
**Adherence to International and National
Recommendations for the Prevention of Surgical Site
Infections in Elective Surgery at Two Tertiary Hospitals in
Oman**

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Abstract

Surgical site infections are the most common healthcare acquired infections among surgical patients. The lives of surgical patients who develop surgical site infections are characterised by prolonged hospital stays and increased morbidity, mortality and increased medical healthcare costs. Consequently, it is recommended that surgical team staff should adhere to specific recommendations and practices to prevent surgical site infections. The risk of contracting surgical site infections depends on surgically related factors such as the duration of one's pre-operative hospital stay, the use of antibiotics in surgery, pre-operative skin preparation with an appropriate antiseptic, the use of aseptic techniques, preoperative hair removal with clippers, and reducing of human traffic flow in operating theatres. In addition to this, patient related factors such as nutritional status, obesity, age, and underlying illnesses like diabetes mellitus are other potential sites of risk. The present study aims to both comprehensively assess adherence to existing guidelines, and compare current preoperative strategies with evidence-based guidelines for the prevention of surgical site infections. Findings from quantitative research underscore that, although perioperative healthcare providers follow the surgical site infection prevention guidelines, they do not fully adhere to current recommended practices. More specifically, findings indicate a lack of adherence to preventative guidelines for surgical site infection, such as duration of antibiotic prophylaxis, preoperative hair removal of the patient with the use of razors (which is no longer recommended), preoperative showering without the use of proper antiseptic agents, and use of incorrect preoperative skin cleaning techniques during the preparation of the incision site. Furthermore, this study identifies issues concerning adherence to other measures recommended intraoperatively, including, frequent opening of the operating room door and movement of people in the operating room during surgical procedures, having higher numbers of surgical team staff in the operating room than required for most surgical procedures, the wearing of jewellery in operating theatres, improper usage of surgical masks and caps, as well as using personal mobile phones in operating rooms. The results of this study show that adherence with infection control recommendations in the operating theatre need to be carefully monitored, and risk factors that contribute to health care professionals' non-adherence with recommended practices also need to be identified to improve the quality of routine surgical practice for the safety of the surgical patient.

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List of Abbreviations

Abbreviations	Title
ACE	Academic Centre for Evidence-Based Practice Star Model
APIC	Association for Professional in Infection Control and Epidemiology
ARCC	Advancing Research and Clinical Practice through Close Collaboration
CDC	Centres for Disease Control and Prevention
CS	Caesarean Section
DM	Diabetes Mellitus
EBP	Evidence-Based Practice
GCC-CIC	Gulf Cooperation Council Centre for Infection Control
HCAIs	Healthcare Associated Acquired Infections
NCIs	Nosocomial infections
HCARE REC	School of Research Ethics Committee
HCWs	Health Care Workers
HCPs	Healthcare Professionals
HIS	Healthcare Information System
HTN	Hypertension
ICU	Intensive Care Unit
IPC	Infection Prevention and Control
JHNEBP	Johns Hopkins Nursing Evidence -Based Practice Model
LRTI	Lower Respiratory Tract Infections
MDROs	Multidrug Resistant Organisms
MOH	Ministry of Health
MOI	Ministry of Information
MRSA	Methicillin Resistant Staphylococcus Aureus
NICE	National Institute for Health and Clinical Excellence
NS	Not Significant
OR	Operating Room
OT	Operating Theatre
PPE	Personal Protective Equipment
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis

RCTs	Randomised Control Trials
RERAC	The Research and Ethical Review and Approvals Committee
RRESC	The School's Research Review and Ethics Screening Committee
SD	Standard deviation
SPSS	Statistical Package for Social Science Research
SSI	Surgical Site Infection
STROBE	The Statement Strengthening the Reporting of Observational Studies in Epidemiology
UAE	United Arab Emirates
UK	United Kingdom
UP	Universal Precautions
USA	United States of America
UTIs	Urinary Tract Infections
VAP	Ventilator-Associated Pneumonia
WHO	World Health Organization
HRQoL	Health-Related Quality of Life
Hrs	Hours
COPD	Chronic Obstructive Pulmonary Disease
VAP	Ventilator Associated Pneumonia
CAUTI	Catheter Associated Urinary Tract Infection

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Chapter One:

Introduction and Context of the Study

1. Chapter One: Introduction and Context of the Study

1.1 Thesis Organisation

This thesis consists of eight chapters. A brief precis for each is included below.

Chapter One: Introduction and Context of the Study

This chapter serves as an introduction to the study. It provides the underlying rationale for the study, outlines the problem to be investigated, delineates the aims of the study, and maps out the research questions. Moreover, this chapter provides an overview of surgical site infections (hereafter abbreviated as SSIs), illustrates the extent of the problem, as well as the impact of SSIs, pathogenesis of SSIs, mode of transmission, and pathophysiology. Finally, this chapter presents a typology of SSIs and contributing risk factors for SSIs to stress the historical significance of the study.

Chapter Two: Profile of Oman

Chapter 2 provides a detailed description of the Sultanate of Oman, centred around its location, political and economic status in the sultanate of Oman, [culture of Oman](#), healthcare system and occurrence of SSIs among surgical patients in Oman.

Chapter Three: Literature Review

This chapter consists of a critical literature review of extant research, which provides the evidence base for the present study. The chapter begins by explaining the literature search strategy, before proceeding to explore literature, which investigates adherence to international and national recommendations for the prevention of SSIs, and qualitative research that explores the manifold factors affecting this non-adherence. [This chapter also explores the cultural and linguistic diversity](#)

in health care. This chapter concludes by stating the research questions and showing how these have emerged out of gaps in extant research.

Chapter Four: Methodology

Chapter 4 outlines the methodology of the study, encompassing the theoretical framework, research design, demographics of the participants, recruitment procedures, data collection, inclusion and exclusion criteria, data management, ethical considerations and issues related to rigour. Furthermore, the chapter addresses at length the adopted methodology, explicating specifically why mixed methods research is appropriate for the present study and what potential benefits can be obtained from using this approach.

Chapter Five: Pilot Study

Chapter 5 focuses on the methodology of the small-scale pilot study, which was carried out to test the feasibility of the observation schedule and to ensure that the interview guide was suitable for capturing the required data. Finally, this chapter highlights potential problems with the data collection tools.

Chapter Six: Findings of the Quantitative Study

Chapter 6 reports the findings of the quantitative study on preoperative and intraoperative infection control practices for the prevention of SSIs. This chapter discusses the findings on routine nursing and medical procedures related to preoperative patient preparation and intraoperative infection control practices, in conjunction with data on general demographics, basal clinical features of patients and characteristics of surgical procedures.

Chapter Seven: Findings of the Qualitative Study

Chapter 7 reports the findings pertaining to the current infection control practices for the prevention of SSIs, as well as the perceived obstacles to adhering to evidence-based guidelines. The chapter examines the following themes in detail: knowledge of infection control and accessibility of clinical practice guidelines; integration of evidence-based guidelines in practice; strategies for preventing SSIs; and perceived barriers to implementing key recommendations from selected guidelines.

Chapter Eight: Discussion and Conclusion

Chapter 8 unpacks the main findings of the thesis and compares these with extant literature and evidence-based guidelines. Moreover, it delineates the key implications for clinical practice, education and future research. Finally, the chapter addresses limitations, and concludes the report on the study.

1.2 Introduction and Background of the Study

Healthcare associated infections (hereafter abbreviated as HCAs) are deemed the most common medical problems that threatening the health of patients (Fan et al. 2014). SSIs are wound infections that ordinarily occur either in 30 days of invasive procedures (Ahmed et al. 2012; Spagnolo et al. 2013), or up to one year after surgery in the case of patients who have implants (Bjerknes et al. 2014; Owens and Stoessel 2008) and affecting either the incision or deep tissue at the operating site (Singh et al. 2014). Findings from several studies show that SSIs are one of the most common postoperative complications affecting patients who undergo surgery and the most common type of healthcare acquired infections (Jan et al. 2010), which causes approximately 14% to 17% of all HCAs and currently account for 38% of nosocomial infections (hereafter abbreviated as NCIs) (Ahmed et

al.2012; Mulu et al. 2002; Spagnolo et al. 2013; Malone et al. 2002; Elola-Olaso et al. 2011). Hence, identifying and applying evidence-based practice (hereafter abbreviated as EBP) which can aid in the minimisation of SSIs is an important clinical objective (Anthony et al. 2011). In this respect, several studies have outlined general risk factors for SSI, ranging from the main patient-related (endogenous risk factors) to procedure-related (external risk factors) that influence the risk of SSI (Rao et al. 2011; Spagnolo et al. 2013). Although SSI is one of the most common HAIs, it is nevertheless one of the most avoidable complications stemming from surgery (Young et al. 2011). Consequently, the Centres for Disease Control and Prevention (hereafter abbreviated as CDC) have devised comprehensive range of evidence-based guidelines during preoperative, intraoperative and postoperative periods for the prevention of SSIs (CDC 2011; WHO 2016). Whilst it is well-established that SSI is multifactorial, healthcare workers (hereafter abbreviated as HCWs) play a critical role in the prevention of factors related to surgical procedures during both preoperative patient preparation and intraoperative care (Oliveira and Gama 2015).

Both international and national guidelines, and some literature by Durando et al. (2012); Davis et al. (2008) and Oliveira and Gama (2015), have proposed preoperative and intraoperative measures for the prevention of SSIs. Some of these measures include minimising the length of preoperative hospital stays, preoperative bathing or showering with skin antiseptics (chlorhexidine solution), avoiding shaving altogether or, if necessary, doing so with clippers, quality of preoperative skin preparation with an appropriate antiseptic, optimal usage of antibiotic prophylaxis, wearing of surgical attire and controlling and reducing traffic flow in ORs (CDC 2011; Durando et al. 2012; Oliveira and Gama 2015). Considering this, finding direct scientific evidence that conclusively demonstrates that proper implementation of these measures during preoperative and intraoperative care restricts the pathogenesis of SSI and modification of these risk factors will,

ultimately, lead to a minimisation in SSIs (Moucha et al. 2011; Oliveira and Gama 2015). Although the critical importance of these measures is extensively discussed in international guidelines and literature, there is a relative dearth of studies evaluating the application of preoperative and intraoperative practices for the prevention of SSI in elective surgery worldwide (Durando et al. 2012). More specifically, there are hitherto no studies assessing how international and national recommendations of preoperative and intraoperative procedures for the prevention of SSI are applied in surgical practices in Oman. Resultantly, the present study aims to evaluate adherence to SSI prevention guidelines by HCWs in Oman, and to examine perceived barriers to the implementation of evidence-based guidelines for the prevention of SSI. Subsequently, the results will be compared to other studies and evidence-based guidelines.

1.3 Statement of the Problem

Postoperative wound infection is an infection that can occur post-surgery (CDC 2010). Despite implementation of best practice measures during pre- and intraoperative periods, SSIs continue to occur during surgical procedures (Manian 2014). Thus, adherence to proper perioperative infection control practices while providing care for surgical patients is essential to minimise hospital acquired infections. It is estimated that 1.7 million HCAs occur every year, whilst SSIs alone account for 290.000 of total HCAs and approximately 8.000 deaths (Tsai and Caterson 2014). Evidently, infections related to surgical procedures are a universal problem, and SSI is one of the most common infections related to health care (Allegranzi et al. 2011). Historically, surgical outcomes were poor up until the early nineteenth century, with the major risk factor being SSIs (Humes and Lobo 2009). It is estimated that 3% to 5% of all patients undergoing surgery will acquire an SSI (Anderson et al. 2010; Singh et al. 2014). The most common HCAs are SSIs, such as urinary tract infections (hereafter abbreviated as UTIs) and lower respiratory tract infections (hereafter abbreviated as LRTIs). However, of these, SSIs are one of the more notable risks deriving from any surgical procedure

(Mater 2014). For example, SSIs are one of the most common complications after intra-hospital invasive surgery procedures across the world, particularly in developing countries (Bellusse et al. 2014; Fan et al. 2014). It thus constitutes a major issue, as postoperative wound infection is the most common cause of nosocomial infection, accounting for 77% of deaths (Gouvea et al. 2015). Whereas, 40-60% of SSIs are thought to be preventable (Rafati et al. 2014).

Consequently, the CDC introduced the term 'SSI' to distinguish infection deriving from a surgical incision from an infection stemming from a traumatic wound (Reyes et al. 2011). The estimated 500,000 SSIs contracted in the United States (hereafter abbreviated as US) annually represent the second most common infection among surgical patients, and prolong hospitalisation by 7-10 days (Awad 2012; Diaz and Newman 2015). The prevalence of HCAs in the United Kingdom (hereafter abbreviated as UK) is similar to that of the US. In the UK, there are approximately 300,000 HCAs contracted annually (Cherry et al. 2012). As aforesaid, SSI is one of the most common HCAs; however, it is also potentially the most avoidable complication stemming from surgery (Young et al. 2011). Hence, agencies like CDC (2011), the Association for Professional in Infection Control and Epidemiology (hereafter abbreviated as APIC), the National Quality Forum, the National Institute for Health and Clinical Excellence (hereafter abbreviated as NICE) clinical guidelines on prevention of treatment of SSIs (CDC 2011; Leaper et al. 2013; Diana et al. 2011) and the Gulf Cooperation council Centre for infection control (hereafter abbreviated as GCC-CIC) have all established infection control measures aimed at preventing SSIs. Using CDC (2013) and GCC-CIC (2014) guidelines, the present study assesses adherence to international and national recommendations for the prevention of SSIs. Strict adherence to correct infection control preventive measures while providing care for surgical patients in operating theatres (hereafter abbreviated as OTs) and surgical wards is essential for minimising infection. Therefore, surgical team staff were encouraged to use infection control evidence-based practices. Moreover, it is important that surgical team staff be informed about the

best available EBP, as well as keeping their knowledge of evidence-based guidelines up-to-date. For the purposes of this study, adherence is defined as the ability of HCWs to comply with recommended evidence-based infection control guidelines to prevent infections among surgical patients. In addition to this, adherence to antibiotic guidelines was defined as using antibiotics in accordance with clinical diagnosis and local guideline recommendations (Khalili et al. 2012). Hitherto, no studies have evaluated how preoperative and intraoperative infection control procedures for the prevention of SSI are applied in surgical practices in Oman. Hence, the present study aims to both comprehensively assess current preoperative and intraoperative strategies for prevention of SSI, and to compare their application with respect to evidence-based guidelines for the prevention of SSIs.

1.4 Pathogenesis of Surgical Site Infections

Contamination occurs during the perioperative period, whilst the haematogenous spread of microbes occurs after perioperative care and is associated with primary bacteraemia or infection at the incision site (Greene 2012). It has been found in the literature that pathogens that may cause wound infection are acquired either endogenously from the patient's own flora present on skin or from opened viscus or exogenously from contact with operative room personnel or the environment (Singh et al. 2014). In this sense, it is understood that SSI is caused by microorganisms introduced into the incision site at the time of the operative procedures (Kirby and Mazuski 2009). It is found that most SSIs are associated with gram-positive organisms that are part of the normal skin flora, including *Staphylococcus Pyogenes*, *Methicillin Resistant Staphylococcus Aureus* (hereafter abbreviated as MRSA), *Enterococcus*, as well as gram-negative organisms such as *Pseudomonas Aeruginosa*, *Enterobacter* and *Klebsiella* (Greene 2012; Rubin 2006; Joyce and Lakshmidevi 2009;

Spy 2013). The presence of a biofilm also plays a critical role in the pathogenesis of SSIs post-surgery (Greene 2012; Lepelletier et al. 2013; Quinn et al. 2009).

1.5 Mode of Transmission and Pathophysiology of Surgical Site Infections

SSIs result from an interaction of microorganisms in a health care setting, a compromised host and a chain of transmission (Spy 2013). Such Infection occurs when microorganisms are introduced through the surgical incision as a result of bacteria or fungi migrating from the patient's skin or gastrointestinal tract (hereafter abbreviated as GI) like microflora (endogenous infection), or direct transfer from surgical instruments, hands of healthcare professionals via the airborne route (exogenous infection) (Harrington 2014). When microbes enter the wound the incision site becomes contaminated and develops SSI (Harrington 2014). In other cases, bacteria can enter the body and travel via the bloodstream, or deposits on prosthetic implants can also be the source of infection (Harrington 2014).

1.6 The Impact of Surgical Site Infections on patient outcomes

Postoperative infectious complications such as SSI may have negative impact on patient health-related quality of life (hereafter abbreviated as HRQoL) (Badia et al. 2017). There is some evidence to support that SSIs are a major cause of morbidity and mortality, associated with extended length of postoperative hospital stays, higher medical costs, and jeopardised health outcomes (Anderson 2014; Diaz and Newman 2015; Junker et al. 2012; Lipke and Hyott 2010; Nabor et al. 2015). Additionally, distress may also be caused to the surgical patient and family members if the patient is admitted to hospital for a long time (Badia et al. 2017). Similar findings have been reported by other studies, which showed that patients who developed SSI are twice as likely to die, 60% more likely to spend time in an intensive care unit (hereafter abbreviated as ICU), and up to five times

more likely to be re-admitted to hospital (Kirkland et al. 1999). SSIs occur in the surgical site after surgical procedures and have a harmful effect on patients' subsequent treatment. Indeed, approximately 5% of patients undergoing open surgery develop an SSI (Leaper et al. 2013; NICE 2008). Therefore, the impact of SSIs should not be underestimated (Kirkland et al. 1999; Nessim et al. 2012), as they ultimately have a significant effect on a patient's postoperative outcomes (NICE 2008). Indeed, SSIs can present life-threatening post-surgery complications, and patients who develop an SSI are more likely to spend an additional 7 to 10 days in hospital (NICE 2008). SSI remains a significantly complicated problem in postoperative patients (Al Maqbali 2016). However, SSIs are preventable in most cases of elective surgery if evidence-based guidelines are stringently followed. Therefore, it is recommended that HCWs should adhere to proper perioperative infection control measures as part of a critical step towards preventing SSIs.

1.7 Categories of Surgical Site Infections

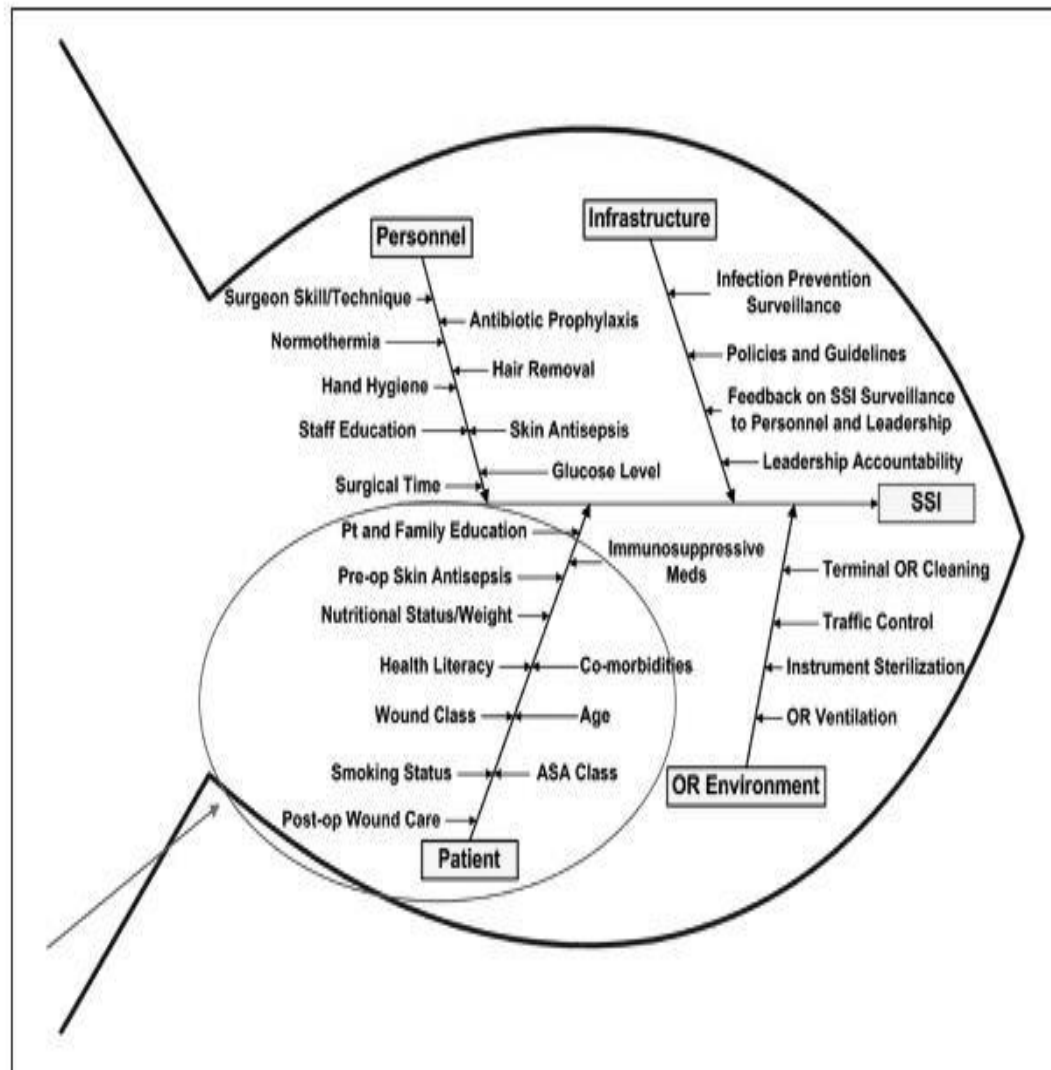
Surgical wounds are classified into four groups consisting of clean (class I), clean contaminated (class II), contaminated (class III) and dirty procedures (class IV) (Philips et al. 2014). Clean surgical procedures are where there is no infection or inflammation present. In this class, the risk of developing an SSI is below 2% (Zinn 2013). The second class of clean/contaminated surgical procedures characterise those procedures in which the gastrointestinal (GI), respiratory and urinary tracts are entered under controlled circumstances and no infection is encountered (Zinn 2013). The risk of SSI ranges from 5% to 15% in surgeries involving this type of wound class (Zinn 2013). In the contaminated class, surgical procedures that are open, accidental fresh wounds or a major break in sterile technique can all lead to the presentation of acute inflammation. The risk of SSI is greater than 15% in surgeries included in the contaminated class (Zinn 2013). The final dirty/infected class

involves old traumatic wounds, and the risk of SSI in this type of surgery accounts for up to 30% of all HCAs (Zinn 2013).

1.8 Contributing Risk Factors for Surgical Site Infections

The literature underscores manifold risk factors for SSIs in surgical patients. Surgical procedure factors are divided into two groups: patient related risk factors and surgical procedures risk factors. Several patient-related risk factors have been associated with the onset of SSI, such as pre-existing infections, malignant disease, diabetes mellitus (hereafter abbreviated as DM), trauma, shock, hypothermia, hyperglycaemia, obesity, malnutrition, hypoxia, immune deficiency, old age, smoking, and respiratory insufficiency (Apisarnthanrak et al. 2003; Barbosa and Silva 2012; Barnes 2015; Cheadle 2006; Florman and Nichols 2007; Lepelletier et al. 2013; Mangram et al. 1999; Reyes et al. 2011). Similarly, surgical procedures factors include such measures as reduction in the length of preoperative hospital stay, use of personal protective equipment (hereafter abbreviated as PPE), careful prepping and draping for surgical procedures, avoiding removal of patient hair, or, if absolutely necessary, being done outside of the OR using clippers, bathing with antiseptic agents, appropriate preoperative antibiotic prophylaxis administration, skin antisepsis, restricting the movement of personnel and reducing traffic flow in Operating rooms (hereafter abbreviated as ORs), clean surgical scrubs, sterile technique and wearing of surgical attire (Barnes 2015; CDC 2011; Davis et al. 2008; Durando et al. 2012; Harrop et al. 2012; Lepelletier et al. 2013; Mangram et al. 1999; McHugh et al. 2014 ; Oliveira and Gama 2015; Sanchez-Arenas 2010). The contributing factors of SSIs are presented in figure 1. The understanding of HCWs about the risk factors that affecting the incidence of SSI in elective surgery may contribute to the quality of care provided to surgical patients and minimise the risk of infection (Fusco et al., 2016).

Figure 1: Diagram Showing Factors Affecting the Risk of Developing a Surgical Site Infections (Edmiston and Spencer 2014).



1.9 Aims of the Study and Research Questions

The study aims to investigate the current preoperative and intraoperative infection control practices for SSIs, and to identify the manifold factors associated with noncompliance to recommendations.

The specific research questions are:

- What is the level of adherence of HCWs to international and national guidelines for preventing SSI during elective surgery in surgical wards and OTs in Oman?

- What are the factors determining the uptake and utilisation of SSI prevention guidelines during elective surgery in Oman?

