please.

MOHD Y. AL-YOUSEF

Dr. FATIMA HUZAM AL OTAIBI

Consultant, Rheumatologist

Head of IRB

Director of Academic Affairs & Research

King Fahad Hospital Hofuf, Al Ahsa, Kingdom of Saudi Arabia

HASA-KFHH-RESEARCH@MOH.GOV.SA
013/5753121 - EX: 2973

Appendix 11: Ethical approval from the university of Glasgow

4th August 2021

MVLS College Ethics Committee

Project Title: Implementation of infection prevention and control guidelines in Saudi Arabia
Project No: 200200149

Dear Dr McFeely

The College Ethics Committee has reviewed your application and has agreed that there is no objection on ethical grounds to the proposed study. It is happy therefore to approve the project.

- Project end date: As stated in application.
- The data should be held securely for a period of ten years after the completion of the research project, or for longer if specified by the research funder or sponsor, in accordance with the University's Code of Good Practice in Research: (http://www.gla.ac.uk/media/media_227599_en.pdf)
- The research should be carried out only on the sites, and/or with the groups defined in the application.
- Any proposed changes in the protocol should be submitted for reassessment, except when it is necessary to change the protocol to eliminate hazard to the subjects or where the change involves only the administrative aspects of the project. The Ethics Committee should be informed of any such changes.
- You should submit a short end of study report to the Ethics Committee within 3 months of completion.

Yours sincerely,

Jesse Dawson
MD, BSc (Hons), FRCP, FESO
Professor of Stroke Medicine
Consultant Physician
Clinical Lead Scottish Stroke Research Network / NRS Stroke Research Champion
Chair MVLS Research Ethics Committee

Institute of Cardiovascular and Medical Sciences
College of Medical, Veterinary & Life Sciences
University of Glasgow
Room M0.05
Office Block
Queen Elizabeth University Hospital
Glasgow
G51 4TF

jesse.dawson@glasgow.ac.uk

Appendix 12: Ethical approval from hospital A

[redacted] شبكة Network

وزارة الصحة Ministry of Health | برنامج التحول الوطني 2020 | رؤية 2030 vision

Eastern Health Cluster تجمع الشرقية الصحي

شبكة صحة القطيف

إدارة الشؤون الأكاديمية والتدريب

[redacted].sa

8361000 – ex: 54154

التاريخ: ١٤٤٢/١٢/١٨هـ

المرفقات:

من	رئيس لجنة أخلاقيات البحث العلمي د /[redacted]
إلى	رئيس قسم الباطنيه – العنايه المركزه – الجراحه - مكافحة العدوى - السجلات الطبية المحترمين
الموضوع	تمكين باحث

السلام عليكم و رحمة الله و بركاته

زينب اوال **ماجستير تمريض** سعودية

نفيدكم بأنه تم مناقشة طلب المذكورة أعلاه بإجراء دراسة تحت عنوان:

Implementation of infection prevention and control guidelines in Saudi Arabia

[redacted]SREC0 282 /2021)

وتمت الموافقة عليه من قبل لجنة أخلاقيات البحث العلمي لدينا بالمستشفى حيث أنه تم توقيع الباحثة على سرية البيانات .

نأمل تمكين المذكورة أعلاه من إجراء البحث وتزويدها بالمعلومات المطلوبة ما أمكن على أن لا يتأثر سير العمل لديكم ..

علماً بأن فترة تجميع البيانات لمدة ٣ أشهر .

ولكم جزيل الشكر

013 - 8361000 @E1_QCH ER-HOS-QCH@MOH.GOV.SA

Appendix 13: Ethical approval from the hospital B

DHN

[redacted]

IRB

Approval Letter

Category of Approval: Expedited or Full Board
IRB Reg: H-05-D-107

Dear Ms. Zainab

[redacted] IRB is pleased to inform you that submission dated 08/08/2021 for the study mentioned below was approved.