1.10 The Specific Objectives of the Study

This study is guided by the following objectives:

1. To assess the length of preoperative hospital stays in patients undergoing elective surgery.
2. To evaluate the appropriateness of antibiotic prophylaxis selection, the timing of administration and duration of specific surgical procedures in two hospitals.
3. To assess the application of preoperative antiseptic skin preparation in relation to SSI prevention guidelines.
4. To evaluate whether hair removal is carried out in accordance with SSI prevention guidelines.
5. To determine adherence to preoperative showering or bathing in elective surgery in relation to SSI prevention guidelines.
6. To monitor the OTs' traffic pattern (doors opening during surgery and number of OT personnel present during surgical procedures).
7. To investigate factors underpinning non-adherence to SSI preventive guidelines.

1.11 Significance of the Study

Given that there are as yet no empirical studies which have investigated adherence to guidelines specifically in Oman, the findings of this study have critical significance in terms of enabling surgical team staff to practice evidence-based guidelines and, in turn, provide best practice for surgical patients. Moreover, the findings of this study could also contribute to enabling OTs to improve their compliance to infection control guidelines for surgical infections in OTs, as well as aiding the

identification of gaps between current application and international and national guidelines. Finally, a better understanding of the potential disjuncture between evidence-based guidelines and current practices may contribute to improved perioperative surgical patient care.

1.12 Chapter Conclusion

This introductory chapter has provided a broad overview of the genesis of the thesis, and has specified its manifold aims and objectives. This chapter has also sketched-out an outline of the thesis, by providing a broad overview of both the scope of the problem and contributing risk factors for SSIs. The next chapter provides background socio-economic and political information about the specific research site of Oman.

Chapter Two:

Profile of Oman

2. Chapter Two: Profile of Oman

This chapter intends to provide some important contextual information about Oman. More specifically, the chapter explains details about geography, population, political and economic situation and health care services in Oman.

2.1 Background on Oman

Oman is located in the south-eastern corner of the Arabian Peninsula, bordering Saudi Arabia (hereafter abbreviated as KSA), United Arab Emirates (hereafter abbreviated as UAE) and Yemen (Figure 2) (MOH 2016, WHO 2010). The total landmass of the Sultanate of Oman comes to approximately 3,165 thousand square kilometres (MOH 2015a). The Sultanate is composed of varying topographic areas, consisting of plains, wadis (dry river beds), highlands and mountains (MOH 2015a). Most of the country is either desert or barren land with mountains. Moreover, the weather differs from one area to the next; during the summer, it is hot and humid in the coastal areas and hot and dry in the interior region (MOH 2015a). The coastal plains overlooking the Gulf of Oman and the Arabian Sea form the most important plains, amounting to 3% of the total landmass along with sand and desert which account for 82% of the total area, while the mountains make up the remaining 15% of the total area (WHO 2006). The Sultanate of Oman is administratively divided into 11 Governorates, which are further divided into 61 Wilayat (MOH 2015a). According to the census, the population of Oman was around 4,550,538 at the end of 2016 (MOI 2016), of which around 2,325,982 (50.1%) were Omani citizens and 1,892,143 (49.9%) expatriates (Times of Oman 2017). It is also a young population; between 14.9% and 35.7% of the population are under 5 and 15 years respectively, whilst only 6% are 60 and over (MOH 2015a).

Figure 2: Geography of Oman, Adapted from Omanid (2013)



2.2 Political and Economic Situation in the Sultanate of Oman

Oman is a middle-income economy that is heavily dependent on depleting oil resources and gas exports, which provide up to 76% of government revenues, with agriculture, fishing, industrial activity and services making up the rest (Strolla 2013). In fact, Oman does not have the same amount of oil resources as its neighbours in the UAE and KSA, not to mention that the extraction cost of oil is higher in Oman. At present, Oman is encountering fundamental economic challenges. Most

notably, its population is increasing while its oil reserves are decreasing. Despite this, the Omani economy has benefited from the fact that global oil prices have remained high over the last few years (Katz 2004). Whilst Oman's economy is currently primarily based on oil income, the Sultanate's policies have nevertheless consistently focused on creating appropriate conditions for investment, providing infrastructure and developing national manpower to help stimulate the economy and, in turn, solidify the Sultanate's position (Strolla 2013). Consequently, any changes in the Omani economy are crucially important, which goes some way to explaining why this matter is taken so seriously by policy makers (Al Saqri 2013).

Oman, under the leadership of His Majesty Sultan Qaboos bin Said, has an altogether stable political, economic and social system and good relationships with neighbouring countries (WHO 2010). The political situation in Oman is extremely stable, and this geopolitical stability helps to support different aspects of the country including health care development (MOH 2014a). As a result, leadership and governance in the Oman health care system have been able to manage resources and revenues to the great benefit of the overall health of the Omani people (MOH 2014a). The Government of Oman, through the Ministry of Health (hereafter abbreviated as MOH), has a health policy based upon providing basic principles of comprehensive public and health services to its population through primary health care (MOH 2014a).

2.3 Culture in Oman

Oman is an Islamic and Arabic country with manifold cultural and social contexts (Al Shafae 2001). Omani culture is based on Islamic traditions, beliefs and cultural norms, which play an integral role in people's lives (Al Busaidy and Borthwick 2012). Oman is unique in the sense that it is made up of people from different cultures and ethnic backgrounds, including Baluchi, Zanzibari and South Asian (Al-Zadjali et al., 2015; Safari and Globe 2014). Consequently, working with culturally diverse people in Oman can raise potential conflicts and misunderstandings between HCWs and their patients. Although in Oman people have the freedom to practice any religion, Islam and Islamic jurisprudence constitute the principal sources of legislation (Peterson 2004). Arabic language is the predominant medium of communication in Oman, but there are other indigenous languages used, including English, Urdu, Hindi, Baluchi and Swahili (Al-Zadjali et al., 2015). Despite Oman's official language being Arabic, many Omani people are able to speak English, particularly in healthcare facilities. According to Al-Zadjali et al. (2014), Islam informs both the culture and people's lifestyles in Oman. For instance, in Oman female healthcare providers and patients prefer to wear headscarves and long-sleeved clothes to cover their forearms (Al Busaidy and Borthwick 2012). Hence, the traditional Omani dress code for female healthcare professionals also poses challenges for clinical settings, especially in OTs. Most Muslim people respect modesty in terms of dress, and it is evident that most people do not like to see females exposed in public (Almutairi et al., 2012). According to Albougasm (2016), all aspects of people's lives in Oman are guided by the holy Quran and Sunna (prophetic traditions interpreted by the Prophet Mohammed-peace be upon him). Thus, different cultural backgrounds can cause significant challenges for expatriate HCWs practicing different cultural beliefs and values. This finding is supported by Hodges (2015) who found that cultural differences are integral in shaping Omani people's lives and how they perceive their healthcare. Hodges (2015) argues that Omani people are open-minded compared to other Arabic countries. Thus,

notwithstanding the role of religion and culture, Omani people are freeing themselves from some restrictions associated with cultural traits, while, simultaneously, opening themselves up to new beliefs (Jabur 2008). Therefore, these rapid changes have had a positive effect on the nature of healthcare in Oman. Moreover, this cultural diversity among HCWs may cause manifold problems pertaining to cultural traditions, language differences and communication barriers.

Al Shafae (2001) demonstrated that HCWs consist of a mixture of Omani and non-Omani health professionals from different nationalities and cultures (Al Shafae 2001). Therefore, it was evident that there were conflicts stemming from cultural diversity and language between HCWs (Al Shafae 2001). This is supported by a statistical report from the MOH (2015) which demonstrated that in Oman 32% of health professionals working in healthcare services were expatriates from different countries. In Oman, there are HCWs working in OTs and engaged in patient care who come from various countries, including Egypt, India, Pakistan, Philippines, Sudan, Iraq and Morocco. It has been argued that this dependence on expatriate HCWs from different cultural backgrounds creates language difficulties within clinical practice, which, in turn, leads to problems in maintaining patients' quality of care (Al Shafae 2001). For example, it has been found that women in Oman have difficulty thinking about and expressing their feelings (Jabur 2008). It is evident that in Oman healthcare settings, culture and language have been identified as key challenges for HCWs working with patients or other staff from different cultural backgrounds. Therefore, the traditional structure of Omani culture needs to be considered as part of the healthcare delivery system. Despite this aforesaid cultural diversity among HCWs, Oman has undergone manifold radical improvements in healthcare services, education and technology (Jabur 2008).

2.4 Healthcare System in Oman

Health care services have developed extensively over the course of the last several years in Oman. Indeed, the healthcare infrastructure in Oman is well developed, with 57 hospitals providing primary and secondary health care and a network of 173 health centres, extended health centres, and outpatient clinics that provide government-subsidised health care to both citizens and residents of Oman (Al Awaidy et al. 2009). Communication and road networks are similarly well developed, ensuring rapid access to health care for 95% of the population (Al Awaidy et al. 2009). Whilst effective health policies, and initiatives underpinned by a primary health care approach have made significantly positive changes to health and mortality rates over the past four decades, the most important health challenges in Oman concern controlling noncommunicable diseases and other conditions related to unsafe behaviours and unhealthy lifestyles (WHO 2010).

At the beginning of the 1970's there were only 2 hospitals with 12 beds and 10 clinics, whereas by 2013 the MOH was running 49 hospitals and 195 health centres (MOH 2015b). Today, there are a total of 4,998 hospital beds (MOH 2015b). The MOH is responsible for ensuring the availability of health care to those people living in Oman (MOH 2015a). Making primary and specialised health care available to the entire citizenry is integral for reducing the mortality and morbidity rates from different diseases, and in terms of providing an advanced health care comparable to that of developed countries (MOH 2015a). In addition, the MOH is seeking to develop health care services to a level that accommodates both population growth and rapid socioeconomic development in the country (MOH 2013). The health care system in Oman has witnessed continuous development both in terms of its efficiency and quality (MOH 2013). Moreover, the MOH has adopted a range of preventive measures geared towards eliminating infectious disease in communities and health care settings, in conjunction with applying the latest preventive measures to control chronic diseases and avoid any control complications (MOH 2015a).

It is important to note that Oman has witnessed notable successes in health development concerning reduction in mortality, especially pertaining to childhood mortality, and has also achieved remarkable success in controlling major communicable diseases (WHO 2010). Besides, the MOH has also established an infection control programme to both improve patient's quality of care and ensure patient safety. This programme also addresses the emergent threat of multidrug resistant organisms (hereafter abbreviated as MDROs) and common pathogens in hospitals. The national standards and infection control guidelines have been developed in accordance with the GCC-CIC guidelines, and infection control committees can be found in many hospitals (WHO 2010). In addition to this, numerous seminars and workshops have been organised to improve HCWs' knowledge of infection prevention and control (hereafter abbreviated as IPC) practices; however, further work is required in terms of establishing a national surveillance and reporting system (WHO 2010). Health care in Oman is free of charge and the health care system is designated as a national public health care system (MOH 2014a). Finally, the MOH has established a health vision 2050 initiative over the coming 40 years, with the express aim of encouraging the Omani people to live healthy and productive lives (MOH 2014a).

2.5 Prevalence of Surgical Site Infection in Oman

SSIs continue to be regarded as the most common surgical complications in the world, particularly in developing countries (Fan et al. 2014). As aforesaid, there is a relative dearth of studies examining the incidence and distribution of SSI in Oman. In fact, a literature search produced only two studies which investigate the incidence of SSIs in two different hospitals in Oman. A retrospective cross-sectional study by Dhar et al. (2014) and a retrospective review of records by Balkhair et al., (2014) sought to determine the incidence of SSI in patients undergoing a Caesarean Section (hereafter abbreviated as CS). The retrospective cross-sectional study by Dhar et al. (2014) at a regional referral hospital in Oman shows that CS wound infections occurred in 211 (2.66%) cases, and were

confirmed by positive bacteriology in 164 (77.7%) cases. The results of this retrospective study demonstrate that the highest rate of infections between the period of 2001 to 2012 was 4.01% overall, whilst 149 (70.61%) women were diagnosed with SSIs following being discharged from hospital. Between 2011 and 2012, of 565 elective CSs, there were 20 cases of developed SSIs at a regional referral hospital (Dhar et al. 2014). Moreover, the authors reported that SSI prolonged the length of hospitalisation for an average of 5-8 days (Dhar et al. 2014). The study also explained that most of the women who developed a SSI following discharge returned 6-10 days later, complaining of fever, wound discharge, pain and redness. The results of this study emphasise the need to implement infection controls, such as preoperative preparation, antisepsis, reducing the use of absorbable sutures, using antibiotic prophylaxis to requisite standards in order reduce the rate of SSIs. One could argue that SSI rates are higher than acceptable standards, which necessitates the need for a study evaluating adherence to international and national guidelines in Oman.

In a similar vein, Balkhair et al., (2014) illustrated how out of a total of 29,245 admissions 315 registered patients developed MDROs, whilst SSIs were discovered in 9.7% of all MDRO affected patients. This study is important as it demonstrates an increasing trend of SSIs and MDROs in Oman (Balkhair et al. 2014). These results were in accordance with inspections conducted in another governorate hospital. The inspection was conducted to assess the rate of SSI among CS patients. The results found that in 181 cases, 6 (3.31%) patients developed SSIs (MOH 2014). Similarly, another investigation conducted over a 2-month period at the same hospital, focused on 68 appendectomy cases, reported that the rate of SSI was 2.94 per 100 appendectomy cases (MOH 2014). Consequently, it was recommended that there needed to be improved adherence to current guidelines for the prevention of SSI (Dhar et al. 2014). These authors proposed specific measures for preventing SSI, including: bathing on the day of surgery; avoiding unnecessarily shaving hair; using electric clippers when possible; proper sterilisation of instruments; antibiotic prophylaxis;

hand washing; antiseptic skin preparation; encouraging proper OR garments. IPC guidelines have subsequently been updated, reviewed and implemented on the intranet of both hospitals for easy access by any HCWs. Moreover, there are more strict rules and policies for non-adherent staff concerning IPC measures (MOH 2014a). However, there is still a lack of adherence to SSI prevention guidelines in hospitals in Oman. Every major hospital has developed or updated their own policies and procedures for control of infections (MOH 2014a), but there is no record of how these are actualised in practice; hence, this study aims to evaluate adherence to international and national recommendations.

2.6 Chapter Conclusion

This chapter has provided some important contextual information about Oman, particularly as it pertains to the political and economic determinants of the Oman healthcare system. Furthermore, this chapter has provided data on the rates of SSIs in specific hospitals in Oman. The next chapter presents a review of extant literature.

Chapter Three:

Literature Review

3. Chapter Three: Literature Review

3.1 Introduction

This chapter presents a review of the literature concerning adherence to international and national recommendations for the prevention of SSIs and perceived barriers to guideline adherence. The studies are critiqued with respect to the Strengthening the Reporting of Observational Studies in Epidemiology (hereafter abbreviated as STROBE) checklist for appraising research. The chapter then proceeds to delineate the adopted search strategy, before critically appraising and synthesising relevant studies, with especial attention paid to identifying gaps in the evidence base. As part of this appraisal and synthesis of extant research studies, each of the studies was analysed and the key findings summarised in tabulated form (See the full overview of the articles in Appendix 1). The key questions guiding the literature search process are listed below.

Literature review questions:

1. What studies have been undertaken to assess adherence to the prevention of SSI during the preoperative and intraoperative period?
2. What methods have been used?
3. How valid are the findings?

3.2 The Literature Search Process

The search procedure was carried out in three phases: at the outset, I used the key terms in the academic database discussed in the section below. Then, subsequent to reading the titles and abstracts of the relevant articles and scientific articles they were saved as electronic files. Finally, full articles located via the academic database were reviewed and analysed for the purposes of the study. The search of the published literature was conducted using several electronic databases,

including OVID, EMBASE 1947 to present, EMBASE 1996 to November 16, 2015, British Nursing Index (BNI), Medline/PubMed, ScienceDirect and Cumulative Index of Nursing and Allied Health Literature (CINAHL). Further literature searches were conducted using a more general browser (Google Scholar). The search engine Google Scholar was specifically used to find additional articles identified in the reference lists of those studies found in the database searches. Whilst the initial systematic literature search focused on the period between 2001 and 2016, it has subsequently been updated during the writing up stage of the thesis to include literature from 2016 up to and including June 2017. To remain abreast of newly published work, I have created search alerts which provide updates on either the latest literature on a specific research topic or the latest issue of the key journals published in the field. The identified articles are then screened and assessed for eligibility using a two-step approach: keyword electronic database; and secondary search of cited references to identify further studies. The search was combined with Boolean operators “OR” for addition and “AND” to expand or limit the search in terms of retrieving the most relevant articles. Table 2 in Appendix 2 identifies the key search terms used, number of articles identified through database searching and the number of articles considered eligible for the in the literature search. During this systematic search process, three library technicians from Cardiff University were consulted to help with online and offline literature searches. In addition to this, several meetings were organised with librarians to discuss manifold issues and strategies related to conducting comprehensive searches of academic literature. The next section explains the inclusion and exclusion criteria (For further details regarding inclusion and exclusion criteria see Appendix 3).

3.3 Study Inclusion and Exclusion Criteria

Studies included in the literature review were required to meet the criteria stated below. Specific inclusion criteria were employed for the selection process; articles needed to be empirical studies in the English language and published between 2001 to 2017. All studies which explored adherence to SSI prevention guidelines in elective surgeries were included, while studies either published prior to 2000 or not in English were excluded from the review. In addition, published studies that were not considered directly relevant due to their focus on emergency surgeries in trauma Centres and specific surgical procedures (ear, nose and throat, eye, obstetric and gynaecological surgery) were not included as part of this study. Finally, the exclusion criteria included literature on paediatric patients undergoing elective surgery. The final selection of the core literature was based on the aforesaid inclusion criteria, whilst any papers that corresponded to any of the exclusion criterion were ultimately omitted.

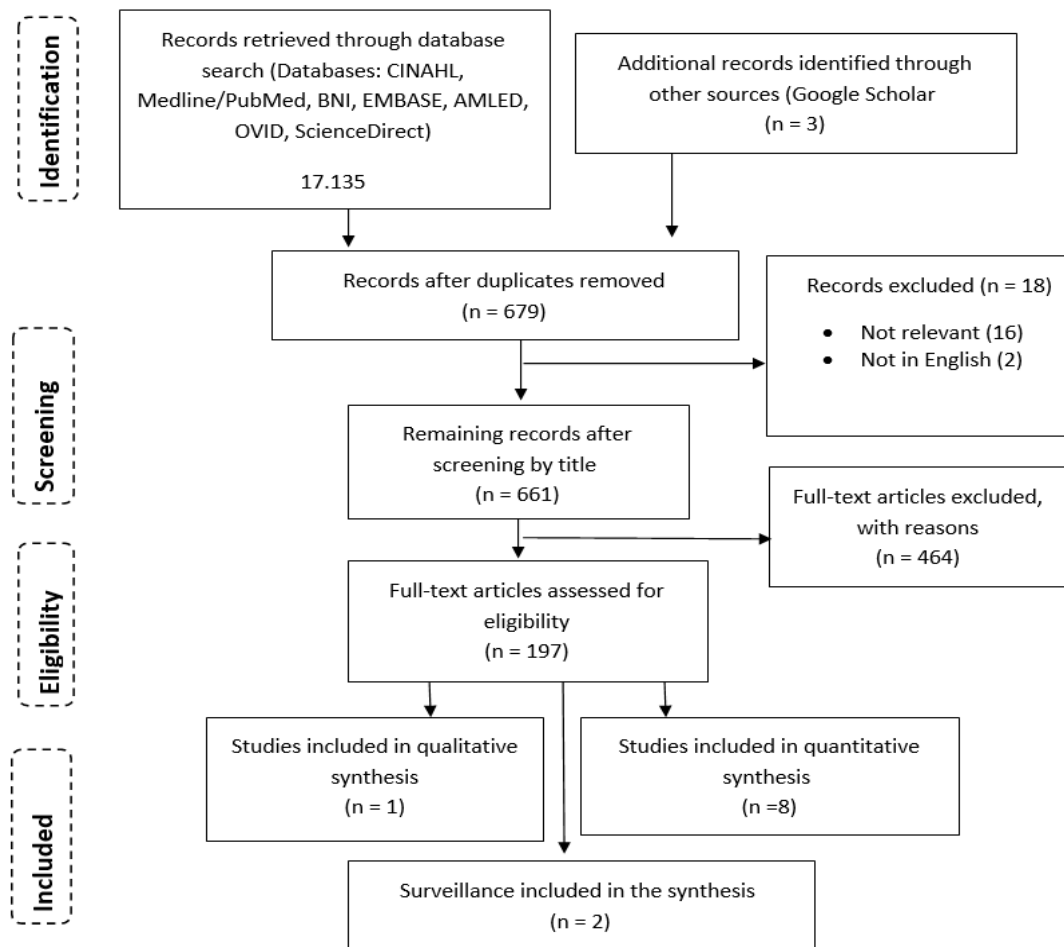
3.4 Findings of the Electronic Searches

When conducting a literature search to discover the relevant evidence, there were a veritable array of literature sources identified. The overall results of the electronic literature search are presented in Appendix 4. Due to the restrictions of word count in this thesis, I have listed the final 11 articles in Appendix 1. To appraise and synthesise the research studies, each of the studies were analysed and the key points and findings were summarised in tabulated form. After screening all the literature, only 11 studies examining adherence to international and national recommendations were ultimately identified. However, no single study was found evaluating adherence to SSI prevention guidelines in Oman. A Preferred Reporting Items for Systematic Reviews and Meta-Analysis (hereafter abbreviated as PRISMA) flowchart of this literature selection process is presented below (Figure 3). The researcher retrieved 6 full-text articles which consisted of 2

prospective observational studies (Durando et al. 2012; Penalver-Mompean et al. 2012), 3 cross-sectional surveys (Davis et al. 2008; Demir 2009; Pan et al. 2009), and a single retrospective case-control study (Tadros et al. 2013). Moreover, the physical search identified another three articles that include a prospective observational study (Oliveira and Gama 2015), a cross-sectional survey (Mater 2014), and a descriptive, cross-sectional qualitative study (Christoforo and Carvalho 2009). Due to the relative dearth of literature, this search was expanded to include two national surveillances (Castella et al. 2006; Diana et al. 2011). SSI surveillances were selected because they evaluate the application of SSI control procedures recommended for the prevention of SSIs. Those articles derived from various countries, including three from Italy (Castella et al. 2006; Durando et al. 2012; Pan et al. 2009), two from Canada (Davis et al. 2008; Tadros et al. 2013), two from Brazil (Christoforo and Carvalho 2009; Oliveira and Gama 2015), one from Turkey (Demir 2009), one from Spain (Penalver-Mompean et al. 2012), one from Switzerland (Diana et al. 2011) and one from Jordan respectively (Mater 2014).

As one can discern from the above, the literature is international in scope which serves to further underscore the contemporary importance concerning the problem of SSI. Some of the studies by Durando et al. (2012), Oliveira and Gama (2015), Davis et al. (2008), Pan et al. (2009), Penalver-Mompean et al. (2012), Mater (2014), Castella et al. (2006) describe the current infection control practices for SSIs in general surgery departments, and compare their findings with evidence-based practice guidelines. Other studies by Cristoforo and Carvalho (2009), Diana et al. (2011) and Demir (2009), evaluate both pre- and intraoperative practices adopted by HCWs for the prevention of SSIs. Furthermore, studies by Tadros et al. (2013) focus on preoperative risk factors for MRSA SSI. The following section describes the critical appraisal tool used to evaluate the literature review. It is therefore concluded that the studies were identified in the search aimed to evaluate HCWs' adherence to international and national standards.

Figure 3: Preferred Reporting Items for Systematic Reviews and Meta-Analysis Flowchart for the Selection of Studies, Outlining Retrieved, Excluded, and Included Studies. From Vasudevan et al. 2015.



3.5 Choice of Critical Appraisal Tool

The purpose of this critique is to evaluate whether the evidence is sufficient for answering the research question and to identify lacunae in knowledge in this field for the strict purpose of justifying the undertaking of the study. A critical review of the literature represents a critically important step in terms of constructing a research methodology and appropriate methods for investigating the research questions. According to Burns and Grove (2009), the most effective form of research evidence is empirical knowledge, generated from the synthesis of a variety of study findings in the

same area. These critiques can then be used to ascertain whether the findings are accurate, believable and meaningful for clinical practice (Cutcliffe and Ward 2007; Ryan et al. 2007). To evaluate the quality of the literature, the author used the STROBE appraising checklist to appraise the literature review. The STROBE appraisal tool was utilised because it has been designed to review observational epidemiological studies, and thus strongly contributes to improving the quality of reporting on observational studies (Ebrahim and Clarke 2007). It is widely used and provides general reporting recommendations for descriptive observational studies, as well as literature that examine relationships between risk factors and health outcomes (Elm et al. 2007; Vandebroucke et al. 2007). The critique used six criteria with which to evaluate the scientific literature. Items appraised were the aims, study design, sampling and sample size, data collection, data analysis and ethical considerations. The following section evaluates the strengths and weaknesses of published research reports.