Date	01/09/2021		
Protocol Number	NUR-01		
Protocol Title	Implementation of infection prevention and control guidelines in the Eastern province, Saudi Arabia		
Principal Investigator	Zainab Abduallh Awal		
Email		Mobile	0
Affiliation		Department	Nursing
Sponsor/Funding	Royal Embassy of Saudi Arabia		
Documents Reviewed with Version number and date (if applicable)	Application Form for General Research V2, Research Proposal Form V3, CV, GCP Certificate, Questionnaire, Informed Consent form V2		

Decision

[redacted] IRB has **approved** the protocol after careful review. Approval is given for **one year** from the date of this letter. This is to confirm that [redacted] IRB operates in accordance with NCBE regulations and ICH GCP E6 R2.

Approval Conditions

- The Principal Investigator or one of the co-PIs should be presently employed at Dammam Health Network (DHN). This is required for access to the DHN premises, patients, clinical samples, medical records & existing database.
- Abide by the rules and regulations of the Government of Saudi Arabia, NCBE, DMC IRB and the ICH-GCP guidelines.
- To conduct research as per the approved documents.
- Research participant confidentiality should be protected at all times.
- All researchers are required to have current and valid certificate on Protecting Human Research Participants (GCP).
- In case of any amendment to the approved documents, the Principal Investigator is required to request the IRB approval before implementation.
- You are required to submit a Progress Report every **3 months** (In case of Clinical trials) / **1 year** (in case of other types of research).
- If the research is not completed within the 1 year approval period, PI will be required to request extension letter from the IRB one month before the expiry of the approval.
- Document Retention: all study documents should be kept by the Principal Investigator for a period of **5 years** from study completion.
- This letter gives you an ethical clearance to implement your study according to the approved documents and you still need to obtain administrative approval from the site/s where the study will be conducted.

Appendix 14: (Phase III) Semi-structured interview guide for healthcare workers

University of Glasgow | College of Medical, Veterinary & Life Sciences
Nursing & Health care School

Title of project: Implementation of infection prevention and control guidelines in Saudi Arabia

Name of researcher(s): Zainab Awal

Healthcare workers (one to one interviews)

Introduction

Good morning/ afternoon and thank you for your time today. I am Zainab Awal and the interview today is to hear about your experiences and views towards IPC guidelines and it will help to provide further insights into any potential barriers to and facilitators of the implementation of these in medical and ICU settings in Saudi hospitals.

Before we begin, can I check that you received the information about this study? Have you had time to read it? Would you like to ask any questions about the research? I would like to record the interview today. This will help me to accurately record the information. The recording will only be available to myself and my supervisors. Are you happy for me to record this? I will start with recording your consent.

The information you share today is confidential. Your responses will be stored separately from any information about you, and we will not share the information with anyone. When I report the information, we will take care to anonymise any quotes we use so that it will not be possible to identify anyone from the quotes used.

Perceptions

- can you tell me about your experiences of healthcare-associated infections'?
    - (prompt - did they include staff becoming infected in this?
    - if yes, can you mention an example, did you get involved?)

- What do you think are the major infection problems in your department?
  (Prompts – how frequent is this, what factors do you think spread this?)

- What factors contribute to the spread of infection in your ward / department?
    - (Prompt - What do you think caused that?) e.g *invasive procedures, VAP, Central line,,*
    - *Medical ward: folly's catheter?*

- Can you tell me about what guidance you have here on infection control?

    - (Prompts – is it national/local guidance? How evidence based it is? How do you learn about or find out about what guidance is available? How do you access this? How often you access this?)

- Is there a link nurse in your department? Do you get any guidance related to IPC from her?

- Lets talk about hand washing, when is this necessary?
- There are mixed views about washing hands after you remove gloves – what do you think of that?"

- Can you tell me about other infection control practices (standard precautions) in the area you work in?
    - (Prompts - do you think that HCWs have a good understanding of the importance of hand hygiene- the importance of PPE? respiratory hygiene and safe disposal of sharps/ waste?

    - Can you tell me about managing waste? Are there any specific practices there?" Prompt if needed "What about separating waste?"

    - There is an expectation that you will establish a sterile field for catheterisation, wound dressing etc – is that always necessary? Why? Why not? Can you maintain a sterile field in the clinical area? Why / why not?
      (Prompts: is there anything that makes it difficult for you?)

- Did you receive any training on infection control? Was this useful / adequate?