3.6 Critiquing the Literature

The studies fell into four groups: those where the data were collected via direct observation; interviews; a retrospective case-control; and those in which surveys and questionnaires were used instead of observing practice.

3.6.1 Direct Observational Studies

With respect to the studies by Durando et al. (2012), Penalver-Mompean et al. (2012), and Castella et al. (2006), several methodological limitations and weaknesses were observed. In Durando et al.'s (2012) study, data were collected by direct observation, reviewing of medical and nursing charts and standardised interviews with HCWs and patients in surgical wards and OTs. The study by Oliveira and Gama (2015), collected data through a prospective direct observation of 18 surgeries. Similarly,

in Penalver-Mompean et al's. (2012) research, data was generated via direct observation of 7 hospitals.

Observational studies have both their limitations and their advantages. Firstly, observational studies are an invaluable source of information with respect to assessing surgical teams' attitudes towards clinical practice guidelines in a natural setting. The observational prospective, cross-sectional descriptive studies by Durando et al. (2012), Penalver-Mompean et al. (2012), and Castella et al. (2006) were deemed appropriate as they are consistent with the aims and objectives of this study. They were also instructive in terms of guiding the researchers in the above studies to observe routine clinical practices in natural settings. Furthermore, it is a feasible approach through which to evaluate adherence to SSI procedures in OTs, because observations provide expedient descriptive and correlative information, and identifies important interactions between the key variables (Dohoo et al. 2012, p.157; Prasad et al. 2013). In the selected studies, the authors found insightful information and identified interactions between variables. For instance, these studies found that there was a significant association between perioperative preventive measures and the occurrence of SSIs.

Direct observation is one of the most commonly adopted methods of measurement through which to monitor compliance to guidelines. However, this method is also subject to forms of bias including observer bias, and even the Hawthorne effect (Brown et al. 2015; Hass and Larson 2007; WHO 2009). For observational studies, a major concern is reactivity, that is, the way in which the observed behaviour is affected by the presence of the researcher (Schweigert 2012). The Hawthorne effect, which derives from the awareness of being observed, is assumed to inflate adherence rates to SSI prevention guidelines. Indeed, the Hawthorne effect has been widely assumed to increase the hand hygiene adherence rates of HCWs when observers are present (Hagel et al. 2015). The Hawthorne

effect can also lead to an overestimation of the true rates of adherence to evidence-based clinical practice guidelines. However, this is due, in part, to making the observer role clear to those being observed and informing the participants about the aim of the research. Hence, as part of the strategy to mitigate the Hawthorne effect, the observer must spend as much time as possible in natural observational settings and collect data on different days and at varied times, both to make sure that data is comprehensive, but also to enhance the validity and reliability of the data. These measures are especially important for overcoming the reactive effects of the observer's presence (Bowling 2014). In this respect, the observational study carried out by Durando et al. (2012) was not blinded randomisation, and, as such, may be susceptible to the Hawthorne effect. Whereas, in other studies by Oliveira and Gama (2015) and Castella et al. (2006) the Hawthorne effect could have been mitigated because of the small number of cases in the sample.

Another key limitation concerns sample size and representativeness of the sample. The studies by Penalver-Mompean et al. (2012) and Oliveira and Gama (2015) consisted of a relatively small sample size, which may affect the applicability of their findings to a wider population (sample size is provided in Appendix 1). The findings are also limited due to the non-representativeness of the sample, which, once again, makes it difficult to generalise findings to other settings where adherence to guidelines might be different. Moreover, Oliveira and Gama's (2015) study was conducted in a single hospital and thus the results cannot be generalised outside that specific context. This is important as Dohoo et al. (2012), Ben-Shlomo (2013, p.39) and Elwood (2007) argue that participants should be representative of the larger target population to increase the rigour of the study. Therefore, it is vital to increase the sample size (Rothman et al. 2008).

On the contrary, to these aforesaid studies, both Castella et al. (2006) and Durando et al's. (2012) studies involved a large sample size. More specifically, the study by Durando et al. (2012) consisted

of a range of 717 surgical procedures, representing 26.2% of the overall surgical interventions (n=2.733) performed during the one month survey period in a tertiary teaching hospital in Italy, which indicate that the sample size is representative of all surgical procedures. It is noteworthy that this study included different type of elective procedures, such as general surgery (n=151;21.1%), orthopaedic surgery (n=131; 18.3%), ear, nose, and throat surgery (n=99;13.8%), obstetric and gynaecologic surgery (n=89; 12.4%), cardiac, vascular and chest surgery (n=63; 8.8%), urologic surgery (n=62; 8.6%), neurosurgery (n=35; 4.9%) and others (n=87; 12.1%). As well as this, it accounted for different wound classes, such as class I (clean) (n=388; 54.1%), class II (clean-contaminated) (n=270; 37.7%), class III (contaminated) (n=39; 5.4%) and class VI (dirty) (n=20; 2.8%). Consequently, these results can be generalised to the population as this sample was representative of the size of the target population.

Castella et al. (2006) conducted their survey across 49 hospitals in Italy. A total of 856 patients were observed and 88% of the operations were surgical wound class I or II. In this study, all types of general surgery were included, including elective surgeries and day surgery (Surgery performed in the OR on a patient who was hospitalised for less than 24 hours before operation). This study has been conducted in the ORs of 49 hospitals in Italy, which show that patients who participate in the study are considered to be a representative sample from all surgical procedures. This indicates that when researchers use specific criteria to minimise potential threats, the consistency of the results is strengthened (Polit and Beck 2012). See sample size in Appendix 1.

3.6.2 A Cross-Sectional Survey

In the studies by Demir (2009), Mater (2014) and Davis et al. (2008), data were collected through surveys, while Diana et al. (2011) and Pan et al. (2009) used a cross-sectional survey for data collection. There were several limitations identified in these studies. Firstly, given that their analyses are predicated upon data from surveys or self-administered questionnaires, some investigators found that adherence to certain practices were overestimated (Pan et al. 2009). In this respect, the authors failed to reduce bias and mitigate the Hawthorne effect as data was collected using surveys or questionnaires instead of direct observations of practice, which have the potential to highlight lapses (Beldi et al. 2009). Moreover, by using a survey the research is susceptible to a recall bias, and there is also potential for subjects to provide the best answer (Davis et al. 2008). In light of this, some authors attempted to reduce bias by making the surveys anonymous and designing questions that were non-motive based and balanced (Davis et al. 2008).

Demir (2009) collected data through interviewing charge nurses in OTs instead of observing practice. Face-to-face interviews offer advantages in terms of both data quality and exploring issues from the perspective of participants (Dohoo et al. 2012). However, interviews can also impact upon the validity of the data. For example, results can merely reflect the charge nurses' subjective views about their clinical practice, and, thus, there may be a potential bias between actual behaviour and the data generated (Demir 2009). Furthermore, collecting data via face-to-face interviews can also lead to information bias, because the charge nurses may deviate from the focus of the interview and produce biased responses by changing their responses to the questions.

These studies also involved small sample sizes. In the questionnaire survey by Pan et al. (2009), both the sample itself and the sampling procedures are not well discussed. What one can discern however, is that there were 24 cardiac surgery units who participated in this study which represents

only about 25% of Italian cardiac surgery units. Indeed, the questionnaire was sent to 24 cardiac surgery units and 17 (72%) of them returned the questionnaire. Certainly, to obtain high response rates and increase co-operation, researchers should try to include a large sample size (Rothman et al. 2008). Hence, although these 17 centres do perform over 10,000 surgical procedures per year, nevertheless the sample size was small and thus did not represent the entire population. In this study, the questionnaire was sent to the investigator in charge of the project at each centre. It is evident that the potential selection bias and rate of participation may have affected the external validity, and thus the results must be interpreted carefully due to the limited generalisability. Selection bias, of course, emerges when a sample is not randomly selected and recruited in such a way that they are not truly representative of the target population (Hammer et al. 2009). The fact the questionnaires were completed with the help of the nurses in charge of the cardiac departments and OTs does help to standardise the collection of data, if they are a representative sample of a target population (Rattray and Jones 2007). However, it has been argued that the format of the interview questionnaire itself plays a bigger role in participation rates than simply using a questionnaire in the first place (Rothman et al. 2008). In fact, using a questionnaire as the primary data collection tool leaves one susceptible to misunderstood questions, skipped answers, and is least easily monitored (Rothman et al. 2008). This study represents an analysis of self-report studies which may overestimate adherence to some clinical practices. In this study, 17 of the 24 participating units (71%) answered the questionnaire. This is a high response rate, one which increases the accuracy of the findings and, as such, strengthens the generalisability of the results.

The limitations of this study are similar to those discussed apropos Pan et al. (2009). Davis et al. (2008). The survey included 589 surgeons currently practice in Alberta, Canada. This study included surgeons from different specialisms, such as general surgeons, vascular/and cardiothoracic surgeons, gynaecologic surgeons, orthopaedic surgeons, plastic surgeons, and neurosurgeons. This

study represents one group of surgical team personnel, hence the study group may not be entirely representative of the target population. The authors analysed the data with respect to a small sample size which, although a 42% response rate can be considered excellent for survey, may not adequately represent all surgeons currently practicing in the area. Consequently, non-response bias may lead to information bias because the outcomes from responders could differ from other responders (Dohoo et al. 2012). Further, the principal problem with this study is that not every surgeon answered every single question in the survey.

Demir (2009) performed a prospective, cross-sectional descriptive survey in 24 OTs across 11 hospitals in Turkey. In this study, there are no details provided about how many participants were recruited, and, as such, it is difficult to gauge the sample size. Consequently, it is also hard to extend the conclusions to a broader population (Dohoo et al. 2012). Besides, Diana et al. (2011) developed a standardised 56-item multiple-choice questionnaire. Despite the high response rate to the questionnaire in this study, there are some limitations need to be discussed. First, the authors included a very small number of surgeons (50), its result can therefore not be generalised to other hospitals where adherence to guideline recommendations might be different. On the other hand, this study was based on a questionnaire and not on direct observation of daily practice, which may show lapses and susceptible to recall bias. Evans et al. (2008) suggest that self-administered questionnaires are more susceptible to item non-response. Consequently, it is not possible measure actual adherence to practice guideline without continually observing behaviours (Garfield et al. 2011). Lastly, self-report measures included self-administrated questionnaires may provide information regarding HCWs' knowledge of evidence-based guidelines but they are subject to bias and may not reflect actual existing practices in any true sense so, they should not be used as the sole measure of guideline adherence (Adams et al. 1999).

3.6.3 Retrospective Case-Control Studies

Tadros et al. (2013) utilised a retrospective case-control method to collect their data. In the case-control study by Tadros et al. (2013), there were 38 people in the treatment group and 76 in the control group, which may indicate an imbalance between the respective groups and mean that their results might not be applicable to patients hospitalised elsewhere. It is ordinarily required that both cases and controls are representative of the same target population (Geneletti et al. 2009). Hence, this study can thus be said to have low external validity due to the small numbers of sample cases used to represent the whole population, and, ultimately, might not be applicable to other hospitals (Tadros et al. 2013). Moreover, because Tadros et al's. (2013) study is based upon a retrospective case-control study, this means that it is also susceptible to selection bias as retrospective case-control studies, by design, are more prone to selection bias than other epidemiological studies (Geneletti et al. 2013).

3.6.4 Qualitative Studies

The descriptive, cross-sectional, qualitative study by Christoforo and Carvalho (2009) was performed in surgical units in two hospitals in the city of Ponta Grossa. Data collection was carried out via structured interviews. The study consisted of 129 patients, selected according to a convenience sample. In this study, the data was collected using structured interviews. This content validity of data collection instrument was tested with a pilot study. Based on the review of literature, one can surmise that there appear to be five types of study, including: direct observations of practice; direct observation followed by interviews of surgical staff and patients; surveys without observations; interview studies; and case-control studies. After critically evaluating these different type of studies, it is found that direct observations provide the most meaningful findings, because direct observation studies provide rich descriptive data and correlative data (Prasad et al. 2013). Moreover, it is found

that observational studies are essential for monitoring daily clinical practice more closely, and, in turn, provide rich and meaningful evidence to inform comparative effectiveness clinical decision-making that is simply not possible via other methods (Berger et al. 2012; Yang et al. 2010). One could argue that direct observation supported by interviews is the strongest approach through which to explore adherence to guidelines because it provides the most valid and complete data. Despite these limitations, I believe that the findings from this work are of vital importance.

3.7 Synthesising the Literature

This section will examine the primary literature which focuses on adherence to recommendations for routine practices to prevent SSIs. Accordingly, this sub-chapter is comprised of three sections. The first section considers studies that have assessed adherence to preoperative surgical procedures that are recommended for the prevention of SSI. These measures include reducing the length of preoperative hospital stay, preoperative hygiene, preoperative bathing or showering with an antiseptic, proper preoperative hair removal, appropriate administration of antibiotic prophylaxis and preoperative skin antisepsis. Section two examines the contributed intraoperative infection control practices for SSIs that include managing of traffic flow in and out of the ORs, as well as aseptic and principles of sterile technique in ORs, such as pre-surgical hand antisepsis, preoperative skin antiseptic preparation, surgical scrubbing, the wearing of surgical attire, cleaning and disinfection of environmental surfaces, use of protective boundaries such as surgical masks, surgical caps, surgical gloves, application of surgical wound dressing and so on. This is proceeded by a review of those studies that have investigated factors affecting non-adherence to the use of evidence-based guidelines for SSIs.

3.7.1 Section 1: Review of Literature on Preoperative Surgical Patient Preparation

This section reviews the literature regarding preoperative procedures for the prevention of SSIs. This review took into consideration primary research studies that investigated adherence to international and national recommendations for the prevention of SSIs.

3.7.1.1 Summary of Findings for Section One

There is often a disjuncture between guidelines and clinical practice, which can result in surgical patients not receiving appropriate care during the preoperative and intraoperative phases. This review found that whilst some of the activities observed were appropriate, others diverged from the recommended best practice. The findings of literature with respect to the preoperative phase demonstrate that the majority of HCWs were not compliant with guideline recommendations for preoperative bathing or showering with antiseptics, methods used for preoperative hair removal, duration of antibiotic prophylaxis (where the duration exceeds the half-life of the drug in order to maintain adequate bactericidal serum and tissue level), the use of appropriate intraoperative skin preparation techniques, removal of jewellery, wearing of surgical attire such as surgical masks to cover the nose and mouth and caps to cover hair during surgery, keeping the door closed during the entire surgical procedures except for movement of equipment and patients, and minimising the number of people in the OR. The reasons for non-adherence to these measures have hitherto not yet been studied in the requisite depth (Durando et al. 2012). However, some interesting studies which have investigated factors affecting non-adherence to guidelines have identified manifold factors, including lack of agreement with guideline recommendations, lack of communication, lack of awareness, lack of resources and staff, low priority, lack of clarity, workload issues, lack of knowledge and negligence as the main issues underlying non-adherence. The following section

examines studies related to preoperative hospital stay. Full details about the findings can be found in an extraction table in Appendix 1.

3.7.1.2 Preoperative Hospital Stay

There were two studies examining the preoperative length of hospital stay as a potential risk factor for, and thus a way to mitigate, SSIs. Data on adherence to preoperative length of hospital stay was assessed by Pan et al. (2009) and Christoforo and Carvalho (2009). In the first, Pan et al. (2009) found that there was a lack of adherence to preoperative length of hospital stay protocol in Italian cardiac surgery units, whereas it was acceptable in the two hospitals based in Brazil (Christoforo and Carvalho 2009). Pan et al. (2009) observed that 2 (12%) of the units purported that they adhered to preoperative hospital stay protocol, however there was insufficient details about the mean time spent in hospitals before the surgery or how long patients stayed in the hospital immediately prior to surgery. Similarly, Christoforo and Carvalho (2009) identified that the level of adherence to length of hospital stay was acceptable because the authors found that 61% of surgical patients were admitted on the same day as the surgery, compared to 31% one day prior to the operation. This was consistent with CDC guidelines which highlighted that the preoperative length of hospital stay should be as short as possible so as to avoid colonisation by hospital strains of bacteria, which are more likely to result in infections caused by bacteria that are resistant to antibiotics and more difficult to treat (CDC 2011; Gupta and Agrawal 2015), which, in turn, jeopardises health outcomes (Reichman and Greenberg 2009). The findings of the literature found that surgeons were not fully compliant with guidelines; however, what these studies failed to document were the reasons for the prolonged preoperative length of hospital stay. The next section discusses adherence to preoperative skin preparation.

3.7.1.3 Preoperative Bathing or Showering with Skin Antisepsis

This section describes eight studies which focus on the preoperative antiseptic preparation procedure. Regarding preoperative procedures, Durando et al. (2012) found that all of the patients (717) undergoing surgery had a preoperative shower in most cases, either using a common detergent in 624 (87%) of the cases, or an antiseptic solution like chlorhexidine and trichlorophenol 43.4% of the time, as per the recommended guidelines. These results are in accordance with recent evidence, but yet the authors state that there was no evidence supporting the use of antiseptic solutions in reducing SSI rates. In this study, nearly 70% of patients had a preoperative shower within 8 hours before the surgery. In a similar study, Davis et al. (2008) found that surgeons with longer clinical experience were more likely to recommend preoperative bathing to patients; however, the authors asserted that the senior surgeons were less inclined to recommend and adhere to antiseptic bathing with chlorhexidine. Analysis of this data revealed that 23% of surgeons recommend that patients bathe with an antiseptic solution before surgery. It may be that surgeons are not recommending this procedure because some surgeons believe that most patients have already been instructed in the outpatient clinic to bathe with an antiseptic solution on the day of the surgery, or, alternatively, it could be that surgeons are aware that there is insufficient evidence to support any correlation between the use of chlorhexidine and a reduction in SSIs. These results corroborate those of Penalver-Mompean et al. (2012) who found that 3 out of 7 hospitals recommended showering or bathing with antiseptic agents at least the night prior to the surgery, which is in accordance with CDC guidelines. Conversely, Castella et al. (2006) emphasised that 78% of patients had a shower either on the day before or the day of the surgery, using soap in 80% of cases and antiseptic agents in the remaining 20% of cases. This indicates that this procedure was not in accordance with national and international guidelines, which state that the patient should shower with an antiseptic agent before surgery (CDC 2011; GCC 2013).

Oliveira and Gama (2015) were more specific yet still and noted that preoperative bathing on the day of surgery was provided for 15 (83.3%) patients, 11 (73.3%) of whom had it in the hospital and 4 (26.7%) at home, using chlorhexidine soap in only one (6.7%) instance, which indicates that this practice diverges from the international guideline recommendations. However, data analysis revealed that this procedure is controversial among guidelines, as some antiseptic agents like chlorhexidine have been shown to reduce skin bacterial counts. In regard to this practice, some patients took shower in the day of surgery without using antiseptic agent which goes against recommended practices. Moreover, it was found that lack of adherence to this recommendation could be down to the fact that HCWs believe that there is no sufficient evidence to demonstrate the reduction in the SSI rate after preoperative antiseptic bathing (Durando et al. 2012; Webster et al. 2007; Spruce 2014). Regarding this practice, Demir's (2009) contribution to this debate was to emphasise that there was a lack of adherence in terms of skin preparation. Specifically, they showed that preoperative showers with an antiseptic agent was observed in 2 (8.4%) cases, which showed that preoperative antiseptic bathe were not done in many OTs, which demonstrates significant differences between evidence-based guideline recommendations and actual practice.

More recently, the analytical gaze has been cast over other contributory factors for SSIs in Arabic countries. For example, the study by Mater (2014) in Jordan found that when surgeons were asked about whether they recommended to patients preoperatively bathing with an antiseptic, 52.6% of the respondents stated that they did not do so. One further finding was that, although all patients undergoing surgery did shower, soap and water were used in almost all cases. Despite HCWs knowing that patient's skin can be a major source of bacterial contamination, most of them failed to adhere to the recommended practice.

Whilst studies by Tadros et al. (2013) and Diana et al. (2011) highlight that surgeons routinely recommend preoperative bathing, the use of antiseptic agents is common in most of cases. According to Tadros et al. (2013) 90.3% of patients had a preoperative chlorhexidine shower. On the other hand, Diana et al. (2011) state that 75% of the surgeons routinely recommend a preoperative antiseptic shower before elective surgery. On the contrary, Christoforo and Carvalho (2009) demonstrated significant differences between recommend practice and current practice. The findings of their study showed that bathing was provided to more than half of the patients (58.9%) before the operation. Christoforo and Carvalho (2009) found that there was a lack of adherence to bathing, with 41% of surgical patients not being bathed prior to surgery, 53% of patients bathed at home, whilst the remaining 6% of patients were bathed in the hospital. These results indicate that bathing with an antiseptic solution is one of the most important methods in terms of reducing infection, but the results of the clinical research reports revealed a significant discrepancy between guideline recommendations and actual practice. The results also confirm that knowledge and clinical experiences does not always influence adherence to guidelines in clinical practice (Davis et al. 2008; Durando et al. 2012).

With respect to appropriate antisepsis of the incision site area, Durando et al. (2012) purported that appropriate skin preparation was done in 97.4% (n=698) of surgical procedures, with iodoform (n=524; 75.1%) and chlorhexidine (n=119; 17%) the main agents used. This study thus underscored that there was good adherence to current guidelines pertaining to skin preparation and the use of antiseptic agents. Demir (2009) also found that in 24 OTs in 11 hospitals there was 100% compliance with skin antisepsis guidelines. According to the authors, skin cleaning was undertaken using either povidone iodine or savlon (chlorhexidine gluconate and cetrimide). In addition to this, Davis et al. (2008) stated that all the surgeons surveyed were using appropriate antiseptic agents, such as chlorhexidine, povidone iodine or alcohol solution for intraoperative skin preparation; however,

there were some discrepancies about the actual method of application of skin preparation which was correctly applied in 69% of cases. Regarding this type of care, skin disinfection before and after skin closure is routinely done by 73 (66%) of the surgeons respectively, with 80% of those surgeons using iodine-based solutions. When it comes to skin preparation, lack of adherence was also observed in 41% of operations across 24 Italian cardiac surgery units (Pan et al. 2009). The authors found that preoperative antiseptic skin preparation was applied incorrectly in under half of the cases, which indicates that HCWs adherence to this specific recommendation was not always optimal. Diana et al. (2011) also reported that skin disinfection was performed by (66%) of the surgeons. The authors observed that 80% of surgeons prefer iodine-based solution for preoperative skin preparation. Despite this procedure, adherence to recommendations for skin antisepsis in the surgical site were generally high, whereas practices concerning the method of application contradicted the guidelines by not cleaning the skin in concentric circles moving toward the periphery area.

3.7.1.3.1 Rationale for Including Showering/ Bathing with an Antiseptic Agent

I treated the data and conclusions drawn from them according to the practice that is considered appropriate in Oman. The Oman guidelines broadly follow CDC recommendations but on the topic of antiseptic showering and bathing they differ to suit the local need - antiseptic is thought to be necessary in Oman because many people do not bathe every day and before surgery the additional safeguard of antiseptic is believed to be warranted. The international guidelines are meant to be adopted according to local need. The local guideline in Oman has been modified so that it meets local need. Therefore, I am using a modified approach to the CDC guidelines in relation to antiseptic bathing/showering. The audit tool used for this study was recommended nationally at the time of the data collection. Therefore, it is important to advise patients to bathe before surgery with an

antiseptic agent to reduce both skin flora and transient bacteria (Milstone et al. 2008). According to MOH (2015) antiseptic bathing is one of the important measures to reduce SSIs. Despite that this practice does not form part of the CDC guidelines, some literature and guidelines, such as AORN, for example, still advocate the use of antiseptics and argue that because standards of personal hygiene for some people in the Middle East do not match those assumed by the experts who draw up the international guidelines, as well as the fact that there is evidence that SSIs are ordinarily caused by skin flora, antiseptic bathing/showering is thus still considered to be important. Unfortunately, in many areas in Oman antibiotics are readily available without prescription and thus patients may have access to them, which, in turn, means that their skin flora is likely to show evidence of resistance. Multidrug Resistant Organisms (MDRO) represents a major challenge in Oman, so strict adherence to infection prevention guidelines is important for preventing the spread of infection (Balkhair et al. 2014). Furthermore, it was found that the presence of community acquired Methicillin Resistant Staphylococcus Aureus (MRSA) was high among hospital visitors (Pathare et al. 2015). Therefore, antiseptic bathing is vital for preventing the risk of postoperative wound infections. In addition, it is evident that a lot of OR staff in Oman are from other countries and, as such, could be carrying antibiotic resistant infections picked up in their own countries and, consequently, contributing to this risk. Therefore, this practice could be useful in preventing infections that are resistant to antibiotics (Alvarez et al. 2018). Although there is a relative dearth of literature supporting the notion of preoperative bathing with an antiseptic, it is nevertheless essential in Omani culture. First, the geographical location of tribes in Oman differentially influence their cultures. This occurs among people from more conservative cultures who are not used to taking a daily bathe. In Oman, surgical patients, both literate and illiterate, come to health care facilities from cities, deserts, towns and villages. Indeed, some patients are from very remote villages in the desert where it is unusual to bathe every day. Furthermore, some older people,

whether they live in towns or villages, are not accustomed to taking baths regularly, which has a detrimental effect on their personal hygiene. For these reasons, it becomes crucial for patients to bathe with an antiseptic detergent to reduce the SSIs. Studies by Zhen et al. (2017), Edmiston et al. (2015), Donskey and Deshpande (2016), Milstone et al. (2008), Garibaldi (1988) and Kristin et al. (2015) found that preoperative bathing or showering with an antiseptic decreases skin microbial colony counts on the skin of surgical patients and decreases the risk of infections. This indicates that bathing with an antiseptic agent is essential in local hospitals, because preoperative skin preparations with antiseptic agents, such as chlorhexidine, are effective against a wide-range of Gram-positive and Gram-negative bacteria (Mistry et al. 2017). This finding is in accordance with those of Climo et al. (2003), who reported that chlorhexidine is effective in reducing the bacterial burden on patients' skin and in preventing contamination. It is noteworthy, however, that patients undergoing surgical procedures should be advised to take an antiseptic bathe prior to surgery.