- Can you tell me what your thoughts are on compliance with these practices from your experience?
    - (Prompts - what makes you say this? Are some measures/guidelines easier to comply with than others? Why is this? (or why not?) what are the advantages of performing these measures/ Are there disadvantages of preforming some of these)

- What prevents or make it difficult for you to perform IPC measures?
    - (Prompts- what prevents or make it difficult for you to perform hand hygiene/ PPE/ respiratory hygiene/ safe disposal of sharps and waste/ sterilisation or disinfection)

- What helps or motivates you to perform IPC measures?
    - (Prompts- What helps or motivates you to perform hand hygiene/ PPE/ respiratory hygiene/ safe disposal of sharps and waste/ sterilisation or disinfection
- What is the influence of other colleagues' perceptions and practices, what is the influence of adequate training, is there support for implementing guidelines across the hospital and department or is this lacking?

- Have you worked during a pandemic (MERS, SARS, Covid19)? If yes, do you think that had any impact on infection control practice in your area?
    - (prompts- how did this affect your practice?)

- In relation to infection control, do you think there is anything else that I should include in my questions in future interviews Is there anything you would like to add?

- Thank you for your time today. Would you like to know about the study findings? If yes, how can we get that to you?

Closure

Thank you for your time today. Would you like to know about the study findings? If yes, how can we get that to you?

Appendix 14: Summary of coding descriptions (phase 1)

Codes	Description of code meaning	Example of evidence/ quotation
Workload	The influence of heavy workload on the practice of HCWs	“long working hours, heavy workload and low nurse–patient ratio. These factors not only had reduced their motivation, but also had affected their ability to implement VAP preventive measures”.(Atashi et al., 2018)
Reminders	Putting some advertisements such as posters to remind the staff of the behaviours	“They need to put up advertisements especially LEDs everywhere” (P#8; Par#3), Messages on desktop computers, tracts, and brochures posted in various parts of the hospital can be good reminders of this behaviour (P#14; Par#8). (Ghaffari et al., 2020)
Shortage of staff	Shortage of staff restricts their compliance with IPC	“Lack of time to wash hands would require adjusting workforce schedules; however, due to lack of medical staff and especially nursing staff in Egypt, it is not likely that hospital management is able to lessen the workload of the nurses in the near future”(Lohiniva et al., 2015)
Accessibility of supplies	Lack of supplies or facilities including soap, alcohol rub and sinks	“Three-quarters of respondents said it was difficult to access protective equipment, such as gloves, aprons, and face protection. One nurse said, “More personal protective equipment should be available.” (Salem and Youssef, 2017)
Lack of organization	Supplies exist but are not organised	“The reasons for difficult access included lack of organization as the person responsible for the storage was not always available and/or alcohol gel bottles were located at the far end of the ward. (Lohiniva et al., 2015)

Quality of products	The quality of the products affects compliance	“The better quality the soap, the less allergic it is and the better stuff it has, the more comfortably the nurses will use it” (Ghaffari et al., 2020)
Monitoring process and its difficulties	Monitoring is important but supervisors face difficulties which result in ineffective monitoring	“Supervision is a significant factor behind performance improvement. It helps ensure the accurate performance of tasks. However, our participating nurses and nursing managers noted that they had no adequate time for supervision, received no supervision-related training and had limited knowledge and skill for effective supervision”. (Atashi et al., 2018)
Feedback	Feedback on the performance of infection control measures at an individual level can affect compliance	“Some participants stated that all health care providers should be empowered and mandated to remind or provide feedback to hospital staff observed not washing their hands, regardless of seniority and discipline”.(Salem and Youssef, 2017)
Negative feedback	The influence of negative feedback on the performance of IPC precautions from leaders	“I was washing my hands at all times and my name was reported just because I forgot to perform hand hygiene once. I was not praised when I was doing well but I was punished when I made a mistake only once.’ (Ng, Shaban and van de Mortel, 2017)
Positive feedback	Positive feedback from leaders	“According to the participants, reinforcement and reward can enhance nurses’ motivation for taking VAP preventive measures” (Atashi et al., 2018).
Organisational culture	The practice of healthcare workers at the workplace is influenced by the organisational culture which includes leadership and the work environment	“The respondents affirmed that the culture is influenced by the leadership of the organization. If you do not have the culture, you can have the best education programme in the world, but it will not be taken up at all if it is not supported by the leaders”.(Salem and Youssef, 2017)

Beliefs	Different beliefs on the different forms of HH inform their preferences	“They perceived that traditional handwashing was costly and less time effective than alcohol-based hand rubbing, as stated: "Handwashing consumes water and hand towels" (Allied Health 1); "Handwashing requires more time than alcohol-based hand rubbing" (Allied Health 2)(Khuan, Shaban and van de Mortel, 2018)
Hands dryness	Some products make hands dry and lead to skin issues	“we use too much liquid and our skin gets irritated and this all plays a role”.(Ghaffari et al., 2020)
Hand hygiene preferences for patients	Preferences of the form of HH for patients	“I have not heard my colleagues complaining that they don’t prefer alcohol-based hand rubbing" (Nurse 2). (Khuan, Shaban and van de Mortel, 2018)
Importance of hand hygiene	Hand hygiene is important for some HCWs but still there are people who consider it less important	“It is very important to see hand washing as a primary priority”(Ghaffari et al., 2020)
Personal beliefs	Beliefs of HCWs on the importance of IPC precautions based on their religion and morals	“They noted that nobody performs an action without having strong belief and positive attitude towards it. Consequently, they were not accustomed to assign high priority to some nursing care measures, because they did not consider them as vital” .(Atashi et al., 2018)
Danger for HCW and others	HCWs perform hand hygiene when they deal with infected patients, and they need to protect themselves and others	“The participants agreed that by implementing the requirements of Standard Precautions in their daily practice they are protected. A nurse working in an internal medicine ward said "... they can protect me [the Standard Precautions] ... I have read a lot about them [protective equipment] and I am confident that I am well protected." The term protection was not only limited to their own protection but also to their families' as well” .(Efstathiou et al., 2011)
Education and training	Education and training on infection control are inadequate	“Furthermore, they received no training in the use of PPE. 'I have not received proper training on PPE.' (P1: paediatrics consultant)”(Paul et al., 2020)

Frequency of education	Regular education is recommended	“The hospital also held annual seminars on HAIs for nurses and physicians. The participants felt that all HCWs should take part in regular workshops/seminars every three months and hands-on training in hand hygiene techniques, use of PPE, and blood spill management”. (Paul et al., 2020)
Quality of education	Quality of education should be assessed to improve quality of care	“ there were no effective evaluations for assessing the effectiveness of the programmes in improving nurses’ performance”.(Atashi et al., 2018)
Type of education	Different ways of teaching about IPC precautions are recommend	“All interviewees recommended ongoing support and training through seminars, and the introduction of audiovisual aids and case study approaches. Some participants suggested the use of actual patient case studies. “I do believe real case studies are what people remember,” one nurse said”.(Salem and Youssef, 2017)
Knowledge and awareness	HCWs’ knowledge and awareness on all IPC precautions	“respondents in several discussions mentioned their concern about catching airborne infections or blood-borne pathogens due to needle-stick injuries, but believed that hand hygiene had little effect on protecting them against those infections.(Lohiniva et al., 2015)
Awareness of Healthcare-associated infections (HAIs)	Awareness and knowledge of HAI	“Participants had some idea of the definition of HAIs, their significance, and their different types, such as central line catheter-associated infections, catheter-associated urinary tract infections, ventilator-associated pneumonia, and surgical site infections. 'My understanding is that they are infections transmitted or acquired by a patient as a result of being in the hospital.(Paul et al., 2020)
knowledge on the importance of HH	Some HCWs have knowledge deficit regarding the necessity of HH	“Moreover, some participants did not adhere to the principles of hand hygiene despite acknowledging its importance to patient health. I know the great importance of hand hygiene; yet, I usually do not follow the guidelines. You know, if I want to strictly follow the guidelines, I should spend half of my time on hand washing. I do not wash my hands unless I find them really