3.7.1.4 Preoperative Hair Removal

Preoperative hair removal is one of the main risk factors that can contribute to the onset of SSI (Oliveira and Gama 2015). Therefore, this section provides summaries of eleven studies which examine adherence to the recommended practice for preoperative hair removal. Durando et al. (2012), Penalver-Mompean et al. (2012), Pan et al. (2009), Castella et al. (2006), Demir (2009), Tadros et al. (2013), Christoforo and Carvalho (2009), Diana et al. (2011), Mater (2014), Oliveira and Gama (2015), and Davis et al. (2008) investigated preoperative hair removal procedures, covering different types of operations. In these studies, the authors reported that adherence to recommendations of hair removal needs to be improved, pointing towards a significant disjuncture between guideline recommendations and current practice. Whilst, traditionally speaking, surgical team staff have included the routine removal of hair from the incision site as part of preoperative

preparation, there are numerous studies and international and national guidelines which propose not shaving the incision site (Al Maqbali 2016; CDC 2011).

In the first study, Durando et al. (2012) note that hair removal was performed in 261 (36.4%) operations, 77.8% occurring in the ward itself, 92% of which were done by razor during surgery, 6.1% with clippers and the remaining 1.9% with depilatory cream. These results are in complete contradistinction to current international and national guidelines. In fact, the guidelines state that, if necessary, hair should be removed immediately prior to the surgery, preferably with clippers (CDC 2011). For further details, please see the data extraction table in Appendix 1.

Even though there is strong evidence supporting this recommendation, not to mention that the appropriate procedure can also be relatively easily performed, a lack of adherence with this practice has been routinely found in similar studies. For example, Davis et al. (2008) found that 163 (83%) out of 196 surgeons who responded to the survey removed patient's hair in the OR, using clippers in 123 (63%) of the operations, a razor in 63 (32%) of the cases, whilst 10 (5%) used a depilatory cream. The findings demonstrate that the method of hair removal varied among different surgeons (for further details see the data extraction table in Appendix 1). The analysis of this data indicates that the use of methods of hair removal according to specialist was statistically significant ($P=0.004$). These results were in accordance with those of Penalver-Mompean et al. (2012), who found adherence to skin preparation was suboptimal, whilst those related to hair removal directly contradicted current EBP. In addition, Penalver-Mompean et al. (2012) reported that six of the seven hospitals recommended manual shaving or using an electric shaving machine, which is also inconsistent with current EBP.

In Castella et al's. (2006) survey, the results showed that out of 856 operations, a total of 88% of patients had hair removed one night prior to surgery (60%), with clippers used in 141 (38%) of cases,

razors in 75% of the operations and depilatory cream used in 33 (8%) of the cases. They argued that with respect to preparation of the surgical patient, both the timing and methods used for hair removal diverged from the international guidelines. The authors also found, troublingly, that clippers were simply not available in certain surgery departments, and thus a razor was used in more than half of the cases. Data from another study (Oliveira and Gama 2015) showed that in 27.7% of operations hair removal was performed inside the OR by razor in 80% of cases and the remaining 20% with clippers. Similarly, it was reported that preoperative hair removal was done in nearly 23 (95.8%) cases, even though current guidelines do not recommend this procedure (Demir 2009). This survey shows conclusively that shaving is still widely in use, and thus may increase the risk of SSI.

Studies have also shown that shaving the surgical site with a razor is preferable for many surgeons. Indeed, the study by Mater (2014) documented that 29.8% of surgeons removing patient hair in the ORs use clippers in 57.1% of the cases and razors 42.9% of the time (For further details, see the data extraction table in Appendix 1). As the above studies demonstrated, there are significant differences between EBP and actual practices. When comparing the different specialists, the study by Mater (2014) also showed that 100% of orthopaedics surveyed stated that patient hair removal was done in the OR, whereas 29.4% of general surgeons and 0% of cardiac surgeons answered yes to this recommended practice. In a similar vein, Diana et al. (2011) reported that shaving was performed in the OR with clippers by 90% of the surgeons who responded. According to the authors, most of the surgeons request preoperative hair removal regardless of the type of surgery, and shaving was performed in ORs with electric clippers by 90% of the surgeons who responded, which is bad practice because shaving should be done outside ORs to both minimise the dispersal of loose hair and to avoid contamination of the sterile field (Pfiedler Enterprises 2012).

In a further study by Tadros et al. (2013), it was observed that hair removal was done in 31 (81.6%) of cases compared with 53 (69.7%) of controls, which was the main contributing factor in the transmission of the outbreak. Interestingly, Christoforo and Carvalho (2009) mentioned that 34% of patients at hospital A were shaved, compared to 28% at hospital B. among those who were shaved, 32% of hair removal was done at home and 58% did it at the hospital (Christoforo and Carvalho 2009). In this study also observed that this procedure was done 2 hours before the surgery using blades in (59%) cases, razors in (39%) cases and scissors (2%) in operations (Christoforo and Carvalho 2009).

The previous studies identified that some care procedures are provided in adherence to recommended practices, however in certain cases notable divergence was observed with respect to the timing of hair removal and the methods used for hair removal. These findings strongly suggest a lack of adherence pertaining to hair removal and a marked difference between current practice and what guidelines posit should be practiced. However, these existing studies also show that it is not clear whether hair removal preoperatively affects rates of SSIs, but if hair removal must be removed it is clear that clippers should be used because it appears to result in fewer SSIs (Al Maqbali 2016; CDC 2011). Adherence to these recommended practices contribute to providing a safe environment for the patient that minimises the potential for SSI.

3.7.1.5 Antibiotic Prophylaxis Administration

During the process of the literature search nine scientific studies were identified that focused on surgical antibiotic prophylaxes. The studies by Durando et al. (2012), Davis et al. (2008), Mater (2014), Pan et al. (2009), Castella et al. (2006), Diana et al. (2011), Tadros et al. (2013), Oliveira and Gama (2015) and Penalver-Mompean et al. (2012) were conducted in different health institutions, and sought to understand the behaviour and attitudes of surgical team staff toward antibiotic

prophylaxis administration. Adherence to antibiotic guidelines were assessed with respect to selection of antibiotic, dosage, timing and duration of antibiotic prophylaxis. Overall, adherence to optimal choice, timing and duration of antibiotic prophylaxis was deemed to be inadequate, thereby making additional efforts necessary (Yalcin et al. 2007). The following studies are useful in providing rich detail about the use of antibiotic prophylaxes for surgical patients. For more details, see the data extraction table in Appendix 1. In spite of the efforts to encourage proper implementation of guideline recommendations for antibiotic prophylaxis, suboptimal of selection of antibiotics prophylaxis and duration administration have been reported in many countries (Imai-Kamata and Fushimi 2011).

Durando et al. (2012) posit that more than half of the 493 surgical patients (68.8%) received antibiotic prophylaxis. The results showed that in 373 procedures (75.7%), antibiotics were given at the proper time, whilst the timing was inappropriate in 21.3% (n=105) of cases. Additionally, when both choice and indication of antibiotics were evaluated, prophylaxis was judged appropriate (n=203; 35.5%), less acceptable (n=256; 44.8%) and inappropriate (n=316; 55.2%) with respect to procedures. In this study, the appropriate drugs were given for 402 (70.3%) of the 572 procedures. The findings showed that in more than 50% of the interventions for which national guidelines did not recommend prophylaxes, it was still given. This indicates that surgeons are encountering difficulties in adhering to guidelines. Therefore, adherence to best practice was still relatively poor (44.8%).

Similar findings have been reported across other studies. For example, Davis et al. (2008) conducted a survey study exploring adherence to antibiotic guidelines, and also identified that there was no statistically significant difference in the use of antibiotic prophylaxis in relation to surgical specialists. The study findings showed that antibiotic prophylaxis was used routinely by 193 (88%) of 219

surgeons. It was noted that there was also a discrepancy about when these antibiotics were administered. Furthermore, the study highlighted that of 231 surgeons, 37% (n=87) responded that they were following the recommended practices, 30% (n=70) stated they were merely doing what they had been taught, whilst 11% (n=24) stated they were following hospital policy and 22% (n=51) failed to provide a reason. From these results, one could argue that most of the surgeons used prophylaxis, but in such a way that was inconsistent with guidelines. For further details, see the data extraction table in Appendix 1.

The aforesaid results are congruent with Pan et al's. (2009) findings, in which they stated that written antibiotic prophylaxis guidelines were available in 94% of the units, and, more notably, that 18% of the units administered antibiotic prophylaxis at the proper times. Even though 94% of the 17 units have written guidelines on antibiotic prophylaxis, only 65% administered antibiotic prophylaxis at the correct time, on anaesthesia induction. This perhaps indicates that written evidence of the recommendations does not influence adherence to antibiotic prophylaxis guidelines in one's practice. The study findings confirm that surgical teams find it difficult to adhere to antibiotic prophylaxis guidelines, results which are supported by another study by Castella et al. (2006) who argued that the choice of antibiotic prophylaxis was not always in line with present guidelines.

Castella et al. (2006) have evaluated the different parameters of prophylactic antibiotics, such as choice, timing and duration of antibiotic prophylaxis. Data from their study showed that antibiotic prophylaxis was administered to 63.3% (n=526) of 827 patients, of which 68.4% received the antibiotic in 30 minutes of the operation, 27.7% on the day of the operation, 3.4% during the operation and 2% the night prior to the operation. Results revealed that the choice of prophylaxis agents was appropriate in 56% of cases, acceptable in 27% and inappropriate in 4.8% of cases. The

results of this study clearly demonstrate that the timing of antibiotic prophylaxis was correct in 84% of operations, although it is observed that prophylaxis was given more than 60 minutes prior to surgery in 25% of instances. This was incorrect practice because prolonged administration of antibiotics may lead to multidrug resistance (Castella et al. 2006). For further details, see the data extraction table in Appendix 1.

While Castella et al.'s (2006) seminal study provides poor evidence through which to demonstrate conclusively poor adherence to antibiotic prophylaxis, one should note that other studies have reported similar experiences. Mater (2014) posited that results varied when HCWs were asked to rate their adherence towards how well they believe they follow antibiotic guidelines. According to Mater (2014), out of the 57 surgeons who responded 87.7% stated that they were using antibiotic prophylaxis routinely in surgery to reduce SSIs. 40.4% of surgeons rated their adherence to antibiotic prophylaxis as very good, 38.6% considered their adherence to be excellent, whilst 19.3% believed their adherence was good or average. For more details, see the data extraction table in Appendix 1.

In conjunction with this, Diana et al. (2011) estimated that more than 50% of surgeons administer antibiotic prophylaxis less than 30 minutes (49%), or more than 60 minutes in 6% of cases, prior to incision. Furthermore, the results showed that antibiotics were used in prolonged procedures of over 3 hours (11%), 4 hours (55%) or 6 hours (32%). This appears to concur with Tadros et al.'s (2013) and Penalver-Mompean et al.'s (2012) findings in their assessment of antibiotic prophylaxis administration. Tadros et al. (2013) in a retrospective case-control study found that out of 38 cases, 6 (15.8%) received antibiotic prophylaxis compared with 68 (89.5%) of controls. In this study, lack of adherence was identified with respect to timing of antibiotic prophylaxis. In addition, inappropriate antibiotic prophylaxis was identified in 8.9% of the cases reviewed with no statistically significant difference between cases and controls ($P=0.55$). Similarly, Penalver-Mompean et al.

(2012) reported that antibiotic prophylaxis was used routinely in all seven hospitals, which indicate that actual practice is different from evidence-based guidelines for the prevention of SSIs. However, no information was provided on antibiotic choice, timing, and duration of antibiotic administration.

Finally, consistent findings were documented in a similar study conducted in Brazil (Oliveira and Gama 2015), which examined antibiotic administration in 18 surgical procedures. The results of this study are in accordance with previous studies, which stated that there was lack of adherence to some aspects of antibiotic prophylaxis. The results of this study clearly confirmed that the use of prophylaxis was observed in 14 (77.8%) patients. The results also showed that the antibiotic was appropriate in 11 (78.6%) of cases and acceptable in 21.4% (n=3) of cases. Additionally, the findings suggested that antibiotics were administered by the surgical team in 60 minutes of incision in 78.6% (n=11) of cases, more than 60 minutes before incision in 7.15% (n=1), whilst 14.3% (n=2) of patients received the antibiotic after the incision. Finally, out of the 14 patients who received an antibiotic, 42.9% (n=6) of patients received multiple doses during surgery.

It is noteworthy that previous studies have shown that surgical teams encountered difficulties adhering to certain aspects of antibiotic prophylaxis, especially with respect to duration and choice of antibiotic prophylaxis (Castella et al. 2006). However, the factors affecting non-adherence to antibiotic guidelines were not assessed in the previous studies. Therefore, the literature demonstrates that the reasons for non-adherence to guidelines must be evaluated, and, ultimately, great effort should be dedicated to providing HCWs with evidence supporting the implementation of the guidelines, particularly as it pertains to the use of antibiotic prophylaxis. One can conclude that current practice around antibiotic prophylaxis administration diverges greatly from surgical antibiotic prophylaxis guidelines; hence, a disjuncture between current practice and evidence-based

guidelines for antibiotics has been identified. The next section summarises the literature related to intraoperative infection control practices for the prevention of SSIs.

3.7.2 Section 2: Review of Literature on Traffic Flow in Operating Room

This review has identified that there is a relative dearth of high-quality publications in this area of research. Consequently, this section focuses on four pieces of research conducted by Durando et al. (2012), Oliveira and Gama (2015), Tadros et al. (2013) and Castella et al. (2006) to determine adherence to clinical practice guidelines pertaining to traffic flow in ORs. Durando et al. (2012), Oliveira and Gama (2015), Tadros et al. (2013) and Castella et al. (2006) all found that there was a lack of adherence concerning both keeping the door open during operations and with respect to the number of surgical personnel in the OR.

Durando et al. (2012) observed that the doors of the OTs were mostly open during the duration of the operation in 36.3% (n=254) of cases. Their findings also demonstrated that more than 90% of the elective surgeries were performed with fewer than 10 HCWs, with an average of six health professionals and 3 members of the “clean” surgical team. These results show that the number of people in the OR was as one would expect for a typical operation, whilst, in contrast, keeping the door open for periods of time during surgery is clearly not in line with recommended practices.

Further, Tadros et al. (2013) observed that there was unnecessary traffic flow in and out of ORs. However, one should note that this study used a relatively small sample size. A study by Castella et al. (2006) however, reported that the mean number of persons in the OR during surgery was 6 people, although in 5% of surgeries there were 5-7 surgeons and in 6% of cases there were 4-10 people classified as other personnel, such as medical or nursing staff. Moreover, during surgery doors were opened an average of 12 times, and in 3% of operations doors were opened on more than 50 occasions. The findings from this study thus underscore that, whilst there were a limited

number of personnel located inside ORs, doors were nevertheless frequently opened during operations.

Oliveira and Gama (2015), who undertook a prospective observational study in Brazil with a small sample of surgical interventions (18 surgeries in total), highlighted that doors were kept open during surgical procedures on 16 (88.9%) occasions, and remained open in 1 (5.6%) instance for 90% of the total duration of the surgery. However, it is important to note that these observations did not consider those instances in which doors were opened for people or equipment. It was observed that 9 professionals were present in the OR. Therefore, in this study there was a lack of adherence concerning both keeping the door open during operations and the number of personnel present in the OR, which was shown to be larger than required for interventions. What the literature again demonstrates is a marked disjuncture between recommended practices and guidelines, particularly pertaining to doors being open in ORs. Lack of adherence was also observed in terms of the management of traffic flow in the OR, which suggests that greater attention should be paid to reducing unnecessary traffic in ORs, as part of the ongoing initiative to prevent postoperative wound infection. This is critical as limiting movement and traffic in the OR has been seen to lead to reductions in SSI rates (Pokrywka and Byers 2013).

3.7.3 Section 3: Review of Literature on Intraoperative Aseptic Practices in Operating Room

Inappropriate behaviour by surgical teams can lead to environmental contamination in the OR and, in turn, SSIs (Birgand et al. 2014). Measures conclusively proven to decrease SSIs include use of surgical attire (surgical gown, sterile surgical gloves, surgical masks covering both mouth and nose, and caps fully covering hair), hand hygiene, surgical scrubbing, removal of jewellery, and the use of protective barriers (Mangram et al. 1999; Spruce 2014). The results of prior studies underscore that these crucially important measures were not always necessarily adhered to, which is in direct

contravention to both international and local guidelines (Castella et al. 2006; Demir 2009; Oliveira and Gama 2015). Oliveira and Gama's (2015) work revealed that most members of surgical teams used the requisite surgical attire and jewellery. Having said this, their findings still demonstrated that, although there existed clear guidelines, there was still a continued failure to fully adhere to wearing the appropriate surgical attire. For instance, their results showed that out of 70 HCWs, only 10 (14.3%) used goggles, 41 (58.6%) used shoes without covers, 5 (7.2%) managed to wear the cap properly so as it covered their hair and ears, 70 (100%) used a gown, 68 (97.1%) wore the mask in its proper position, and 70 (100%) used surgical gloves. When it comes to wearing of jewellery in OTs, none of the surgical team members fully attired in gloves and gowns were wearing a ring, bracelet or watch, and those who wore a necklace/chain 11(15.7%), maintained these accessories inside the gown at all times and only exposing the earrings 19(27.1%)and eye glasses 21 (30%) (Oliveira and Gama 2015). From these results, it is evident that there is a need to improve adherence to the correct use of surgical attire, although one should note here that adherence to wearing surgical gloves was 100%.

Contradictory findings have also been reported. For example, Castella et al. (2006) observed that adherence to the wearing of surgical attire was good. They describe how all surgical personnel, except for one anaesthesiologist, wore a cap/hood. Indeed, of the 4,933 surgical personnel present in ORs, 87.5% of them correctly wore a cap/hood so that it completely covered their head hair, whilst 97% wore their masks as recommended, that is, they covered their nose and mouth. However, it was found that 14% of surgical team members and 37.9% of anaesthetists failed to change their mask between operations, even in those cases where it was visibly soiled, which is poor practice as masks should always be changed between surgeries. Indeed, surgical face masks have been shown to have a significant effect on the number of bacterial organisms falling into the incision site (Kelkar et al. 2013), hence why it should be changed between procedures. As well as this, shoe

covers were worn by 96% of people in the OR, although it was also observed that 6.8% of anaesthetists did not wear either type of footwear. In addition, the findings illustrate that 96% of surgical personnel adhered to the requisite standards of asepsis in terms of donning sterile gloves and gowns. Furthermore, this study found that jewellery was worn by 11.6% of surgeons, 22.1% of instrument nurses, 56.1% of anaesthetists and by 45% of other people in the OR. This was incongruent with the findings of Demir's (2009) study, who found that jewellery was worn in most OTs. According to Demir (2009), surgical caps and masks were always worn in all of the OTs observed, which is consistent with current guidelines attempting to decrease the chances of contracting a SSI. In the study by Demir (2009) correct preoperative surgical scrub using appropriate antiseptic was observed in 91.6% of cases, which was found to be in accordance with recommendations. These findings thus draw attention to an observable divergence in current OR procedures, such as wearing of surgical attire and removal of jewellery.

Similarly, Demir (2009) reported that staff did not change their clothes when coming in and out of the OT in 20.8% of cases and wore a long white coat over scrub suits before leaving their department. Although Woodhead et al. (2002) posits that there is hitherto no evidence-based research that proves that either wearing surgical attire outside the OT or returning to the OT without changing into clean theatre suits increases SSI rates, it is nevertheless still extremely poor practice and in direct contravention of present guidelines. Further, surgical caps and surgical masks were always worn across the observed OTs, which is consistent with the recommended protocol, while shoe covers were not worn in more than half (66.6%) of the OTs. The literature thus demonstrates that the current recommendations for HCWs as it pertains to wearing gowns, masks which cover the nose and mouth, sterile gloves and caps that cover one's hair during surgery, wearing protective clothes, avoiding wearing jewellery, appropriate preoperative and intraoperative hand antisepsis for surgical team members are well recognised. However, there was a general lack of adherence

reported for other procedures, such as the wearing of jewellery during surgery, inappropriate hand antisepsis and inconsistent use of surgical attire. Considering this observed disjunction between guidelines and current practices, the next section seeks to delineate the manifold factors underlying this non-adherence.

3.7.4 Section 4: Review of Literature on Barriers Affecting Non-Adherence to Guidelines among Surgical Team Staff

This section focuses on five studies that examined the manifold factors affecting non-adherence to guidelines. Although this is a critically important area of inquiry, the reasons for non-adherence to SSI preventive guidelines have hitherto not been studied in any significant depth (Durando et al. 2012). Having said this, previous studies have identified a range of barriers curtailing the successful implementation of EBP in a host of professional groups, including physicians and nurses. For example, studies by Demir (2009), Castella et al. (2006), Oliveira and Gama (2015), Mater (2014) and Diana et al. (2011) put forward a typology of the key barriers undermining adherence guidelines in clinical practice. These factors concern: knowledge; attitudinal and behavioural factors; guideline recommendations factors; and environmental factors.

Demir (2009) and Castella et al's. (2006) studies emphasised that a lack of resources, such as not having access to clippers or antiseptic bathing solution, in conjunction with other issues pertaining to careless behaviour, such as OR traffic, leaving doors open, lapses in aseptic techniques when donning surgical attire, and inappropriate usage of aseptic techniques for skin preparation were the most common barriers put forward to explicate non-adherence to guidelines. These findings were corroborated in Oliveira and Gama's (2015) study, in which they found that measures that were not adhered to stemmed from negligence or a lack of knowledge by professionals concerning the importance of adherence to the basic recommendations laid out in the guidelines. Contravention of guidelines was identified with respect to breaking sterility, having an unnecessarily large group of

people in ORs, using blades for hair removal, and prolonging antibiotic prophylaxis for more than the recommended 24 hours post-surgery.

According to Mater (2014), there are manifold factors influencing adherence to guidelines, such as lack of infection control programmes, lack of skills concerning sterilisation, low prioritisation, inadequate training of HCWs, ignorance of existing guidelines, and lack of evidence-based guidelines. To cite just one example, some interviewees stated that intraoperative recommendations were not written down per se, but, rather, were based upon a surgeon's previous experiences and education. Indeed, the author stated that some surgeons with extensive experience were particularly resistant to updating their practices apropos new guidelines. Resultantly, it is recommended that additional training in professional knowledge and skills are conducted that highlight the importance of implementing these recommendations (Mater, 2014; Oliveira and Gama 2015).

In a similar vein, Diana et al. (2011) posited in their study that personal beliefs and attitudes majorly impact upon people's clinical practices, which goes some way to explaining why surgeons are so reluctant to implement all of the proposed measures in their clinical practice. According to Diana et al. (2011), the strongest barriers to adherence to EBP concerned a lack of standardisation in surgeon's behaviour, a general ignorance of evidence-based guidelines, and a notable perception that there is a lack of evidence for many preventive measures. The findings thus suggest that cumulative experiences are not necessarily associated with more rigorous adherence to guidelines by senior surgeons, although surgeons' opinions do indeed influence their behaviour. In conclusion, the studies illustrate that lack of adherence to guidelines is related to multiple factors, including guideline recommendation factors, environmental factors, such as a lack of education and lack of

resources, and behavioural factors, such as lack of agreement with guidelines and perceived lack of evidence.