		contaminated, because I believe that infection is not transmitted as easily as they say. (Atashi et al., 2018)
Knowledge on waste management	Some HCWs have lack of knowledge in relation to waste management	“Many participants were unaware of the process of hospital-generated waste management or the management of blood and chemical spills. Nurses tended to have a better idea than doctors and junior residents, as they often deal with blood spills using a blood spill kit”.(Paul et al., 2020)
HH practice is routine	The practice of hand hygiene become a routine as it was traditionally performed.	“Lifestyle, personality, and organisational culture, as other classes derived from this article, play a key role in hand washing behaviour. Family education, workplace rules and regulations, and a culture of hand hygiene can help promote this behaviour. On the other hand, the experience of performing the behaviour must become a habit, otherwise the intention to perform the action will lose its importance for the person. (Ghaffari et al., 2020)
Nurse's Compliance	Compliance of nurses compared to other health professionals	“However, the nurses doing the procedures in comparison demonstrated an impeccable handwashing technique before starting the sterile procedure”.(Paul et al., 2020)
Hand Hygiene when using Gloves	The necessity of hand hygiene when wearing gloves	“Many respondents believed that hand hygiene between touching patients was not a necessity when they wore gloves”.(Lohiniva et al., 2015)
Hand hygiene between patients	Performing hand hygiene before the start of a procedure or between touching the patients is a new behaviour in some hospitals/ departments	“The new behaviour norm that had come to be accepted was to perform hand hygiene measures before the start of a procedure such as giving medication to all patients of the ward. The norm had become so well established that respondents believed that it was in accordance with the hospital policy that in fact required hand hygiene between touching patients”. (Lohiniva et al., 2015)

Physicians' compliance	Physicians' compliance with hand hygiene policies	"Most of the residents performed hand washing for less than 30 s. They, however, did not follow the five moments of hand hygiene, as advocated by the World Health Organization (WHO) before commencing a sterile procedure".(Paul et al., 2020)
PPE compliance	HCWs are not using PPE as required	"Participants believed that the use of PPE is restricted to isolation rooms and ICUs. Furthermore, they received no training in the use of PPE". (Paul et al., 2020)
Feeling not clean	Doing hand hygiene when dealing with specific patients including bad mannered patients.	"handwashing was a behaviour that enabled them to achieve cleanliness: "I prefer using water and soap because this will give a feeling that I am clean" (Nurse 1).(Khuan, Shaban and van de Mortel, 2018)
Practice of leaders, supervisors and consultants	When HCWs witness the practice of others particularly those in higher positions, their practice can be affected positively.	"when my top rank does a certain thing, I do too. Also, if I think that the head nurse, although she recommends hand hygiene but does not practice this behaviour herself, this behaviour of her will have a deterrent effect for me and others like me" (Ghaffari et al., 2020)
Visible dirt	HCWs tend to clean their hands when their hands are dirty.	"As long as hand washing was not enforced by doctors and there was no visible dirt on their hands, nurses were unlikely to comply with hand hygiene guidelines".(Lohiniva et al., 2015)

Appendix 15: Summary of coding description (phase 2)

Codes	Description of code meaning	Example of evidence/ quotations	Focus group
1. Daily IPC tasks	Tasks that infection control members do everyday	ICN8: I do daily rounds, observation of patient dressings. I check the patients results and I isolate patients based on the that. If the results are not available, the patient will be isolated. Otherwise, they will be isolated based on transmission-based precautions. I also observe standard precautions including hand hygiene.	FG2
2. Hand hygiene	hand hygiene compliance	ICN7: Observing infection control practices like standard precautions and hand hygiene ICN8: The HCWs are also not compliant to hand hygiene but I believe this is an issue that exists all around the world.	FG2 FG2
3. Hand hygiene after removing gloves	hand hygiene non-compliance after removing gloves	ICN1: I feel there is a misunderstanding about wearing gloves. When HCWs wear gloves, they do not wash their hands after removing them. They feel safe and are under the protection of the glove and the glove will keep their hands clean. We are now focusing a lot on hand hygiene after removing the glove. we emphasise on the importance of this step and it is part from the five moments of hand hygiene that must be adhered to, through the annual basic skills training session.	FG1
4. Challenges associated with HH device	When HCWs used some methods to improve HH, there were not effective	ICN7: actually, we didn't continue using it because of some challenges especially when the sensor become weak under the gown, but I know that some hospitals got really good results when they continue using this device.	FG2