The above findings are supported by the results of other qualitative studies by Lugtenberg et al. (2010), who similarly reported that there are several barriers preventing successful implementation of research evidence in health care. These problems range from: lack of agreement with guidelines; lack of awareness and familiarity; lack of motivation; attitudinal barriers - self-efficacy, lack of evidence; environmental factors - lack of time/ workload, lack of resources, and lack of reimbursement; guideline factors - unclear or ambiguous guideline recommendations, not up-to-date; and patient factors – patient's preferences, patient's ability and demands (Lugtenberg et al. 2010).

Furthermore, a cross-sectional study conducted by Khammarnia et al. (2014) in Iran found that more than half of the participants agreed that 56% and 57% of barriers to the implementation of evidence-based guidelines are related to organisational and individual related factors respectively. More specifically, participants identified barriers at an organisational level that included a lack of cooperation between staff, lack of human resources, lack of internet access at the hospital, and workflow. Whilst individual related factors encompassed a lack of time to read the evidence-based guidelines (83.7%), insufficient proficiency in English (62.0%), age, educational level, job experience and lack of knowledge. In their study, the authors showed that lack of time is a common barrier preventing the implementation of EBP.

A cross-sectional survey study with a mixed-methods qualitative-quantitative design was conducted by Jahansefat et al. (2016) in Iran. The study consisted of 53 HCWs who were divided into 3 groups of physicians, nurses and nurse assistants. This study identified different barriers preventing the implementation of EBP to prevent ventilator-associated pneumonia (hereafter abbreviated as VAP).

These barriers included individual factors, such as negative attitudes, low levels of knowledge, and organisational factors such as lack of time, lack of facilities, ethical issues, as well as the lack of clarity in the recommendations, absence of support, paucity of supervision and poor teamwork. With this in mind, it is important that these aspects should be taken into consideration when health decision-makers and health managers attempt to increase the adherence of HCWs to evidence-based guidelines.

There have been several studies evaluating compliance with surgical prophylaxis guidelines in hospitals worldwide, but hitherto there are few studies exploring factors that affect non-adherence. Out of those limited range of studies, the barriers towards implementation of surgical prophylaxis guidelines that have been identified include lack of awareness, non-accountability, and the false belief that multiple dosages of antibiotics and prolonged therapy is more effective in preventing SSI compared to a shorter duration (Parulekar et al. 2009; Khan et al. 2006). These findings were supported by Kasteren et al. (2003), who argued that the main barriers to the use of prophylactic antibiotics ranged from lack of awareness due to the ineffective distribution of the most recent version of the guidelines, lack of agreement by surgeons with the local hospital guidelines, and environmental factors such as organisational constraints in both the surgical suite and in the ward. According to Kasteren et al. (2003), lack of awareness about the appropriate guidelines were the primary barrier to guideline adherence regarding antimicrobial choice and dosage. From these studies, it is apparent that greater attention should be paid to both providing surgeons with the necessary evidence about the content of the guidelines, and towards trying to achieve consensus before implementing new guidelines (Kasteren et al. 2003). In addition, the culture, linguistic and religious diversity can strangely influence compliance to infection control practices. The next section focuses in cultural challenges that may influence compliance with recommended practices for improving quality of healthcare in clinical settings.

3.7.4.1 Section 4: Cultural and Linguistic Diversity in Health Care

Iwelunmor et al. (2014) and Chiang and Carlson (2003) explored the notion that culture refers to how common traditions, beliefs and practices shape people's social attitudes and behaviour through their interactions with each other in society. According to Swierad et al. (2017), different cultural values and beliefs have a major influence on people's health behaviours, as these different cultural values and beliefs can often be in conflict with one another. Furthermore, McBain-Rigg and Veitch (2011) found that cultural diversity can be a source of conflict and profound misunderstanding between healthcare professionals and patients. Previous studies have shown that culture has a major influence on people's health behaviours and their views on diseases (Rosen 2015). Therefore, they argue that people should be cognisant of different cultures in order to better understand their health behaviour. The results indicate that it is imperative that healthcare facilities raise cultural awareness for all HCWs to provide culturally competent care for patients (Sidumo and Ehlers 2010). A further important result highlighted in another study was that culture functioned as a barrier to healthcare services, in that HCWs had to care for people from different cultural backgrounds (Atanga and Ayong 2017).

Notably, cultural diversity exists in most healthcare facilities, particularly among expatriate health providers who speak different languages and have different cultural values and beliefs (Almutairi 2012). Other studies have indicated a lack of awareness of cultural differences among HCWs who work abroad, not to mention that most expatriate HCWs have not received any cultural training, which, in turn, affects the level of communication and interaction between people from different cultural backgrounds (Brown and Busman 2003; Almutairi 2012). For Almutairi (2012), communication barriers between HCWs and patients are common in many countries characterised by different cultural backgrounds. As a result, many HCWs expressed a willingness to learn about

cultural diversity and develop their Arabic language skills to be more capable of providing culturally competent care (Almutairi 2015).

There are hitherto no studies on the impact of cultural diversity on healthcare outcomes in Oman. However, several studies have explored the impact of cultural diversity on healthcare practices in OTs. The OT is an environment where HCWs work with a multidisciplinary team and, as such, invariably experience challenges in their daily working activities in OTs (Bjom and Bostrom 2008). For example, in the United Kingdom (UK), lack of communication between HCWs from diverse cultural and linguistic backgrounds has been shown to be a major problem during surgical procedures (Bezemer et al., 2015). Moreover, an earlier study found that surgical teams in OTs are not only made up of people from different cultural and linguistic backgrounds, but also with different levels of clinical experience (Bezemer et al., 2011). Consequently, healthcare providers from different backgrounds should be informed about cultural differences and, if possible, taught the native languages (Ulrey and Amason 2001). For instance, research showed that the majority of HCWs in Saudi Arabia were expatriates from different countries (Almutairi et al., 2012). This raised concern because people from different cultures must communicate with each other to take care of a culturally diverse population. Indeed, most nurses were entirely ignorant of Saudi culture, which affected their ability to provide culturally competent care (Almutairi et al., 2012). According to Almutairi et al. (2012), lack of awareness of Saudi culture among HCWs can lead to conflicts and misunderstanding over Saudi patients' behaviour, and, thus, understanding cultural differences can help HCWs to better communicate with each other and provide better care. This point was also supported by Shukri (2005), who observed that expatriate nurses who come from other countries encounter notable problems with cultural diversity and different communication styles (Shukri 2005).

Findings from other studies have highlighted that a lack of knowledge of different cultures and linguistic barriers between non-Arabic speaking HCWs and patients adversely influences the quality of care (Englund and Rydstrom 2012; Rebekah and Carey 2011). Studies conducted by Zaiton and El-Meanawi (2017), Travers et al. (2015), Karout et al. (2013) and Kersey-Matusiak (2103) reported that different cultural backgrounds, race, ethnicity and religion, nationality diversity and language among HCWs are the most common barriers to effectively implementing infection control practices. These authors also posited that non-English-speaking healthcare providers who observe different cultural traditions faced notable difficulties when required to discuss certain medical issues, which restricted their ability to understand and limited their adherence to the recommended practices. Furthermore, they noted that nurses were unable to implement infection prevention and control recommendations effectively due to their respective cultural traditions and language differences. According to the authors, language and culture are thus the most important factors for implementing infection prevention and control practices, of which effective communication is important for improving the quality of care. As the aforesaid studies demonstrate, culture and linguistic diversity play a significant role in terms of implementing effective infection prevention and control practices. Therefore, it is strongly recommended that HCWs should be culturally competent when caring for patients by integrating their culturally diverse experiences and increasing their awareness within their clinical practice (Schim et al., 2006).

In addition to this, Hart and Mareno (2013) stated that a lack of knowledge of other cultural values and norms represented a major challenge to integrating culturally competent healthcare in clinical practice. Therefore, Papadopoulos et al. (2016) and Hart and Mareno (2013) proposed that HCWs should understand different cultures and communicate competently with people from different cultural backgrounds in order to improve the level of care they provide to their patients (Hart and Mareno 2013; Hakim and Wegmann 2002; Bermejo et al., 2012; Jobanputra and Furnham 2005).

The aforesaid results are congruent with Aboul-Enein's (2002) findings that most nurses in Saudi Arabia are expatriates selected from different countries, most of whom have different values and beliefs to those exhibited in Saudi culture. In relation to this, El-Amouri and O'Neill (2011) stated that the United Arab Emirates (UAE) has become a culturally and linguistically diverse country because the majority of HCWs are from different non-Arabic speaking nations. They reported that 80% of the population comprised expatriate HCWs compared with 20% who are local staff, which indicates the presence of many languages and cultural differences that can pose a challenge to the provision of high-quality care (El-Amouri and O'Neill 2011).

This appears to concur with Massoudi's (2006) findings that most expatriate nurses in Saudi Arabia are from diverse cultural backgrounds and that this can lead to a breakdown in professional relationships. In the same way, Alosaimi et al.'s. (2013) investigation of cultural issues among non-Muslim nurses found that cultural language barriers and religious differences influenced non-Muslim nurses' experiences in Saudi Arabia. This is supported by Almutairi (2015), who stated that non-Muslim nurses' experiences of working with patients are affected by manifold factors, including language barriers and a lack of understanding of both Islam and its cultural traditions. The authors found that the religion of expatriate nurses had a major effect on the quality of care provided to Muslim patients. According to Alosaimi et al. (2013), the majority of expatriate nurses felt that religion hindered their ability to provide care. For example, nurses failed to remove patients' clothing, such as the Niqab (face covering). Moreover, their findings suggested that nurses were personally affected by religion and felt that they were not respected by their colleagues because they were non-Muslims (Alosaimi et al. 2013). These results were supported by Al-Wahbi et al. (2014), who demonstrated that some nurses were working for the first time in Saudi Arabia without having any prior knowledge or background information about Saudi culture, and, as such, encountered profound difficulties in providing culturally competent care. Finally, these findings

were supported by Fortier and Bishop (2003), who stated that working with a culturally diverse population requires HCWs to manage complex differences in communication, style, attitudes and language.

Linguistic diversity is one of the challenges facing HCWs in many countries. The studies by Karout et al. (2013) and Schyve (2007) found that cultural and language differences presented critical challenges to patients and HCWs. Specifically, most expatriate HCWs experienced difficulties in communication with native Arabic speakers. Consequently, Shakya and Horsfall (2000) proposed that communication skills training should be provided for all HCWs in clinical practice, especially for non-native speaking HCWs. Evidence highlights that a lack of communication between HCWs can lead to poor clinical decision-making, increased medical errors, prolonged hospital stays and poor patient outcomes (Gregg and Saha 2007). Similarly, Hamilton and Woodward-Kron (2010) found that differences in language and culture can produce misunderstandings, which can seriously impact on healthcare related outcomes and patient safety. Other studies by Kirschbaum et al. (2018), Weiser et al. (2008) and Mazzocco et al. (2009) show that poor communication among surgical team members can lead to an increased risk of wrong incision sites, which, in turn, results in major complications and increases the mortality rate.

Other studies have shown that communication between doctors and nurses is characterised by an explicit power relationship. Weldon et al. (2013) observed that a lack of clarity in power relationships and individual roles impacted on the communication between HCWs. For instance, Awed et al's. (2005) study found that poor communication among surgeons, anaesthesiologists, and nurses caused adverse effects that impacted upon patient safety. Their findings also suggested that surgeons, anaesthesiologists, and OR nurses perceived their level of communication differently. Therefore, respect for cultural differences is integral to improving communication between HCWs

in OT (Kirschbaum et al., 2018). In similar vein, Aldossary et al. (2008) stated that, although the majority of patients and their families in Saudi Arabia spoke Arabic, which is their native language, most HCWs, including nurses, communicated in English. However, other research has observed that many expatriate nurses do not speak English as their first language, nor are they competent in Arabic (Simpson et al., 2006). The above findings are supported by Bezemer et al's. (2011) study, which reported that communication barriers between people from diverse professional, social, cultural, and linguistic backgrounds in OTs constitutes a major problem. The authors argued that, while there are different cultures and tremendous linguistic diversity among HCWs, there are few opportunities to share language and important information.

These findings are supported by Clayton et al. (2016) who argued that difficulties in communication in OTs occur due to cultural diversity among HCWs, which can detrimentally affect the quality of patient care and the atmosphere at work. The findings are in accordance with other studies by Greenberg et al. (2007) and Hu et al. (2012), which indicated that communication barriers pose a significant threat to surgical safety. Greenberg et al's. (2007) study reported that lack of communication is more likely to occur in the preoperative (38%), intraoperative (30%), and postoperative (32%) phases of surgical care. The authors observed that the most commonly observed problems were that information was either never transmitted (49%) or that information was communicated but inaccurately received (44%).

There is scarce data on how teamwork is carried out in the OT (Leinonen et al., 2002). However, some studies conducted in OTs have indicated that teamwork is essential for intra-operative care. Salvage and Smith (2000) observed that the relationship between physicians and nurses is not always straightforward, and, as such, theatre nurses' relationships with surgeons requires special attention (Bjorn and Bostrom 2008). Lovering (2008) noted that the challenge of developing good

teamwork in the OR is influenced by manifold factors, including the surgical team's values and beliefs, and traditional and cultural issues in the workplace environment. Surgeons invariably adopt a leadership role, whilst nurses are considered to be surgeons' assistants in OTs (Jayasuriya-Illesinghe et al., 2016). This testifies to the fact that nurses and doctors have different views pertaining to adherence to clinical guidelines, and, in fact, nurses are more likely to adhere to the recommendations (McDonald et al., 2005; Leach et al., 2011). Leach et al's. (2011) study also showed that surgical team members change from time-to-time, and thus many do not work consistently with one another. Therefore, HCWs experience difficulties in expressing their feelings or asking questions (Edmondson 2003).

A mixed-methods study by Stone et al. (2017) found that the ways surgeons interacted with other surgical team personnel varied greatly. According to the authors, surgeons' behaviour and attitudes strongly influenced how OR staff perceived their leadership. The authors also argued that surgeons used different behavioural strategies to improve team performance, such as avoiding criticising others and increasing the engagement of surgical team members in perioperative tasks (Stone et al., 2017). This is supported by Dorgham and Al Mahmoud (2013), who proposed that nurses and physicians should share responsibility for patient care and respect each other's ability. In this respect, doctors should support nurses by providing greater opportunities for them to participate in clinical decision-making (Dorgham and Al Mahmoud 2013).

This finding was supported by Jayasuriya-Illesinghe et al. (2016), who showed that surgeons perceived themselves as being leaders and viewed themselves as being responsible for other HCWs. Conversely, they stated that nurses occupied a position below that of surgeons in this hierarchy. It is noteworthy that previous studies have shown that a nurse's role was limited to complying with and carrying out surgeons' instructions and providing them with the requisite support.

Furthermore, Fooladi (2003) found that, within Saudi OTs, male nurses from different nationalities appeared to have greater power over female nurses. This is because male nurses in Saudi Arabia do not accept women in positions of authority (Fooladi 2003). Regarding patients' preferences, it was found that gender preferences were more common among female patients than male patients (Ahmed and Alshraideh 2007). Ahmed and Alshraideh (2007) reported that in Jordan, 75% of female patients preferred female nurses, whilst only 3.4% preferred that male nurses care for them. In contrast, the authors found that 33.9% of male patients preferred male nurses and only 9.7% preferred female nurses, which indicates that gender preferences play a major role in healthcare. From these studies, it is evident that cultural differences and language barriers significantly impact on the quality of healthcare and patient safety (Awad et al., 2005). Therefore, it is proposed that HCWs should improve their understanding of their immediate social and cultural context.

3.8 Literature Review Summary

This literature review has drawn attention to the fact that there is partial adherence to some specific recommended measures during preoperative and intraoperative care. These studies showed that the HCWs included in their research generally did not conduct their clinical practice in line with recommendations for the prevention of SSI. Specifically, a lack of adherence was observed in techniques of preoperative skin preparation, prolonged preoperative hospital stays, shaving patients prior to surgery using non-recommended methods, improper duration of antibiotic prophylaxis, and unnecessary traffic flow in OTs. However, some practices were successfully adhered to, such as skin antisepsis and the timing of antibiotic prophylaxis administration. Moreover, the examined literature also identified several factors affecting non-adherence to guidelines, including [cultural and linguistic diversity](#), lack of awareness, behavioural determinants, lack of resources and lack of knowledge. Hence, one can discern that a gap exists between current

evidence and clinical practice concerning SSI prevention, which I discuss further in the section below.

3.9 The Gap Between Evidence and Practice

The gap between evidence-based guidelines and practice must be addressed to achieve optimal practice in this domain. This is no simple matter, as research has demonstrated that translating evidence-based guidelines into practice is a major challenge for HCWs (Eskicioglu et al. 2012; Greene 2014). This is made more difficult yet still because there have been so few studies evaluating adherence to international and national standards worldwide (Durando et al. 2012), and hitherto no studies assessing adherence to recommendations for the prevention of SSI in elective surgeries in Oman. Compounding this, the factors affecting non-adherence to guidelines have not been studied in sufficient depth. As a result, it is recommended that further research be carried out assessing modifiable risk factors in elective surgeries in Oman (Dhar et al. 2014). To address this lacunae in extant research, this study aims to document existing preoperative and intraoperative procedures and compare these practices with evidence-based practice guidelines. Moreover, the study aims to examine surgical teams' perceived barriers to implementing guideline recommendations for the prevention of SSIs in their practice.

3.10 Chapter Summary

There is a relative dearth of studies examining adherence to preventing SSIs in clinical practice by focusing on preoperative and intraoperative infection control measures. These studies discussed in this chapter include observational prospective studies, cross-sectional surveys, self-administered questionnaires and case-control studies. However, most of these studies were deemed to be limited with respect to their size and design. Data were collected using direct observations, interviews and

questionnaires. Some published studies assessed adherence to specific aspects of infection control practices in preoperative and intraoperative periods. Moreover, factors underpinning this non-adherence have yet to be studied. To address this gap, there is a need to conduct a mixed-methods study that assesses what happens in practice in relation to preoperative and intraoperative infection control procedures, and evaluates adherence to guidelines for the prevention of SSI. Furthermore, one must also investigate in greater detail the manifold factors affecting nonadherence to guidelines. The following chapter delineates the methods that were adopted in this study. In this review, the researcher concluded that using questionnaires to assess adherence may lead to response bias, which, ultimately, can affect the validity of the findings. Moreover, this review identified that using self-administrated questionnaires as tool for data collection can lead to an overestimation of adherence to some practices (Pan et al. 2009), or even lead to recall bias as not every respondent may answer every question (Adams et al.1999; Davis et al. 2008). Therefore, it was concluded that self-report questionnaires should not be used as the only measure of guideline adherence, because the increased dependence on self-reports as a measure of quality of care appears to produce gross overestimations of performance (Adams et al. 1999). Consequently, to address this potential methodological limitation, the researcher has adopted a mixed-methods approach, which will be discussed at length in the next chapter.

Chapter Four:

Methodology

4. Chapter Four: Methodology

4.1 Introduction

Chapter Three showed a gap in the literature concerning adherence to guidelines preventing SSIs during elective surgery. This chapter delineates the theoretical framework and research design that underpins the study, and discusses the mixed-methods approach that was adopted to evaluate adherence to guidelines. The chapter also addresses some of the ethical considerations posed by the research.

4.2 Research Questions, Aims and Objectives

The aims of the study are to examine preoperative and intraoperative procedures used in the prevention of SSI, and evaluate their application viz-a-viz international and national guidelines in two governorate hospitals in Oman. In addition to this, the study also seeks to investigate the manifold factors affecting non-adherence to international and national guidelines. The research questions are:

1. What is the level of adherence of healthcare workers to international and national guidelines for preventing SSI during elective surgery in surgical wards and ORs in Oman?
2. What are the factors that determine compliance with SSI prevention guidelines during elective surgery in Oman?

4.3 Theoretical Framework

There is a broad array of evidence-based utilisation theories available which have been used in a range of clinical settings (White and Spruce 2015). As such, these models provide a blueprint for the researcher concerning how to study a clinical problem, such as SSIs (White and Spruce 2015). Translating EBP into practice is essential for improving adherence to guidelines and, in turn, the overall effectiveness of health services. By translating the best EBP into specific recommendations

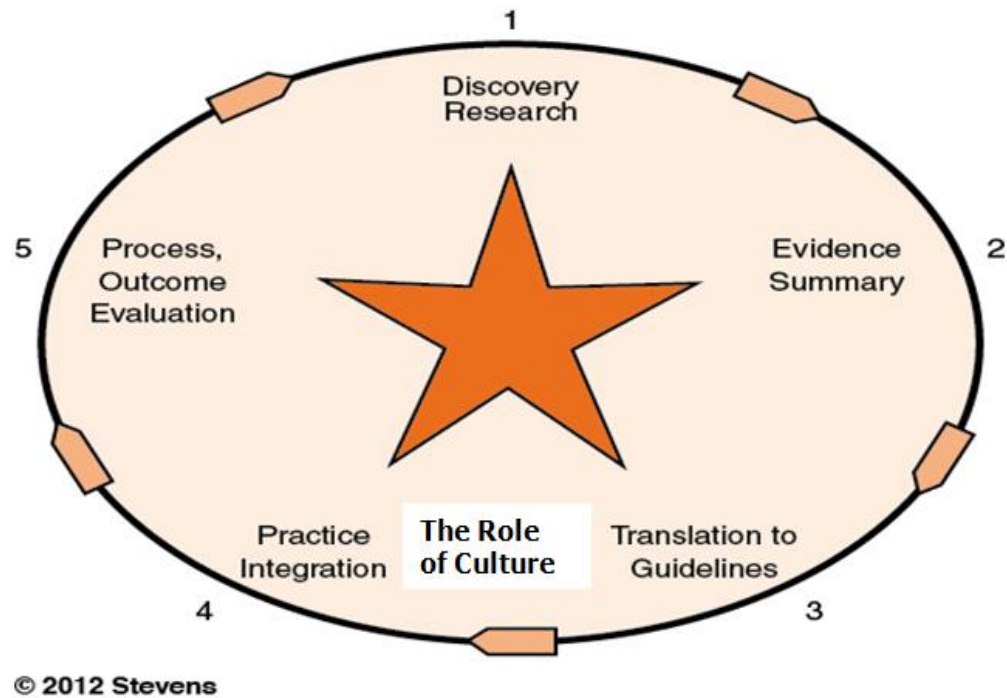
for clinical practice, they can help to facilitate the uptake of new research findings and insights in clinical practice (Lugtenberg et al. 2009). Consequently, EBP should form the basis of care in all perioperative facilities and OTs. However, currently care is not always provided based on evidence-based guidelines, and, in fact, perioperative team members are often unaware of the evidence that is available about their clinical practice (White and Spruce 2015). To prevent SSI, then, a concerted effort is required to translate evidence-based guidelines into practice. This is important as translating evidence-based guidelines into practice also helps the surgical team staff to make quality clinical decisions and, in turn, improve outcomes for patients undergoing major elective surgery. There are various models that underpin EBP and that facilitate the implementation of research findings into practice (Schaffer et al. 2012). These models include the Academic Centre for Evidence-Based Practice (hereafter abbreviated as ACE) Star Model of knowledge transformation, Advancing Research and Clinical Practice through Close Collaboration (hereafter abbreviated as ARCC), the Stetler Model, Iowa model and Johns Hopkins Nursing Evidence-Based Practice Model (hereafter abbreviated as JHNEBP) (Bishop 2007; Gawlinski and Rutledge 2008; Schaffer et al. 2012) and the Evidence-Based Practice Model for Staff Nurses (Reavy and Tavernier 2008). These models are intended to provide a step-by-step guide on how to tackle a clinical problem, such as SSIs, and match it to an intervention based on empirical research to engender an organisational change in practice (White and Spruce 2015).

The theoretical framework adopted in this research is evidence utilisation theory. EBP requires that HCWs carry out actions based on clinically relevant studies (McInerney and Suleman 2010). The ACE Star Model was adopted in this research for the purposes of implementing an EBP infection prevention guideline (Keele 2011). The ACE Star model has been proven to be one of the most effective models through which to translate evidence into practice (Keele 2011), because it includes a tool to help facilitate the actual implementation of evidence-based guidelines. In this way, the

implementation of EBP models help to break down the complexity of the challenge of translating evidence into clinical practice (Schaffer et al. 2012). The ACE Star model was chosen for this study due to the fact that it provides a linear process approach to integrating evidence into practice, not to mention that it is a frequently used EBP model for aiding HCWs in their clinical practice (Stevens 2013) (See Figure 4). In addition, it provides a framework for systematically actioning EBP processes, as well as explaining the type of knowledge necessary for transforming practice (Stevens 2013). It is also widely utilised in clinical practice to assess HCWs readiness to employ EBP (Stevens 2013). The ACE Star Model also puts forward crucial steps for integrating the best research evidence with clinical expertise and patient preferences to achieve EBP (The University of Texas Health Science 2015). This model is thus an expedient framework through which to identify the requisite skills for employing EBP in clinical practice (The University of Texas Health Science 2015). The model consists of five stages, including: the knowledge discovery stage - which focuses on new knowledge identified through qualitative and quantitative studies; a summary of the evidence - which is a synthesis of all available knowledge; translation of evidence-based guidelines into practice; understanding of how culture influences implementation processes and HCWs' use of evidence-based guidelines in their daily practice, integration of evidence into practice – involving identifying factors that could facilitate this process; and evaluation of the potential impact of the evidence-based practice on health outcomes (Stevens 2013). It is critically important to analyse the cultural issues, shared assumptions, beliefs, values and norms in relation to the use of research in clinical practice. There are existing guidelines in clinical practice for the prevention of SSIs in Oman. However, the SSI rate is still high. With respect to practice integration and the implementation of guidelines, non-adherence to certain procedures stems from manifold factors, including cultural issues. The evaluation of non-adherence to guidelines falls within stage 5 of the ACE model. Based

on the results of this study (stage 1), it is essential to tackle the role of culture with respect to translation to guidelines (stage 3) and practice integration (stage 4).

Figure 4: Academic Centre for Evidence-Based Practice Star Model: Knowledge Transformation (The University of Texas Health Science 2015).

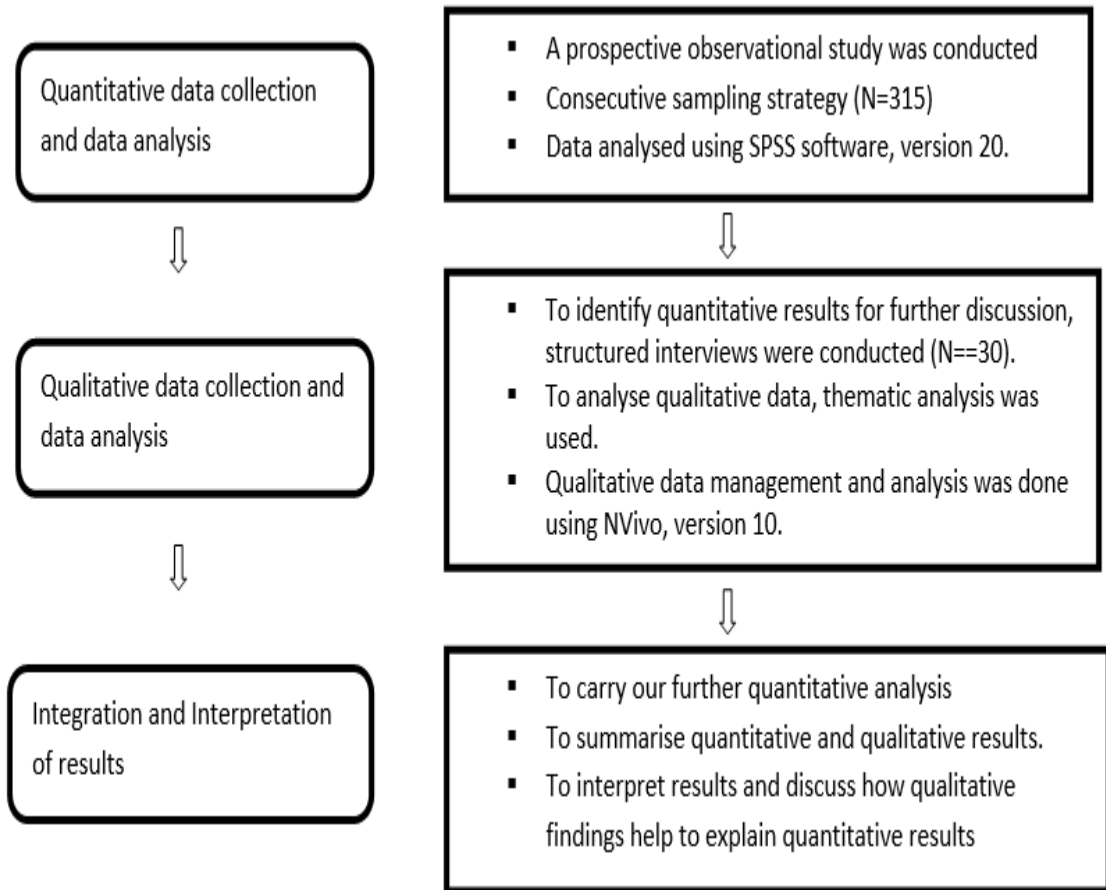


4.4 Mixed-Methods Approach

This study employed a mixed-methods research design and utilised quantitative and qualitative forms of data collection. A mixed-methods approach is a research design that involves the collection, analysis, and integration of both quantitative and qualitative research methods in a single research study to answer the stated research questions (Denscombe 2008; Johnson et al. 2007; Lingard et al. 2008). The approach for this study is characterised by the collection and analysis of

quantitative data, followed by the collection and analysis of qualitative data, whereby the two methods are then subsequently integrated during the interpretation of the findings, as per the prescriptions of Creswell et al. (2004) and Driscoll et al. (2007). Quantitative and qualitative research methods are utilised to provide a more comprehensive understanding of the phenomenon under investigation. The rationale for this approach is that the quantitative data documents what is happening in practice, while the qualitative data helps to explain the statistical results by exploring participants' perspectives in depth (Driscoll et al. 2007). In this mixed-methods study, the findings of phase 1 were obtained by observing practices during preoperative and intraoperative care. In phase 2, data was collected which allowed the researcher to explore the factors influencing non-adherence to guidelines. A mixed-methods sequential explanatory design is thus deemed to be ably suited for evaluating adherence to practices that aid the prevention of SSI (See Figure 5).

Figure 5: Overview of the Mixed-Methods Sequential Explanatory Design Adapted from Limon et al. (2014)



A mixed-methods approach is uniquely suited to this type of study because it is more comprehensive than a single design. This explains why this research method is widely adopted in clinical practice to both understand the complexity of health care, and as a means through which to enhance EBP (Hayes et al. 2013). Further, mixed-methods studies can aid researchers' understanding of potential contradictions between quantitative results and qualitative findings (Patient Centered Medical Home 2013). In a mixed-methods approach, findings are thus likely to be more trustworthy and relevant than if separate approaches were used in isolation (Creswell 2009). Adopting this combined approach allowed adherence to practice to be viewed from both the perspective of the observer

and those who work in surgical departments and OTs. More importantly, as noted in Chapter Three, there are relatively few comprehensive studies on SSI adherence, not to mention that they are ordinarily small in scale and provide scarce detail about the reasons for poor adherence. As a result, the researcher set out in this study to evaluate adherence comprehensively in a large-scale sample (structured observation) and explore the challenges to adherence (interviews) in a sequential mixed-methods study. Despite its popularity, one should stress that mixed-methods studies are not easy to implement, primarily due to the complexity of interpreting results during data analysis (Ivankova et al. 2006; Johnson and Onwuegbuzie 2004; Johnson et al. 2007). Moreover, mixed-methods studies are more time consuming and researchers must put more effort into collecting, analysing and integrating the voluminous data. This also means that it requires a high level of skill on the behalf of the researcher, who must learn about multiple methods and know how to integrate them appropriately (Johnson and Onwuegbuzie 2004). In the proceeding sections, I provide a general overview of the research methods used in the study.

4.4.1 The Quantitative Component of the Study

4.4.1.1 Structured Observation

A prospective non-participant observational study was undertaken in OTs over a 6-month period to gather the required data for evaluating adherence to SSI prevention guidelines in elective surgery. Although observations were undertaken, one should note that in practice these were non-participant observations, where the researcher observes without interrupting normal practice and patient's care. A prospective observational study of elective surgeries at both the pre-and intraoperative stages of surgical procedures was carried out in two Governorate hospitals, for the purposes of evaluating their adherence to international and national guidelines for preventing SSI in elective surgeries. In this study, different types of elective surgeries were observed, including general surgeries, orthopaedic surgeries and other specialist surgeries, as well as different wound

classes, such as clean, clean-contaminated and contaminated. Surgical wound classification was based upon the Association of Perioperative Registered Nurses (hereafter abbreviated as AORN 2015). The initial quantitative phase of the research used validated data collection tools to gather data on preoperative patient preparation and intraoperative infection control practices. These observational tools were based on both the CDC (2011) and the GCC-CIC (2013) guidelines. See Appendix 5 for further details.

There are many strengths associated with using a quantitative research design. Although structured observations can potentially limit the researcher's ability to capture other complex activities that occur in the field spontaneously (Watson et al. 2010), it is probably the most important source of information for understanding health performance, as it allows the researcher to actually find out what HCWs are really doing in terms of their clinical practice. Therefore, it is always cited as the "gold standard" of quantitative methods, as it generates in-depth information about what HCWs do rather than what they think they do, or would like others to think that they do (Gillham 2008; Green and Thorogood 2004). Because structured observations ensure that each surgical procedure is observed and recorded in the same way, it is also for enabling researchers to measure and compare variations between cases (Seale 2004). Hence, observational studies have been widely used in infection control to record actual practice (Moule and Hek 2011). In addition, the structured observation has been effectively used by different researchers like Durando et al. (2012) and Castella et al. (2006) in Italy in a large prospective investigation of OT practice. It has also been used by other researchers like Gould (2011), Pittet (2001) and O'Boyle et al. (2001) who used direct observation research to assess compliance with hand hygiene practices. However, one should also note that it is one of the most complex forms of data collection, requiring a great deal of concentration and attentiveness, as well as potentially being susceptible to observer bias (Haro et al. 2006; Muijs 2004). I discuss these limitations in turn below. A prospective non-participant

observational study was undertaken in OTs over a 6-month period to gather the required data for evaluating adherence to SSI prevention guidelines in elective surgery. Although observations were undertaken, one should note that in practice these were non-participant observations, where the researcher observes without interrupting normal practice and patient's care. A prospective observational study of elective surgeries at both the pre-and intraoperative stages of surgical procedures was carried out in two Governorate hospitals, for the purposes of evaluating their adherence to international and national guidelines for preventing SSI in elective surgeries. In this study, different types of elective surgeries were observed, including general surgeries, orthopaedic surgeries and other specialist surgeries, as well as different wound classes, such as clean, clean-contaminated and contaminated. Surgical wound classification was based upon the Association of Perioperative Registered Nurses (hereafter abbreviated as AORN 2015). The initial quantitative phase of the research used validated data collection tools to gather data on preoperative patient preparation and intraoperative infection control practices. These observational tools were based on both the CDC (2011) and the GCC-CIC (2013) guidelines. See Appendix 5 for further details.

4.4.1.1.2 Rationale for the Use of CDC Practice Guidelines

The findings of this study were assessed against CDC's guidelines to determine the healthcare providers' adherence to internationally recommended practices. The CDC guidelines were used because the local GCC guidelines largely derive from them. The GCC guidelines have not been updated recently in line with CDC and other international guidelines and continue to emphasise some aspects pertaining to the prevention of SSIs more than others. Some of these preventive measures include bathing the patient daily to reduce the number of microbes, avoiding shaving altogether or, if necessary, shaving with clippers, preoperative skin preparation with an appropriate antiseptic, optimal usage of antibiotic prophylaxis and wearing of surgical attire. As the research

was undertaken in Oman, it was of paramount importance to focus on those aspects of the guidelines deemed to be most important by national experts in Oman. The GCC Centre for infection control has completed its updates for the 2nd edition of infection prevention and control practices guidelines in 2013. The GCC guidelines recommend preventive measures, such as reducing the number of skin bacteria by adhering to proper hand hygiene practices, preparing the patient's skin prior to procedures with an appropriate antiseptic agent, using the correct skin preparation for the patient's incision site, if hair removal is deemed to be necessary, then clippers should be used immediately before the procedure, use of a non-touch dressing technique, keeping doors closed during procedures, wearing of surgical masks, removal of all jewellery and wristwatches before entering the OR suite, washing hands and arms up to the elbow with a non-medicated soap before entering the OR, use of appropriate antibiotic prophylaxis and showering with antiseptic. The CDC guidelines consist of many recommendations, some of which are based on valid evidence whilst others are based on expert opinion, and provide clear guidance and advice about how to prevent and control SSIs. Furthermore, CDC guidelines are chosen because they can be modified by selected hospitals to match their own needs (CDC 2016), and because CDC guidelines for the prevention of SSIs are used in the core literature, such as Castella et al. (2006), Pan et al. (2009), Davis et al. (2008), Oliveira and Gama (2015) and Demir (2009). It also provides a new and updated evidence-based practice for the prevention of SSIs (Berrios-Torres et al. 2017). Therefore, I have adopted these guidelines as the principal source of reference for my study.

There is much strength associated with using a quantitative research design. Although structured observations can potentially limit the researcher's ability to capture other complex activities that occur in the field spontaneously (Watson et al. 2010), it is probably the most important source of information for understanding health performance, as it allows the researcher to actually find out what HCWs are really doing in terms of their clinical practice. Therefore, it is always cited as the

“gold standard” of quantitative methods, as it generates in-depth information about what HCWs do rather than what they think they do, or would like others to think that they do (Gillham 2008; Green and Thorogood 2004). Because structured observations ensure that each surgical procedure is observed and recorded in the same way, it is also for enabling researchers to measure and compare variations between cases (Seale 2004). Hence, observational studies have been widely used in infection control to record actual practice (Moule and Hek 2011). In addition, the structured observation has been effectively used by different researchers like Durando et al. (2012) and Castella et al. (2006) in Italy in a large prospective investigation of OT practice. It has also been used by other researchers like Gould (2011), Pittet (2001) and O’Boyle et al. (2001) who used direct observation research to assess compliance with hand hygiene practices. However, one should also note that it is one of the most complex forms of data collection, requiring a great deal of concentration and attentiveness, as well as potentially being susceptible to observer bias (Haro et al. 2006; Muijs 2004). I discuss these limitations in turn below.

4.4.1.2 Limitations of Direct Observation

Whilst the ‘gold standard’ of direct observation yields detailed information, this method has been shown to be subject to biases, including observer bias and the Hawthorne effect (Haas and Larson 2007). The main source of contention with direct observation is the possibility that Healthcare professionals (hereafter abbreviated as HCPs) simply change their behaviour when they know that they are being observed (Gale 2004; McCambridge et al. 2014), as the feeling of being observed can affect individuals’ behaviour in any clinical situation (Schwartz et al. 2013). This is known as the Hawthorne effect. It has been found that the validity of results can be undermined by this as it is difficult for the observer’s presence not to be overtly felt (Gould et al. 2011). In terms of this study, the Hawthorne effect has the potential to result in falsely increased adherence rates. For example,

it is widely accepted that the Hawthorne effect rapidly increases HCW hand hygiene compliance rates (Srigley et al. 2014).

Thus, in order to avoid or mitigate the Hawthorne effect, I spent time in the ORs without conducting observations prior to the commencement of the study in order for OT staff to familiarise themselves with me before data collection started. Additionally, when starting the observation, I introduced both myself and the purpose of the observation to all HCWs who were responsible for patient care during surgical procedures. Furthermore, to try and mitigate the impact of Hawthorne effect, the researcher did not disclose the actual procedures to be observed to the surgical team members in OTs, although participants were made aware that they were being observed for infection control practices. Importantly, all participants received the same level of information regarding the study, so no participant was aware which OTs were being included in this study.

Of course, the observational technique itself is time consuming. Direct observation was performed daily from Sunday to Thursday by the main researcher to collect required data. As I spent long periods of time of observing participants I believe that my presence in OT departments became somewhat routine to participants (McKenna et al. 2007). This also meant that I could develop a rapport and trust, with the result that HCWs felt more comfortable and acted more naturally. In addition, data collection was done through non-participant direct observation to avoid influencing the behaviour of other HCWs. The fact that no significant increase of adherence was noted during this phase suggests that this study was not subject to observational bias. One further limitation of observation was the difficulty in identifying challenges encountered by HCWs in implementing the guidelines. Regardless of such criticisms, observation study provides good insights into how the different HCWs are implementing the recommended practices during perioperative care.

4.4.1.3 Development of the Observation Schedule

The observations were conducted through reference to an observation schedule developed and designed specifically for this study (the observational checklist can be found in Appendix 6). An observational checklist was developed based on present international standards and protocols (CDC 2011), national guidelines (GCC-CIC 2013) and the extensive literature review undertaken for the study. This included list of possible perioperative activities the HCPs were expected to perform while caring for patients undergoing elective surgery. The observational checklist was developed to guide the researcher to collect appropriate data for answering the research questions. The CDC and GCC-CIC guidelines for the prevention of SSIs represent a significant improvement on recommendations for infection control practices based on EBP. For the purposes of enhancing the validity of the instruments and to resolve any discrepancies, the researcher checked both guidelines and found the same information in both. It was also found that national guidelines were derived from international guidelines, and thus there were no divergences found between both guidelines. The observation schedule was divided into a core section, with per and intraoperative recommendations that the tool was designed to be generic and used across all surgical specialisms. The observation schedule was structured as follows: demographic information related to surgical interventions, adherence to preoperative length of hospital stay, preoperative showering or bathing, preoperative hair removal, preoperative skin antisepsis, appropriateness of antibiotic prophylaxis, and traffic flow in OTs.

4.4.1.4 Validity and Reliability of the Observation Tool

The validity and reliability of data collection tools are, of course, important for all research. However, for qualitative research different criteria apply. The main indicators of the quality of a measuring instrument are the reliability and validity of the tools (Kimberlin and Winterstein 2008). Validity can be defined as the degree to which a data collection instrument measures what it sets out to measure (Cutter and Jordan 2012; Laake et al. 2007). Reliability designates the consistency and stability of the measurement technique over time (Marczyk et al. 2005). The observational checklist can be considered as having strong content validity because it was adapted from international CDC recommendations. Subsequent to the instrument being developed, the content validity of the checklist was reviewed by a group of experts from infection control, professionals with over 10 years of experience in either surgery or providing care during operations, who were asked for feedback on whether the observational checklist was accurate, clear, complete, and suitable for capturing the required information. The review panel made some recommendations which were implemented into the checklist. Based on the results of the pilot study, necessary modifications and additions were also carried out. For example, a few typographical errors were pointed out, albeit they in no way affected the overall content. Moreover, a list of the most common antibiotics used as prophylaxis were added into the data collection tool. Following this review, and after subsequently developing the tools, a pilot study was conducted in one hospital for 7 elective surgeries to assess the validity and applicability of the developed tool. Finally, there were deemed to be no problems concerning inter-rater reliability since there was only one data collector.

4.4.1.5 Sample for the Quantitative Study

The recruitment of study participants was based primarily on pragmatic decisions. Specifically, after reading the core literature by Durando et al. (2012), and discussing this issue with clinicians in the OTs and surgical wards, a pragmatic decision was taken to include 315 surgical procedures in the study that met the inclusion criteria and actively monitor these in two Governorate hospitals. Each elective case was selected consecutively from the operation list so as to ensure that the researcher would be able to monitor different types of surgeries. There are around 20 elective surgeries performed every day in hospital "A" and 10 elective surgeries performed daily in hospital "B", which represents 22.5% of the overall surgical activity (n=1400) which is performed monthly in both hospitals. Therefore, the desired sample size was deemed to be 315 surgical procedures, as this number of participants afforded the researcher an opportunity to monitor different types of elective surgical procedures and different surgical wound classes, such as class I (clean), class II (clean-contaminated) and class III (contaminated). Moreover, selecting such a large number of observations is important for ensuring that they represent all types of elective surgery, such as general surgery, orthopaedic surgery, neurosurgery, nephrology and urology surgery. This also allows the researcher to compare different occupational groups, and thus ascertain a potential relationship between the type of surgery and compliance to guidelines in both hospitals.

During a six-month period of study, a total of 315 surgeries were observed, including orthopaedic surgeries, general surgeries, neurosurgeries and plastic surgeries. I observed the surgical teams in both hospitals, which consisted of 187 surgeons, 194 operating theatre nurses, 52 anaesthesiologists and other healthcare professionals. In hospital A, out of the 165 operations observed, there were 141 general surgeries, 152 orthopaedic surgeries and 22 other specialised surgeries. Similarly, in hospital B, a total of 150 surgeries were observed, consisting of 80 general

surgeries, 64 orthopaedic surgeries and 6 other specialised surgeries. I documented 2330 surgical team members who were observed during 315 surgical procedures in both hospitals. The study population included surgeons, scrub nurses, circulating nurses, surgeons' assistants, anaesthesiologists and trainees (medical doctors and nurses). In hospital A, the majority of the surgical team members were observed an average of 11 times. In hospital B, the majority of the surgical team members were observed an average of 17 times. Overall, observations were conducted more than once with all surgical team personnel.

4.4.1.6 The Main Inclusion Criteria

The elective surgical cases observed involved surgical patients above 18 years of age of either gender, who were admitted to a surgical department for elective surgery in the period of the study and able and willing to provide informed consent to participate. All types of elective surgery classified as clean, clean- contaminated and contaminated were eligible for inclusion in the study.

4.4.1.7 The Main Exclusion Criteria

Surgical patients suffering from serious mental problems who were unable to give consent were excluded from the study. Patients who had complications and were in hospital for a second operation were also excluded from this study. Surgical procedures such as vaginal surgery and gynaecological surgery were also excluded on socio-cultural grounds. More specifically, due to the nature of the surgeries many female patients who undergo vaginal surgery or gynaecological surgery feel anxious and uncomfortable at the prospect of exposing intimate body parts to anyone other than surgical team members. Furthermore, most of the female patients would not like to discuss sensitive and confidential issues related to some preoperative procedures, such as removal of hair at the surgical incision site or showering procedures with the researcher. Moreover, any acceptance

or willingness of patients undergoing these types of operations to be involved in the study would be immediately problematised due to the lack of autonomy over decision-making that many female patients have over their own health. In such cases, it is often a woman's parents or husband who ultimately make the decision for them to undergo these types of surgery. To respect this custom, these types of operations were thus excluded. Finally, emergency cases were also excluded because the patient would not be in a fit state to decide, thus making informed consent not feasible.

4.4.1.8 Piloting the Observation Schedule

After the initial research tools were designed, the pilot study was conducted on a small sample of the target population to test feasibility of the observation schedule for the main study. Pilot studies have a well-defined set of purposes for ensuring methodological rigour and scientific validity (Lancaster et al. 2004). To achieve these goals, the researcher conducted a pilot study in one Governorate hospital to check the validity of the schedule for collecting the required data for the main study, and to confirm whether the proposed approach to data collection would be acceptable to the research participants. Overall, the pilot study confirmed that the structured observation checklist was an appropriate technique and expedient instrument for evaluating adherence to guidelines for the prevention of SSIs. However, some amendments were made and included in the final draft. Based on the results of this pilot study minor changes were made to the observational checklist. More details about the pilot study can be found in Chapter 5.

4.4.1.9 Quantitative Data Collection

Two months prior to the study, observations were planned in surgical wards and OTs. Arranging access to the hospitals was done before conducting the study. The observation checklist was developed in line with international recommended guidelines, which focus on perioperative

strategies to prevent SSIs. Permission was sought from the MOH to begin data collection, and then approval was subsequently forwarded to all the heads of the surgical wards and OTs, whilst informed written consent was obtained from all participants. Some relevant data concerning the characteristics of surgical interventions and types of pre-surgical antibiotic prophylaxis were also retrieved from the medical charts using a standardised proforma especially designed for the study (See Appendix 7).

Direct observations were conducted during both preoperative and intraoperative periods of elective interventions. The intra-operative stage that was observed covered the time from skin incision to wound closure. To collect as much data as possible, the observations of surgical interventions in both hospitals were planned to be performed over a 6-month period during elective operations. In hospital “A”, a total of 165 observations were conducted monitoring different elective operations during a 3 month period, whilst 150 observations were conducted in hospital “B”, which constituted the second stage of the study period. All HCWs from both hospitals were asked to participate in the study prior to observation, and, indeed, all of them responded that they would like to participate and that they were ready to support the researcher during the study. Data were collected 5 days per week over a period of 6 months. The observations were carried out in the morning shift for 7 to 9 hours a day as elective surgical procedures are always performed in the morning. Importantly, the researcher collected observational field notes using guidelines developed by LeCompte and Preissle (1993), which were adapted for the purposes of this study (See Appendix 8). Some field notes were also collected to validate the data, and to capture the problems and challenges involved in providing care for patients undergoing elective surgery.

4.4.1.10 The Challenges of Conducting Observations in Healthcare Research

A prospective non-participant observational study was undertaken in OTs over a 6-month period to gather the required data for evaluating their adherence to international and national standards for the prevention of SSI prevention. Although observations were undertaken, one should note that in practice these were non-participant observations, where the researcher observes without interrupting normal practice and patient care. Observation is a research data collecting method which is used to assess what is happening in the healthcare settings. However, adopting this method for gathering data in clinical settings is replete with challenges. First, this method is subject to forms of bias including observer bias, and even the Hawthorne effect. For observational studies, a major concern is reactivity, that is, the way in which the observed behaviour is affected by the presence of the researcher (Schweigert 2012). Indeed, it was a challenge because the researcher used his own perception and judgment about certain behaviours in the OT and these judgments are always based on our perceptions, which could influence the credibility of the data. Moreover, observation is a complex method because it takes long time in order to gain more comprehensive understanding of the practices and it often requires the researcher to adopt different roles to capture the required data. The observations were performed by one observer, so it was difficult to collect additional data about certain behaviours and practices. Therefore, it is important in future research to involve two or more observers to monitor more elective surgical procedures. In addition, I have noted that the observational study needed to be concentrated in order to gain more information.