5. Waste management	Waste management practices	ICN8: For the waste management, the staff is confused because of the regular updates regarding this matter. ICN2: No, many people still do not doon and doff the PPE properly. you have mentioned the most important problems that we suffer from in ICUs and medical departments, and they include hand hygiene, putting on and taking off PPE, and separating waste.	FG2 FG1
6. Additional tasks of IPC team in the ICU	IPC team who works for ICU do some additional tasks	ICN1: for example, surveillance and observation. In the intensive care department, we must do surveillance and collect data so that we can detect health care-related infections and to monitor patients who have invasive devices such as a ventilator, central line catheter, and urinary catheter. We should also monitor patients after surgery for surgical site infection.	FG1
7. Non-compliance	Practices of non-compliance with standard precautions	ICN6: so, the moment that doesn't include direct contact with patient is always missing or neglected. So, HCW doesn't consider that her/ his hands are dirty and that she can transfer any infection to the patient when they enter patients' rooms. However, they always think that the patient will transmit infections to her/him, so they are doing hand hygiene to protect themselves first.	FG2
8. Doctors' compliance	Doctors and surgeon compliance with IPC	ICN6: I would say all doctors are considered the least adherence to infection control practices.	FG2

	precautions e.g. HH and PPE		
9. Time	non-compliance among doctors because of the time pressure	ICN6: I think doctors are not complaint because they deal with critical patients and bedridden patients so, they always in a hurry	FG2
10. Non-compliance among surgeons	Practices of non-compliance among surgeons	ICN1: Surgeons are committed to precautions inside the operating rooms, and when they leave the operating rooms, they do not apply any of them.	FG2
11. Compliance comparison	Some professional groups considered more compliant than others	ICN1: Surgeons are committed to precautions inside the operating rooms, and when they leave the operating rooms, they do not apply any of them.	FG2
12. Radiologist compliance	Some of the IPC members think that some radiologists are not complaint	ICN7: there are some of radiologists who are not complaint. I can see them leaving the radiology department with their gloves on. ICN8: yes, some of them put on the PPE in the radiology department and then enter another department with the same PPE. ICN6: they use the same PPE when they deal with different patients using their portable device. So, if they are going to two patients in one department, they would use the same PPE because they want to protect themselves not the patient. So, they can transmit infections from one patient to another.	FG2 FG2 FG2
13. Protecting themselves	Radiologists protect themselves	ICN6: they use the same PPE when they deal with different patients using their portable device. So, if they are going to two patients in one department, they would use the same PPE because they want	FG2

		to protect themselves not the patient. So, they can transmit infections from one patient to another. ICN7: they feel that they can protect themselves better when they do it this way. They are not aware of the number of organisms they would carry and transfer from their department, the elevators, walls, and doors.	FG2
14. Compliance in the ICU	The potential reasons of HCWs compliance in the ICU	ICN8: there is a strict protocol for the ICU department. So, the staff are obligated to follow. It is not optional. whether they agree/ disagree with that protocol, it should be followed.	FG2
15. Patient nurse ratio	Nurses' compliance with IPC is influenced by patient nurse ratio	Moderator: Do you mean that the patient's condition determines the extent to which the health staff adheres to precautions? Or is this due to the awareness of the health staff about precautions? ICN1: I think there are several influencing factors, namely: the staff's knowledge is an influential factor, the patient's condition, the ratio of the nurse to the patient is another factor, also the available supplies are an influential factor. There are many influencing factors, but the most influential is the ratio of nurse to patient because this represents work pressure. In addition to that is the patient's condition, for example, when there is a patient who is immunocompromised, he needs more care, so the nurses focus on him, because the patient's condition is critical. The department head	FG1

		also takes into consideration the patient's condition and the nurse's competence when assigning the nurses.	
16. Awareness of IPC policies	Infection control polices in medical and ICU are clear and the implementation of them is good	Moderator: Can you outline some of the infection control practices you expect to see in medical and ICU units? ICN2: droplet or contact precautions. Nurses have the competence to apply these precautions, except in some cases where the type of the precaution is not clear. We have clear policies that contain the names of diseases and the precautions to be followed based on the type of disease. Also it includes the isolation period required for each disease. For example, when we ask them to put the patient under contact precautions, they immediately do the following: they put the sign for appropriate type of precaution, they specify the type of PPE.	FG1
17. Awareness of IPC policies in medical wards	The staff in the medical wards are aware of the IPC policies and apply them	ICN2: This also happens in the medical departments. When we visit the departments, we see that they have put some patients in single rooms and put the appropriate precautions for it.	
18. New staff	Hiring new staff and assigning them in one unit	ICN8: also, when hiring a new group of HCWs at the same time and they assign all of them in one department, usually we experience outbreaks during that time.	FG2

19. Trainees	Interns and students from different disciplines	ICN6: well, I think the average of hand hygiene compliance is not zero neither 100. I mean we didn't reach the target but there are things that need to be considered which affect the compliance. For example, we are not only dealing with HCWS, but there is also a huge number of trainees from different disciplines, and patients watchers.	FG2
20. Patients' watchers	Relatives who stay with patients during hospitalisations contribute to the spread of infections	ICN6: Patients' watchers is a challenge by itself so, that person goes to hospital's supermarket and the cafeteria, then comes back to the patient's room. Whatever we tried to teach them, there are no benefits. Often, these will accompany patients in triple bedrooms with other patients. So, the environment of the hospital can contribute to infections and these things are out of our control. In addition, the culture plays a major role.	FG2
21. Culture	The impact of patient's culture as well as the HCWs culture	ICN6: So, the environment of the hospital can contribute to infections and these things are out of our control. In addition, the culture plays a major role. Moderator: what do you mean by culture here? ICN6: like when the patients visit each other without considering the IPC precautions. I have seen post-op patients who sit or visit others, and they may didn't have a shower for 3 days. They can spread or get infections.	FG2
22. shortage of supplies	Shortage of supplies as a factor that contributes to the spread of infections	ICN8: most of the time, the main cause is shortage of supplies even before the pandemic.	FG2

23. shortage of supplies during the pandemic	Experiences of shortage of supplies during the pandemic	ICN1:.Yes, there was a shortage of almost all supplies, and the hospital administration had to provide these materials from the hospital's budget.	FG1
24. workload	Staff experience workload because of shortage of staff	ICN7: In addition, there was shortage in staff and workload. Some of them were dealing with many critical conditions and has no time to change their PPE before they go to the next patient.	FG2
25. Shortage of staff	Shortage of staff caused an outbreak	ICN7: regardless of the pandemic, we always have shortage of supplies or shortage of staff which causes a spread of infection. We had an outbreak of MDR before the emergence of COVID, still I think these are the main causes.	FG2
26. Training	The available training sessions for HCWs on infection control	ICN6: the training that is specific to IPC is BICSL (basic infection control licence skills). We offer this annually.	FG2
27. orientation programmes	the orientation programme is provided for the new staff	ICN7: the orientation programme that given to the new hired staff focuses on infection prevention. It includes hand hygiene, the use of PPE, spill kit, standard precautions and waste management, fit test. And they are the same components that is provided by BICSL annually.	FG2

Appendix 16: Summary of coding descriptions (phase 3)

Codes	Description of code meaning	Example of evidence/ quotations
1. Appreciation	Appreciation motivates staff to be compliant	" there is no appreciation, they even did not give us thank you letters". (RN12, Medical ward, Site B).
2. Assistant nurses	Bringing assistant staff to help nurses	"we have an assistant nurse so if there will be more of them and they come in different shifts, it will be really good because the assistant can do for example the bed making so the one that we have now only attend morning shift and she goes out a lot so, we do the bed making and we send samples…" (RN19, Medical ward, Site B
3. Male nurses	Male nurses provide assistance	"There was a difference, not just for me but for all the nurses because he was the only male nurse here. He was doing things that we used to go around different departments to find an available male nurse to do certain things for us. We wish if we have one in our department, he can do many things for us". (RN12, Medical ward, Site B).
4. Awareness	Awareness of staff regarding IPC practices	"Um-ah also we have the knowledge, if the staff doesn't have the sufficient awareness like she had a procedure that was clean and then she has a sterile