Unfortunately, adopting this method was a challenge because the recruitment of study participants was based primarily on pragmatic decisions and it was difficult to choose the elective surgeries randomly. Therefore, the resultant sample can hardly be regarded as representative of the population. Moreover, undertaking this study required the researcher to maintain a presence

'within' the OT for long periods of time which caused those Healthcare professionals (hereafter abbreviated as HCPs) to simply change their behaviour during the data collection which may have influenced the findings. The disadvantage is that this observational approach may have less validity due to the Hawthorne effect, which states that participants may behave differently when they know that they are being watched (Schweigert 2012). The Hawthorne effect can also lead to an overestimation of the true rates of adherence to evidence-based clinical practice guidelines. Hence, as part of the strategy to mitigate the Hawthorne effect, the observer spent as much time as possible in natural observational settings and collected data on different days and at varied times, both to make sure that data was comprehensive, and also to enhance the validity and reliability of the data. The observational research differs from other methods because the researchers should be well trained in how to observe, what and how to record the data, and how to remain detached and involved at the same time. This was supported by Jackson et al., (2014) who illustrated that the observer who is collecting the data requires shared understanding and training to ensure data quality and to confirm accurate and consistent identification, discrimination and recording of data. Direct observation is valuable because it offers a real data about what is happening in the OT, but it was difficult to observe the HCWs attitudes and thoughts. Thus, Interviews were conducted to gain in-depth data about participants' perceptions which would otherwise not be captured by observations. This means that observations tell the researcher what HCWs do, but do not tell why they chose to do it in this way. One further limitation of observation was the difficulty in identifying challenges encountered by HCWs in implementing the guidelines. Despite these challenges, observation study provides good insights into how the different HCWs are implementing the recommended practices during perioperative care. The observation was an appropriate method because it helped the researcher to overcome the discrepancy between what HCWs say and what they actually do. Observational method is particularly well suited to the study to because it helped

the researcher to explore the adherence level among of the HCWs in OT and to know how people perform their practices. It is a feasible approach to evaluate adherence to SSI procedures in OTs, because observations provide expedient descriptive and correlative information, and identify important interactions between the key variables (Dohoo et al. 2012, p.157; Prasad et al. 2013).

4.4.1.10.1 General Challenges Involved in Conducting this Study

The observational method has its respective challenges and limitations (See evidence in Appendix 25). In this study, observation was one of the methods used to gather data during perioperative procedures. Interviews were conducted to gain in-depth data about participants' experiences which would otherwise not be captured by observations. Although I had permission to observe the surgical team personnel in OTs, I still had to alert HCWs about my presence each time and gain permission from surgical team members to collect the data, due to the fact that team members were different every time. I also experienced challenges in relation to gathering data for long periods of time and finding suitable observational positions to adopt within OT which meant that I had to keep moving from one place to another to capture the required data. Furthermore, delays and cancellations of procedures on the day of surgery represented another challenge during my period of observations. Moreover, due to busy schedules, it was difficult to make appointments ahead of time with the participants, thus making scheduling interviews a challenge at times. Finding interview areas in OTs was also challenging, because of the lack of comfortable places for interviews inside OTs. In order to avoid noise, most of the interviews were thus conducted outside OTs. In many instances, the traffic flow in and out of OR during surgery was a frequent cause of interruptions and distractions for both the operating surgeons and the observer. I also experienced difficulties due to standing for a long time inside ORs without being able to sit during the procedures, which was physically

exhausting. Finally, due to the fact this was my first-experience of conducting a mixed- methods study, it required more effort and time to capture the data needed for this study.

4.4.1.11 Quantitative Data Analysis

The data was edited and analysed using the Statistical Package for the Social Sciences (hereafter abbreviated as SPSS), version 20. Categorical data were presented as frequencies, whereas percentages and continuous variables were presented as a mean or median standard deviation (hereafter abbreviated as SD) and range. A Non-parametric test (chi-square test) was used to examine the relationship between two categorical data for all possible combinations of variables. The level of significance was taken at the level of $P=0.05$. Variables were then described and cross-tabulated. inferential statistical tests were conducted to identify the significant findings in relation to the differences between study groups and the relationships between variables. The data analysis was divided into four recommendations for the prevention of SSIs, ranging from category *IA* (strongly recommended for implementation and supported by well-designed scientific studies), category *IB* (strongly recommended and supported by less- scientific data), category *II* (suggested for implementation and supported by suggestive clinical or epidemiological studies or a theoretical rationale) and unresolved issues (no expert consensus regarding efficacy exists) (CDC 2011). A description of categories of recommendations for the preventing SSIs can be found in Appendix 22.

The highest form of evidence comes from randomised control trials (hereafter abbreviated as RCTs), whilst the lowest derives from expert consensus as there is no firm evidence for that practice. Category 1 includes *IA* and *IB* recommendation categories that should be adopted by all HCWs (CDC 2011). Category *II* recommendations are suggested by experts in the field, but there is no direct supporting evidence. Chapter Six provides a quantitative analysis of the data based on the findings of the direct observation. The cutoff values to determine good, moderate, and poor levels of

compliance were adopted from previously published studies, albeit with some modification to fit the purposes of this study (Ariyaratne et al. 2013; Kim et al. 2016; Nabavi et al. 2015). The levels of adherence to international guidelines were scored in accordance with three classes: good (>80%), intermediate (60-80%) and poor (<60%).

4.4.1.12 Integration and Interpretation of the Study Data

In this study, the researcher utilised a sequential mixed-methods data collection strategy through combining quantitative and qualitative data (Creswell 2003). A sequential explanatory mixed-methods approach was adopted in this study, comprising of a quantitative study to explore adherence to guidelines and a qualitative component to explore factors that influence clinical practice and non-adherence to guidelines. First, the analysis of both the quantitative and qualitative findings were undergone separately using the appropriate analytical tools, before subsequently combining the data to develop a comprehensive understanding of surgical teams' practices concerning prevention of SSIs in surgical wards and OTs. After completion of the quantitative and qualitative data analysis, the two data sets from both studies were compared with existing literature and international initiatives for the purposes of examining similarities and differences between the findings. This enabled potential corroboration of findings in and between methods, as well as allowing for comparisons to be made between what participants said and what they were observed to do in their clinical practice.

4.4.2 The Qualitative Component of the Study

4.4.2.1 Structured Interviews

Qualitative research tools used for data collection included a structured interview guide, which helped to ensure that all the topics were covered during the interview (See Appendix 9). Interviews are one of the most common methods of data collection in qualitative approaches (Andrew and

Halcomb 2009; Diccio-Bloom and Crabtree 2006). Structured interviews were employed in this instance to investigate the factors affecting non-adherence to guidelines, and to gain insights into current practices for preventing SSIs. The structured interviews were conducted using questions developed from the CDC international standards and the review of extant literature, and the same questions were asked to everybody along with standard probes. The researcher used a list of predetermined questions with a limited range of open-ended questions to allow the participants to provide rich and in-depth explanations about infection prevention control practices. Qualitative interviews provide the researcher with an opportunity to encourage the respondent to speak, to probe for more information and clarify meaning (Seale 2004). Moreover, structured interviews are the best approach after observations in terms of producing consistent data that can be compared across the respondents (Robert Wood Johnson Foundation 2008). Specifically, face-to-face structured interview techniques were employed during data collection, and all the interviews were conducted by the researcher. Interview questions were discussed and explained to ensure the inclusion of practical aspects during preoperative and intraoperative stages of care. All interviews were carried out in a convenient location for the participant, to enable them to feel as free as possible to talk. Twenty interviews were held in private areas in surgical wards, three of them in doctors' offices, whilst seventeen were conducted in OTs. With informed consent from the HCWs, the interviews were recorded using a digital recorder, as it has been found that writing notes rather than recording is not sufficiently accurate or detailed enough for qualitative research (Bailey 2008).

4.4.2.2 Development of the Interview Schedule

An interview guide with structured interview questions was prepared by the researcher prior to starting data collection, and was evaluated by experts in the field. The interview guide was specifically developed to assess respondents' views towards their own adherence to preoperative

and intraoperative infection control standards strongly recommended by the CDC, and to investigate HCW's views regarding possible barriers to the use of evidence-based guidelines to prevent SSIs (See Appendix 10). The interview guide consisted of 27 items designed to garner information on preoperative and intraoperative procedures for preventing SSI and perceived barriers to adherence. The interview guide also included prompts to encourage elaboration and elicit themes.

4.4.2.3 Trustworthiness of the Interview Data

Trustworthiness refers to the quality and the truthfulness of the findings in qualitative research (Schmidt and Brown 2015). Before interviews, the schedule was reviewed by (n=3) experts working in both surgical departments and infection control sections. Based on their feedback, the interview schedule was subsequently amended. In addition to this, a feasibility study was also conducted with 3 participants to make sure that it captured the required data and addressed the research question. To enhance credibility, the researcher also used direct quotes from the respondents to reflect their point of view. Furthermore, a random sample was selected to ensure that the participants represented the entire target population. The data was collected using an audio-recorder and transcribed verbatim, which helped the researcher to capture the required data from the interview. In conclusion, by paying attention to the above measures I am confident that the trustworthiness of the study was enhanced.

4.4.2.4 Sample for the Qualitative Study

The target population was surgical team members working in surgical wards and OTs. A random sampling method was used to select HCWs to ensure that each participant from the multidisciplinary team of each clinical list had an equal probability of being selected (Bell 2010, Gerrish and Lacy

2010). The samples were proportionally allocated to each hospital, and participants were selected using computer generated random numbers. The study consisted of 30 surgical team members who were recruited from OTs and surgical wards, and included surgeons (=10), operating theatre nurses (=10) and 10 surgical ward nurses. In this study, a random sampling method was used to select surgical team members with a minimum of 6-months experience of working as a nurse or surgeon who provided direct patient care during the preoperative and intraoperative period.

4.4.2.5 Feasibility Testing of the Interview Guide

As discussed in Section 4.4.2.2, the structured interview guide was developed by the researcher and then reviewed by a panel of three experts with experience in perioperative infection control practices in order to get their feedback on whether the interview questions were clear, objective, and suitable for achieving the aims of the study. As well as this, the pilot study was conducted to ensure that the interview guide was well designed to capture all the required data. The results indicated that interviews were found to be a feasible and acceptable data collection tool for capturing the required information. Furthermore, the interview questions were evaluated by a group of surgical team staff to check for the relevancy and clarity of the questions. In addition, transcripts were then checked against the tape recordings by the researcher, who also conducted the interviews, to ensure accuracy.

4.4.2.6 Qualitative Data Collection

So as to not cause any disruption to their daily clinical work, structured face-to-face Interviews were conducted in both hospitals at a place and time agreed to be convenient for the respondents, the head of the surgical units and OTs, and the researcher. Each interview began with a brief introduction by the researcher about the aims and objectives of the study, what kind of information

was required from them and why they should participate in the study. The respondents were asked if a tape recorder could be used to record the interviews, which all of them agreed to. The interviews were recorded as it helped the researcher to listen carefully to the conversations and to subsequently transcribe the data for analysis. After the participants again agreed to take part in the study and be recorded, the researcher reminded the participants of their rights outlined in the consent form, that is, that they could drop out at any time and have the right to refuse to answer any question since their participation was voluntary. Prior to the interviews the researcher had already built up a rapport and trust, resulting in a comfortable atmosphere during most interviews, which encouraged participants to speak freely and share their experiences. Having said this, several surgeons, OT staff and ward nurses seemed busy, and thus in these specific instances the researcher felt pressure to make the interviews flow smoothly. Most of the interviewees informed the researcher in advance that they could only spare 20 or 30 minutes. Hence, each interview lasted approximately 20 to 30 minutes.

The interview guide consisted of six questions and 27 items. Section A contained 6 items about awareness, familiarity and compliance with current guidelines and recommendations. Section B contained 1 item about implementation problems. Section C contained 16 items about professional roles and clinical experiences. Section D contained 2 items about factors and perceived barriers affecting non-adherence to guidelines. Section E contained 2 items that represented general questions about the study. In addition, several probing open-ended questions were asked for the sake of clarity and additional information. One open-ended question “ Do you want to discuss anything else that you think it is important?” was asked to encourage the interviewees to discuss issues important to them that they felt had not been covered. At the end of the interview the researcher thanked the respondents for their participation.

4.4.2.7 Qualitative Data Analysis

Data analysis started immediately after data collection with each participant. The qualitative software NVivo 10 was used to manage, code and analyse the data. NVivo is a data management package, which supports the principle investigator to manage the data during analysis (Zamawe 2015). The transcripts were entered into NVivo 10 (QSR) software to facilitate the content analysis, as it has been shown to increase efficiency, accuracy, rigour and trustworthiness (Welsh 2002). The next section describes the key steps that were followed by the researcher during the process of thematic analysis, which was selected as the method of analysis. Thematic analysis is a method of identifying, analysing, reporting themes or patterns in data (Braun and Clarke 2006). All interviews were tape recorded using digital devices for that purpose (MP3), and carried out in English language because English is the official language in all healthcare facilities. Moreover, in Oman there is increased emphasis on speaking English between HCWs, because most of the HCPs came from different countries which are English speaking. Therefore, the researcher expected that most HCWs would be comfortable talking in English. The analytical themes emerging out of these structured interviews are presented in Chapter 6.

4.4.2.8 The Framework Method

Emerging themes or categories were developed by repeatedly re-reading the transcripts (Thomas 2006). In this study, the analysis and the coding of the data was based on the principles described by Braun and Clarke (2014). According to Braun and Clarke (2014), thematic analysis is a method for identifying, analysing and reporting themes in the data set. It is widely used in both the social and health sciences (Braun and Clarke 2006). Moreover, it is an ideal framework for analysing data, providing as it does a flexible and expedient research analysis tool, which helps the researcher to identify themes (Braun and Clarke 2006), provides clear steps to follow, and produces a good-

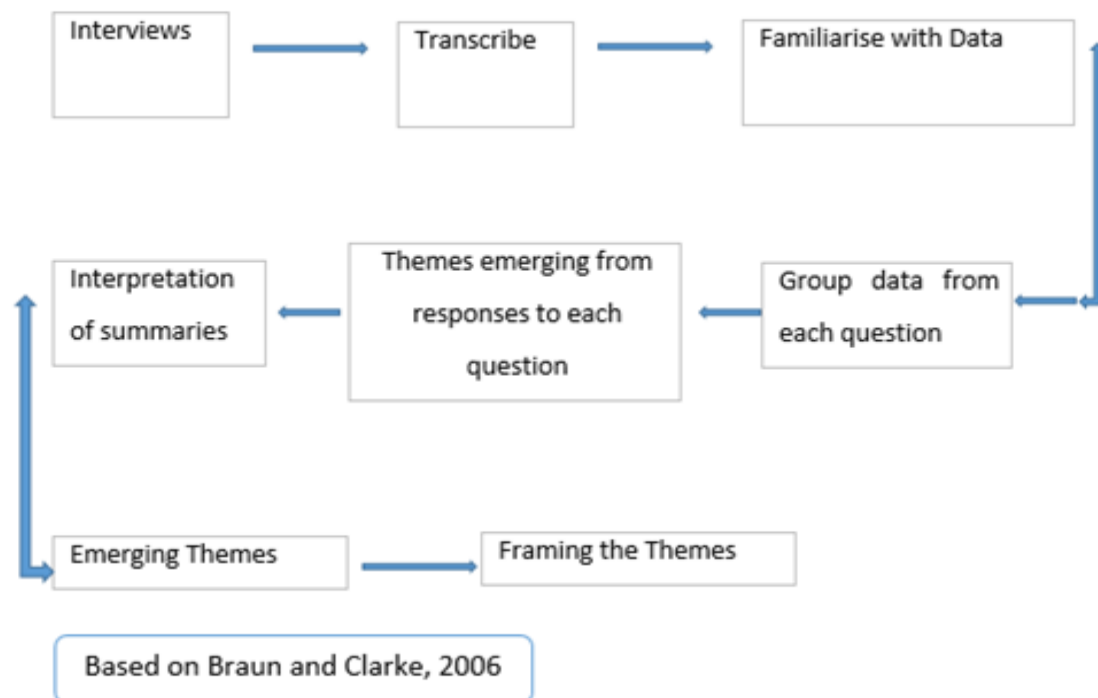
structured output of summarised data (Gale et al. 2013). Therefore, data were thematically analysed using a six step analytical method outlined by Braun and Clarke (2006) and presented in Figure 6 below.

4.4.2.9 The Process of Thematic Analysis

First, after each structured interview the recorded interviews were then transcribed verbatim using Express Scribe Transcription Software and analysed using the above framework method. Then, after completing the transcription, the researcher read the data several times over to familiarise himself with the data and identify emergent themes and categories. Next, the researcher imported the transcripts into NVivo software to organise for thematic analysis. The thematic analysis framework associated with Braun and Clarke (2006) was adapted for analysis of the interviews. Braun and Clarke (2006) outlined a six-stage model for the process of qualitative data analysis. In the first stage, the researcher listens to the interviews and re-checks the transcripts by reading through all of them, which enabled the researcher to familiarise himself with the data. In the second stage, the researcher read the transcripts through at least two times to gain a better understanding of the data, and to begin the process of searching for meaning and patterns in the data to generate the initial codes. In this step, notes were taken on the data and all initial codes were revised multiple times to generate a master codebook (Himelstein et al. 2012). In stage three, the researcher gathered and incorporated all initial codes relevant to the research questions into themes. At this point, further coding also took place to ensure no codes had been missed in the earlier steps. Fourth, all themes were reviewed to make sure that they were in conjunction with their coded extracts. Data in themes should be grouped together meaningfully, to the point where there should be clear and identifiable differences between themes (Braun and Clarke 2006). Subsequent to this, the researcher developed the initial themes and categories. In stage five, the researcher then defined

the themes and categories in the dataset. In the sixth and final stage, a research report was presented for each theme (Braun and Clarke 2006). Results from both phases were analysed separately before being integrated during the discussion phase.

Figure 6: Thematic Analysis Process



4.5 Data Management

The researcher adhered to Cardiff University guidelines for data management and is only the person who has, and will have, access to the data. The quantitative data was exported in SPSS for processing and analysis. In addition, all hard copies were kept in a separate computer file which was password protected. The researcher developed an electronic checklist to record the data immediately, and after entering the data all records, written fieldnotes and signed consent forms were kept in a safe lockable cupboard. Further, following each interview all documents and computers were safely

packed and kept in a safe locked study room. Each participant's audio-recording file was saved under codes such as SA, OTN and SWN and all files were retained in the computer. All collected information was strictly confidential. The length of storage will be in accordance with the Cardiff University guidelines, which states that it will be stored for 15 years.

4.6 Location of the Study

The study was carried out in all surgical wards and OTs in two hospitals in Oman. The department of surgery encompasses the sub-divisions of orthopaedic surgery, general surgery, urology, neurosurgery and nephrology surgery. Both are major hospitals with a capacity of 791 beds, and where surgical teams perform an average of 11,479 surgical interventions annually. Of these 791 beds, 66 are general surgical beds, whilst 150 are orthopaedic beds. The total number of major surgeries in hospital A amounts to 7,379 operations annually, 3,690 of which are orthopaedic operations, 451 are general operations and 3,238 other types of surgery. Similarly, the total number of major surgeries in hospital "B" amount to 5,238 operations annually, 817 of which are orthopaedic surgeries and 1,339 general surgeries (MOH 2014b). In hospital A and hospital B elective surgical patients were prepared for surgery in a designed preoperative area before being transferred to a waiting area in anticipation of their surgery, to ensure both that the patient is well prepared for the surgery and brought to the OR when the preceding case was completed. The process of choosing these hospitals was conducted in accordance with the following procedures. Governorate hospitals, which provide tertiary care services cover a large number of people in the different regions, are considered as tertiary and referral health centres in Oman. Moreover, these hospitals tend to perform more major specialised surgeries.

4.7 Ethical Considerations

The following ethical issues were identified and addressed in this study.

4.7.1 Permission to Conduct the Study

The study was approved by both The School's Research Review and Ethics Screening Committee (hereafter abbreviated as RRESC) (See Appendix 11), and the School of Research Ethics Committee at Cardiff University and Ethical Review for ethical approval (hereafter abbreviated as HCARE REC) (See Appendix 12). After sending a request letter permission to collect data was obtained from the Research and Ethical Review and Approval Committee (hereafter abbreviated as RERAC) at the MOH, Oman (See Appendix 13 and Appendix 14). To secure access to both hospitals, the approval letter from the MOH was distributed and handed over to the director generals in both hospitals. Permission was granted from all heads of units and HCWs who were involved in perioperative care and all HCPs from both hospitals happily agreed to participate in the study. The researcher explained the process of data collection and the ethical considerations pertaining to maintaining anonymity, confidentiality and privacy. In addition, it was made clear to all participants that there were no anticipated risks to taking part in the study and their work would not be affected by participating in this study.

4.7.2 The Participant Information Sheet

The information sheet with details of the study and contact details for the researcher were prepared and given to participants directly by the researcher at the first meeting. The participants' information forms specified what data would be collected, the purpose of the research, that all information collected would be disseminated and that information was kept confidential. Full information implies that consent is fully informed (Cohen et al. 2001), and hence the researcher

must provide full information that is easy to understand before obtaining informed consent (Gerrish and Lacey 2010). With this in mind, the information sheet and consent forms were made available in two languages, including English forms for HCWs and patients (See Appendix 15,16) and Arabic forms for patients that understood them (See Appendix 17). The translation was conducted by the researcher with the help of an Arabic language expert. The information sheet was given or read to each participant and any questions that the participant may have had were then answered. The participants were also given three to four weeks to read the information sheet and decide whether to take part in the study. All participants were informed about the aim and significance of the study to get their consent and make sure they understood they had a right to refuse, withdraw or completely reject part or all the study if they so wished. Participants' names were kept confidential throughout the study.

4.7.3 Informed Consent

With respect to the structured observation, the researcher selected willing healthcare participants after having fully explained the purpose of the research. All participants were asked to carefully read and sign the informed consent form. In each phase of the research, participants were asked to provide written consent to both participate in the study and to allow the researcher to collect the data (For the consent form for HCWs see Appendix 18). The consent form protects and respects the right of self-determination (Cohen et al. 2001). After the researcher had Face-to-face communication with participants to ask if they were willing to participate in the study, the consent form was distributed to all people via an information pack (For the consent form for patients see Appendix 19). In addition, the consent form was obtained from people who were interviewed after discussing the information sheet with them. Once consent was obtained from participants, the second stage involved speaking with them to arrange the date of the interview and time at their

convenience. The research aims and objectives were explained and an invitation then extended to surgeons also. After getting permission for HCWs, the interview was scheduled in the morning that was convenient for all of them and a reminder one day prior to interview was sent to all of them. The schedule of the structured interviews was discussed with participants and permission to audio-record the data was obtained prior to the interviews. In both studies, all of the ethical principles of research such as privacy and justice were considered, and additional time for questions and answered any enquires was also taken into consideration. The HCWs were informed about the right to participate or to withdraw from the study at any time without any penalty.

4.7.4 Participant Confidentiality and Anonymity

The collected data in this study was strictly confidential. Consequently, no participant's identity was linked to the information provided, their names were not used when reporting the results, and their information was not shared with other people in their surgical team. During data collection and analysis, all information collected during observations were stored on personal and Cardiff university computers with secure passwords. In addition, no identifiable information about participants was kept on a laptop computer. Likewise, during data collection and analysis, all data including fieldnotes and interview transcripts were stored either in a locked filing cabinet or on a password protected computer accessible only to the researcher.

Furthermore, the participants from hospital "A" were labelled as SA-A, OT-A and SWN-A respectively, while those from hospital "B" were coded as SA-B, OT-B and SWN-B respectively to protect their identities. In addition, confidentiality will continue to be maintained following the publication of results, whereby the participants' names will be replaced with codes or pseudonyms. The results were also not matched with the identity of the research participants (Cohen et al. 2001). There are no circumstances in which confidentiality was broken. The HCWs were also informed

about their rights to request to destroy their data at any time without prejudice if they no longer wished to be a participant in the study.

4.8 Chapter Conclusion

This chapter has discussed the methods that were utilised in this study as part of a mixed-methods research design. It posited that quantitative results can be explained in greater detail through incorporating them with qualitative data (Hayes et al. 2013). The first phase of the research consisted of observations evaluating adherence to current guidelines. The second phase involved structured interviews to investigate barriers to the implementation of SSI prevention guidelines in clinical practice. In this study, then, the methods involve were a prospective observational study, which was used to describe current practices for preventing SSIs, followed by structured interviews to gain a greater understanding of factors impacting upon non-adherence to guidelines. The results from both methods were analysed separately with the data integrated at the discussion stage. The next chapter describes the pilot study that was conducted to assess the data collection tools.