Codes	Description of code meaning	Example of evidence/ quotations
		procedure so she has to be sterile and here she may have insufficient knowledge". (RN20, Medical ward, Site B, Senior Nurse).
5. Awareness on waste management	Awareness of staff regarding waste management	Not everyone is aware, there are staff especially the new staff are not aware of these guidelines, I see that they do not separate the waste, or maybe they know the guidelines, but they do not have time to separate". (RN14, ICU, site A).
6. Cleaners' awareness	Cleaners' awareness of IPC practices	"The other thing is the cleaners. They have a big role in spreading infections, because the come and wipe the table using the same towel they used for many tables and maybe even the wiped the floor using that towel and they do not even wash it. They just want to do their work. Even when there is blood on the floor, it is known that they should use the spill kit but they do not, they just use the towel and they use the mop that they used for the toilets and everywhere. So, they do not use the kit". (RN15, Medical ward, Site B, Senior Nurse).
7. Communicating updates	Interprofessional communication	"we should always work as teamwork and communicate well with each other, we should all work together like the infection control nurse, doctors, nurses and RT, to know how to fill the gap, some people feel frustrated if they found there is a new thing that they do not know about because they do not communicate well with us, they should make a group". (RN6, ICU, Site B).

Codes	Description of code meaning	Example of evidence/ quotations
8. Annual leaves	The staff annual leaves and their performance at work	"For the annual leaves, everyone is worried because of this new version of covid, the omicron. So, they want to take their annual leaves before they close the opportunity to have again". (RN9, ICU, Senior nurse, Site B)
9. Exhausted	Being tired and exhausted is a cause of non-compliance	"And we were working during the hot weather and wearing the PPE and sometimes we do a procedure like the central line for an hour or two inside the patient room so of course we become exhausted". (RN17, ICU, Site A).
10. Duration of procedures	Some procedures take longer than the anticipated time	"I think when the procedure takes long time, so at the start of the procedure you can see everyone is compliant but then little bit not much break in sterility will happen, but I think it will not be like the caution at the start of the procedure". (RN4, ICU, Site B).
11. life saving	Emergency situation and staff adherence	"Also, this infections can happen during a code and we are giving a breathing, I mean during the CPR. Even during chest compression, we usually very close to the patient. Sometimes we know that the patient has covid or something else but he is in critical situation and there is no time to put on the PPE". (RN10, Medical ward, Site B).

Codes	Description of code meaning	Example of evidence/ quotations
12. Obese patient	Obese patients require an assistant to apply IPC practices	"sometimes the patient is heavy, and it is hard to handle and do the dressing alone um-ah so some of the sterility will be broken here so that can affect it. And I said if there is a staff that can help me, one that can hold the patient and one do the dressing and cleaning in a sterile and correct way, this will also affect but if I'm alone and doing the dressing for obese patient then I just want to do it and finish regardless of the way". (RN16, ICU, site B).
13. shortage of supplies	shortage of supplies in ICUs and medical wards	" Sometimes we do not have all the supplies. Sometimes we don't have sterile gloves or gauze. So you know what I mean, we can't do a proper aseptic technique without these. limited resources are out of our hand". (RN1, Medical ward, site A).
14. Guidance during shortage of supplies	The role of infection control during shortage of supplies	" the infection control department knows about that and they are responsible for these and aware that we do not have them and they should find the alternative". (RN12, Medical ward, Site B).
15. Proximity of supplies	Perceptions on accessibility of supplies	"The most important thing is the supplies like when I was working in the private hospital, there was a sink in each room and in the medication room and the station so this is really good". (RN18, Medical ward, Site B).

Codes	Description of code meaning	Example of evidence/ quotations
16. Quality of products	quality of some products are bad which affects their compliance	"we have another issues like with the gloves, now they are low quality so it can tear in the mid of the procedure so this is considered a source of infection. The quality of the equipment really affect us like the gloves and the gowns". (RN17, ICU, Site A).
17. Causes of HAIs in ICUs	factors that expose patients to acquire infections in the ICUs	" in the ICU most often that the patients do not have peripheral line and have a central line and intubated so they can get the infections easily". (RN14, ICU, site A).
18. Compliance after COVID	staff became more compliant after COVID	"I see the staff is better after covid and there is like obsession, we are just missing the supplies. I think the staff are better now even compared to the period before covid. With covid, the obsession to keep everything clean become among all the staff". (RN10, Medical ward, Site B).

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