Chapter Five:

Pilot Study: Observation Checklist and Interview Schedule

5. Chapter Five: Pilot Study: Observation Checklist and Interviews Schedule

5.1 Introduction

The previous chapter discussed the framework and methods utilised in this study. This chapter provides details about the pilot study, which was conducted since a pilot study represents the basis of a good research approach (Hazzi and Maldaon 2015). This study employed a mixed-methods approach, including non-participant observational study and structured interviews. The principal aim was to validate and modify the research tools for the quantitative (observation checklist) component of the research and the qualitative interview guide. The pilot study was conducted at one governorate hospital and involved observing seven elective surgeries for two weeks using a structured observation checklist. The structured interview schedule was piloted with three nurses at a surgical ward prior to data collection.

5.2 Aims of the Pilot Study

Pilot studies constitute an important aspect of the research process (Duan 2013; Lancaster et al. 2002; Lean et al. 2011; Teijlingen 2000). A pilot study can be defined as a small study to test data collection instruments, research protocols, sample recruitment strategies and other research tools in preparation for a larger study (Abu Hassan et al. 2006; Lancaster et al. 2002). One of the principal aims of conducting a pilot study is that it can be used to assess the appropriateness of an approach that is intended to be used in a large-scale study (Duan 2013). To achieve this goal, the researcher undertook a pilot study in one Governorate hospital in Oman, aimed at determining whether the proposed method of data collection would capture the data required for the study, and to confirm whether the proposed method was acceptable to research participants. More specifically, it helps to inform the researcher whether the data collection tools are clear, and whether the questions in the interview guide are focused and capable of answering the research questions.

5.3 Findings of the Pilot Study

After the pilot study, the researcher used the feedback to improve the data collection instruments. The pilot study showed that most elements used in the observation checklist were appropriate and expedient for observing and capturing the required information regarding adherence to SSI prevention guidelines. Furthermore, the observation study proved to be extremely useful for assessing how people react and behave during clinical practice. Specifically, the results indicated that with respect to the interview schedule the closed and open-ended questions were appropriate for exploring surgical team staffs' perceptions of their adherence to perioperative preventative infection control practices, and for drawing out the perceived barriers that are affecting compliance with clinical practice guidelines. The pilot study also validated that most of the interview questions were understood by the respondents, and that all respondents indicated that they had no difficulties in answering the questions. However, there were some grammatical errors and typographical mistakes that were identified and subsequently corrected. Furthermore, it was suggested that I should add some open-ended questions to the interview guide to allow the respondents to both provide further information that they would like to be included and to give their impressions of the research. For example, questions 18 and 19 in the interview guide aimed to elicit more information about perioperative procedures. The pilot study also helped the researcher to work out the duration of the interviews, which lasted between 20-30 minutes.

Further, the pilot study helped the researcher to determine that a mixed-methods approach was appropriate for the present study. The pilot study also confirmed that data collection tools were suitable, appropriate and acceptable for addressing the research questions. Given that I had no prior experience in conducting observations and interviews with audiotape recorders, the pilot study provided unique opportunities to improve my researcher skills in conducting direct observations for

the purposes of gathering quantitative data, and with respect to conducting structured interviews to gather qualitative data from HCPs. It proved to be extremely difficult to make notes on everything during the interview, so the tape-recorder was very useful as it enabled me to give participants my full attention during the interview, and thus provided a better understanding of how to lead an interview. Specifically, I found that probing is a very effective way to stimulate respondents to provide rich information about the topic and give them the opportunity to continue speaking about their experiences.

In terms of the SPSS statistical package which was chosen for the analysis of the quantitative data, this too was deemed to be appropriate and fit for purpose. Similarly, the pilot also showed that transcription and thematic coding of the qualitative data were suitable, and that the questions were presented in a consistent manner. Finally, I used the same criteria for the selection of participants as I would use in the main study.

5.4 Strengths and Limitations of the Pilot Study

Despite these points above, one should stress that the pilot study was not without its limitations. Firstly, the study was conducted using a very small sample and was not implemented in both the hospitals. In addition to this, the structured interview guide consisted of a limited range of probes that could be used to obtain specific further details about the topic. However, limitations aside, most importantly the results of the pilot test demonstrated that the interview guide and observational checklist were appropriate and applicable for exploring adherence to guidelines, and for investigating factors affecting non-adherence. Chapter five presents the findings from the data gathered through direct observations.

Chapter Six:

Findings of the Quantitative Study

6. Chapter Six: Findings of the Quantitative Study

6.1 Introduction

This chapter presents the findings from the quantitative component of the study, which are divided into two sections. The first section describes the demographic characteristics of the study sample, whilst the second section of data analysis presents the results about perioperative surgical procedures that were strongly recommended to prevent SSIs. Each observed operation in the study was classified as either being adherent or non-adherent with respect to each item. A table was designed to illustrate levels of compliance towards each item on the guidelines by both hospitals individually and together (See Appendix 20). In this section, the data analysis was rated according to the level of underlying evidence (See Appendix 21). Categorical data were summarised using frequencies and percentages, and the subsequent results presented in tables. The data from both hospitals were included in the analysis of the findings.

6.2 Section 1: Demographics and Characteristics of Surgeries Monitored in the Study

6.2.1 Characteristics of the Participating Hospitals

Table 1: The characteristics of participating hospitals (n=2)

Groups	Characteristics	Hospital A	Hospital B
A	Hospital sites	Referral tertiary hospital	Referral tertiary hospital
	Number of operations annually	7,651	5,203
	Bed capacity	490	305
	Surgical beds	325	55
	Total number of surgical procedures	7,651	5,203
B	Surgeons per speciality		
	Orthopaedic surgery	59	15
	General surgery	17	40
	Plastic surgery	27	0
	Neurosurgery	19	0
	Urology surgery	0	0
	Grand total	122	65
	Total of nurses	1,168	618
C	Operating theatre nurse	139	55
	Number of operating rooms	9	5

*Source: Annual report, Ministry of Health (2014).

A. The number of beds and surgical procedures performed annually in each hospital, as illustrated in Table 1.

Table 1 provides information about the participating hospitals. A total of 315 elective surgical procedures in two governorate hospitals were actively monitored. The investigation was carried out in all surgical departments and OTs in both hospital A and hospital B in Oman; the two governorate hospitals have a combined capacity of 795 beds, 380 of which are surgical beds (MOH 2015b), and, on average, surgical teams perform 12,854 surgical interventions annually (MOH 2014b). The total number of major surgeries in hospital “A” amount to 7,651 operations annually (MOH 2014b). Similarly, the total numbers of major surgeries in hospital “B” amount to 5,203 operations annually (MOH 2014b). Overall, there are 122 surgeons and 1,168 nurses, 139 of whom are OT nurses, working in hospital A, whilst there are 65 surgeons and 618 nurses, 55 of which are OT nurses, working in hospital B.

B. Specific information about the category of surgery, as illustrated in Table 1.

The department of surgery is comprised of specific divisions, including orthopaedic, general surgery, plastic surgery, neurosurgery and urology surgery. However, orthopaedic surgeries are more common in hospital A compared with hospital B because it is a specialist orthopaedic and trauma hospital in Oman, which accounted for 3.711 operations annually compared with 731 operations in hospital B. However, hospital B also provides tertiary care service to all other hospitals and healthcare centres in the A' Dakhilyah Governorate.

C. Number of ORs participating in the study

The total number of major ORs in hospital A are 9, 5 of which are dedicated to orthopaedic surgeries, 1 for general surgery, 1 for hand surgery, 1 for neurosurgery, and 1 room for burns and plastic surgery cases. Similarly, hospital B has five ORs, consisting of 1 for orthopaedic surgery, 1 for general surgery and 3 for other specialist surgeries, as can be seen in Table 1.

6.2.2 Baseline Characteristics of the Patients

Table 2: Demographic Information of the Participants

Variables	Number (%)			
Patients' Gender				
Male	207 (65.7%)			
Female	108 (34.3%)			
Total	315			
Patient's Age		Mean	Median	Range
< 60	263 (83.4%)	39.7	35	18-88
60 and above	52 (16.5%)			

Table 2 shows the demographic data of the participants who took part in the study. Most patients were over 18 years old. The mean patient age was 39.7 years (median, 35 years, and ranged from 18 to 88 years of age). One can discern from this table, that 263 (83.4%) of the participants were aged < 60 years, whilst only 52 (16.5%) were aged >80. The female-male ratio in the overall sample was 1.9. Gender distribution was not similar because most of the participants observed were male (65.7%). The size of the female sample (34.3%) was down to the fact that, as aforesaid, female patients who were undergoing vaginal surgeries, obstetric and gynaecological surgeries were excluded from this study. Furthermore, it was found that most patients undergoing vaginal surgeries and gynaecological surgeries had negative attitudes towards involvement in the research, which may be due to privacy related concerns or cultural factors. Moreover, female patients were found to be more likely to be embarrassed when exposed in front of others. Data analysis shows that more than half of all male patients 101 (66.4%) undertook orthopaedic surgery compared to 51

(33.6%) of female patients. This indicates that female patients were less likely than men to undergo orthopaedic surgery. Due to this, male patients were more likely to be involved in this study.

6.2.3 Elective Surgery According to the Operating List

Table 3: Elective Surgical Procedures (n=315)

Hospitals	Surgical services		
	General surgery	Orthopaedic surgery	Specialist surgery
Hospital A	61 (37.0%)	88 (53.3%)	16 (9.7%)
Hospital B	80 (53.3%)	64 (42.7%)	6 (4%)
Total	141 (44.8%)	152 (48.3%)	22 (6.9%)

This table provides details about the 315 elective surgical procedures that were monitored during this study. Out of the 315 surgical procedures, 165 surgeries were observed in hospital A and 150 surgeries in hospital B. These included 141 (44.8%) general surgeries, 152 (48.3%) orthopaedic surgeries, and 22 (6.9%) specialist surgeries. In hospital A, a high percentage (88; 53.3%) were orthopaedic surgeries, along with 61 (37.0%) general surgeries, while a smaller percentage (9.7%) were specialist surgeries. Although 80 (53.3%) of the operations in hospital B were general surgeries, the evidence in this table clearly shows that in hospital A, the high percentage of surgeries were orthopaedic and in hospital B, the high percentage of surgeries were general surgery. This is because hospital A is a national referral centre for trauma and orthopaedics, neurosurgery, and plastic and reconstructive surgery, whilst hospital B is a regional referral care hospital in the Sultanate of Oman.

6.2.4 Characteristics of the Surgical Procedures

Table 4: Characteristics of the Surgical Interventions Monitored in the Study (n=315)

Surgical area	Wound classifications		
	Class I Clean wound surgery	Class II Clean-contaminated wound surgery	Class III Contaminated wound surgery
General surgery	63 (44.7%)	55 (39.0%)	23 (16.3%)
Orthopaedic surgery	152 (100%)	0 (0.0%)	0 (0.0%)
Specialist surgery	15 (68.2%)	5 (22.8%)	2 (9.0%)
Total	230 (73.0%)	60 (19.0%)	25 (8.0%)

* Class of contamination of surgical wounds is taken from the AORN (2015) classification system.

The data shown in Table 4 illustrates the distribution of surgical procedures by wound classifications. The data indicates that 63 (44.7%) of the general surgeries were clean cases, 55 (39%) of the cases were clean-contaminated, whilst 23 (16.3%) cases were contaminated. In this study, all (152) orthopaedic surgery were clean cases. Specialist surgeries included 15 (68.2%) clean cases, 5 (22.8%) clean-contaminated cases, while the remaining 2 (9.0%) were classified as contaminated cases. Details of wound classifications can be found in Appendix 23. Table 4 thus indicates that most of the cases were clean wound surgeries 230 (73%).

6.3 Section 2: Preoperative Surgical Procedures

6.3.1 Preoperative Length of Hospital Stay

Table 5: Preoperative Length of Hospital Stay Guidelines

Duration of preoperative hospitalisation (in Days)							
Hospitals	On the day of surgery	1 day prior to surgery	2 days prior to surgery	3 days or more	Concordance with guidelines (n/%)	Mean/Median	Range
Hospital A	26 (15.8%)	112 (67.9%)	9 (5.5%)	18 (10.8%)	138 (83.7%)	1.51 (1 day)	0-19
Hospital B	11 (7.3%)	117 (78.0%)	6 (4.0%)	16 (10.7%)	128 (85.3%)		
Total	37 (11.7%)	229 (72.7%)	15 (4.8%)	34 (10.8%)	266 (84.4%)		

$\chi^2 = 6.257$, $P = 0.181$, (N.S.)

Table 5 brings together the data on the preoperative length of hospital stay. Adherence to preoperative hospital stay means that when possible, preoperative hospital stay should be kept as short as possible (one day or less) as recommended by current CDC guidelines. The mean for hospital stay was 1.51 days (ranging between 0-19 days, $SD = 2.146$). Out of the 315 elective cases, 266 (84.4%) of the patients were admitted in 24 hours of the surgery. In hospital A, 138 of the patients (83.7%) were admitted one day or less prior to surgery compared to 128 patients (85.3%) in hospital B. Only 15 (4.8%) of the patients were admitted 2 days prior to surgery, and 34 (10.8%) patients stayed in hospital for up to 3-19 days prior to surgery. The mean adherence rate in hospital A was 83.7% compared with 85.3% in hospital B. This shows that there was little variation between hospitals, and there was no association between both hospitals. Overall compliance with

international guidelines was at 84.4% in both hospitals, which indicates that the adherence rate was very high in both hospital A and hospital B.

6.3.2 Duration of Surgical Procedures

Table 6: Comparison of Duration Between Hospitals

Hospitals	Variables				
	1 hour or less	1 to 2 hours	More than 2 hours	Mean/(Median)	Range
Hospital A	66 (40%)	75 (45.5 %)	24 (14.5%)	1.68 (2)	1-4
Hospital B	74 (49.3%)	65 (43.3%)	11 (7.4%)		
Total	140 (44.4%)	140 (44.4%)	35 (11.2%)		

Table 6 presents the duration of surgical procedures in hours. Data from 315 operations in both hospitals were included in the analysis. The mean duration of operations in hours was 1.68 hours (median 2 hours, ranging from 1 to 4 hours). The assessment was subdivided into 3 categories which included the duration of operation for 1 hour or less, duration of operations for 2 hours and duration of operation for more than 2 hours. It was found that 288 (88.8%) of the cases lasted between 1 to 2 hours, whilst 35 (11.2%) operations lasted more than 2 hours.

6.3.3 Preoperative Antiseptic Showering

Table 7: Adherence to Preoperative Showering Guidelines

Hospitals	Variables					
	Preoperative showering or bathing		An antiseptic solution		Overall adherence	
	Applied	Not applied	Chlorhexidine bathing	Soap and water bathing	Adherence to guidelines	Non-adherence to guidelines
Hospital A	150 (90.9%)	15 (9.1%)	84 (50.9%)	66 (40.0%)	84 (50.9%)	81 (49.1%)
Hospital B	134 (89.3%)	16 (10.7%)	0 (0.0%)	134 (89.3%)	0 (0.0%)	150 (100%)
Total	284 (90.2%)	31 (9.8%)	84 (26.7%)	200 (63.5%)	84 (26.7%)	231 (73.3%)

* Antiseptic agents used for preoperative showering or bathing: $\chi^2=106.680$, $P<0.001$, (Significant)

The data listed in Table 7 above shows adherence to preoperative bathing or showering with skin antiseptic to prevent SSI. Adherence to preoperative bathing was defined as adherence to guidelines, which recommend that patients shower or bathe with an antiseptic agent on at least the night prior to surgery (category IB) (CDC 2011). In hospital A, most patients had a preoperative shower, using either a chlorhexidine-based solution (n=84; 50.9%) or soap (n=66; 40%). In hospital B, most of the patients (n=134; 89.3%) had a shower or a bathe on the day prior to surgery using soap. Out of 315 cases, 284 (90.2%) patients had showers, 84 (26.7%) of them using a chlorhexidine solution as per international and national standards. Although preoperative bathing was conducted in the case of most patients (90.9%) in hospital A, preoperative bathing with antiseptic solution in hospital obtained a mean score of 0%. Although preoperative bathing was performed by the majority of patients, there was poor compliance with antiseptic bathing in both hospitals (26.7%).

There was a statistically significant relationship between hospitals in terms of using antiseptic solution for preoperative bathing or showering.

6.3.4 Preoperative Hair Removal

Table 8: Adherence to Preoperative Hair Removal Guidelines

Hospitals	Variables						
	Hair removal performance		Methods of hair removal			Overall adherence (n/%)	
	Hair removal done	No hair removal needed	Clippers	Razors	Depilatory cream	Adherence to methods of hair removal (Use of Clippers or Depilatory cream).	Adherence to timing of hair removal
Hospital A	110(66.6%)	55(33.4%)	25 (22.7%)	85 (77.2%)	0 (0.0%)	27 (22.7%)	67 (40.6%)
Hospital B	98 (65.3%)	52 (34.7%)	27(27.6 %)	69 (70.4%)	2 (2.0%)	29 (29.6%)	55 (36.7%)
Total	208 (66.0%)	107 (34.0%)	52 (25%)	154 (74%)	2 (1.0%)	56 (26.9%)	122 (58.7%)

* Performing of hair removal

$\chi^2=0.062$, $P=0.803$, (N.S.)

* Method of hair removal

$\chi^2=3.757$, $P=0.289$, (N.S.)

* Overall adherence to hair removal

$\chi^2=3.757$, $P=0.289$, (N.S.)

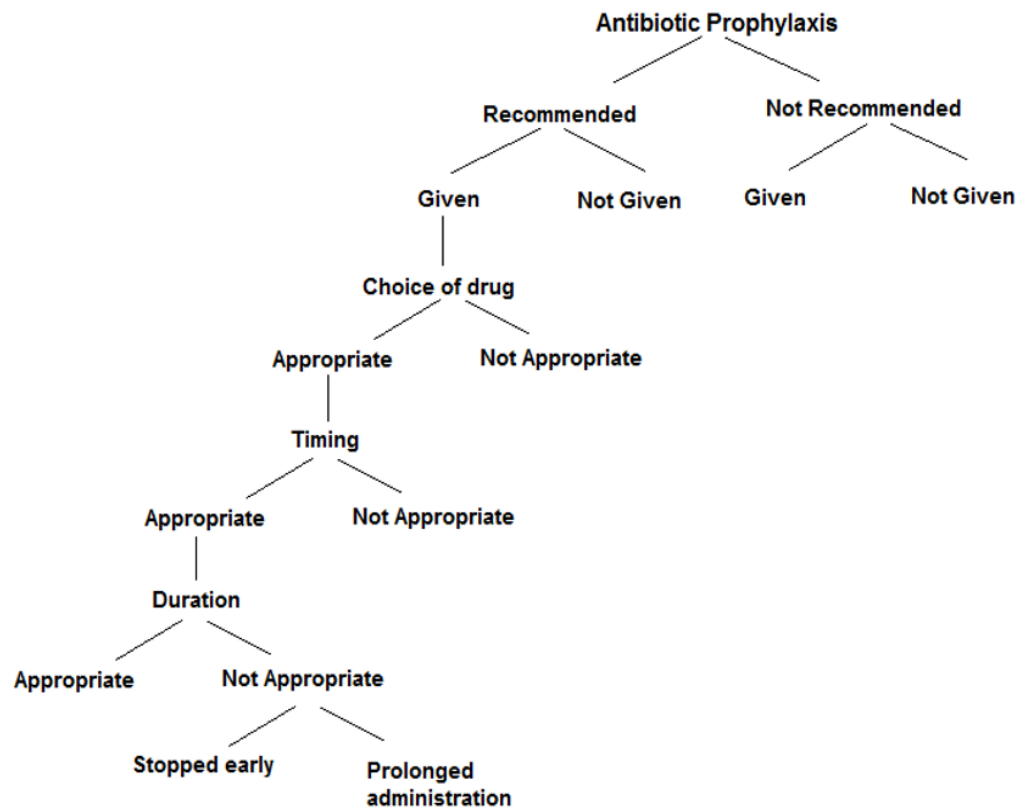
Table 8 lays out the data on preoperative hair removal practices, the method of preoperative hair removal and time of shaving. As one can see above, compliance with the use of appropriate hair removal methods and the timing of hair removal was poor in both hospitals. 208 patients (66%) had preoperative hair removal, using either clippers, razors or depilation cream. With regards to the method of hair removal, the most common method used in both hospitals were razors in 154 cases (74%), compared with 52 cases (25%) were clippers were used, and the 2 (1%) cases in which cream depilation was used. Approximately, 122 (58.7%) cases of hair removal were performed in ORs on the operating table, 73 (35%) patients were shaved in the surgical ward, whilst the remaining 13 (6.3%) cases of hair removal being performed by patients themselves at home. Concerning the use

of appropriate methods for hair removal, the mean adherence rate was 11.35% in hospital A and 14.8% in hospital B. Hair removal was done in the OR in 67 (40.6%) cases with a mean adherence rate of 40.6% in hospital A and 36.7% in hospital B. The overall adherence rate of 38.7% was poor in both hospitals. There were no statistically significant differences between hospital A and hospital B.

6.3.5 Antimicrobial Surgical Prophylaxis

Three different parameters concerning the appropriateness of prophylaxis, such as antibiotic agents, the timing of administration of the first dose, and the duration of prophylaxis were assessed in 315 operations. Prophylactic antibiotic administration compliance was evaluated according to published local guidelines (MOH 2016) on antibiotic choice, duration of prophylaxis, and timing of the first dose. The Surgical procedures and recommended antibiotic drugs can be found in Appendix 3. Data regarding antibiotic selection and post-surgery antibiotic administration was obtained through nursing and medical review. Assessment of individual parameters presented in figure 7.

Figure 7: The flow chart used as method of data analysis for antibiotic prophylaxis (Adapted from Bonello and Stafrace 2016).



6.3.5.1 Criteria for Assessment of Adherence to Local Guidelines

Table 9: Criteria for Assessment of Adherence to Antibiotic Guidelines

Parameters	Concordant if:	Not Concordant if:
Indications of antibiotics	<ul style="list-style-type: none">Decision was made to use antimicrobial prophylaxis.	<ul style="list-style-type: none">Prophylaxis was administered although not clinically indicated
Antibiotic selection	<ul style="list-style-type: none">Select appropriate agents based on the surgical procedure.	<ul style="list-style-type: none">Agent differed from antibiotic recommendations
Timing of antibiotics	<ul style="list-style-type: none">Begin administration in 1 hour before incision to maximise tissue concentration.	<ul style="list-style-type: none">Dosing interval exceeded the recommendations by > 30 minutes
Duration	<ul style="list-style-type: none">Discontinue agent in 24 hours after surgery.	<ul style="list-style-type: none">Dosing interval deviated from the guidelines by > 60 minutes

* Adapted from CDC (2011) and the MOH (2016) guidelines.

Table 9 shows the criteria for assessment of adherence to antibiotic prophylaxis recommendations. Parameters of antibiotic prophylaxis, including antibiotic choice, timing of first dose, and duration of prophylaxis were all analysed. Full adherence to antibiotic prophylaxis guidelines is defined as administering antibiotics in such a way that the correct choice, timing and duration of prophylactic antibiotics is exercised (Aly et al. 2012). Non-adherence to guidelines was designated as when there was a prescription of a non-indicated antibiotic, a divergence from antibiotic protocols or failure to adhere fully with other aspects of the choice, timing and duration of antibiotic prophylaxis. Surgical procedures and the recommended drugs can be found in Appendix 24.

6.3.5.2 Antibiotic Prophylaxis Administration

Table 10: Antibiotic Prophylaxis Administration for Surgical Patients (n=315)

Hospitals	Use of antibiotics in surgical patients	
	Administered	Not administered
Hospital A	156 (94.5%)	9 (5.5%)
Hospital B	141 (94.0%)	9 (6.0%)
Total	297 (94.3%)	18 (5.7%)

$\chi^2=0.043$, $P= 0.835$, (N.S.)

The data documented in table 10 reflects the distribution of sample according to the reported use of antibiotics for prophylaxis. Out of 315 elective surgeries, antimicrobial prophylaxis was administered to 297 (94.3%) patients. In hospital A, 156 patients (94.5%) did receive antibiotic prophylaxis compared with 141 (94%) in hospital B. There was no statistically significant difference between hospitals, which indicated that surgical antimicrobial prophylaxis is routinely used prior to major surgeries in both hospitals.

6.3.5.3 Adherence to Guidelines of Antibiotic Prophylactic Use in Elective Surgery

Table 11: Evaluating of Antibiotic Prophylaxis Administration in Elective Surgery (Choice, Timing, and Duration of Prophylaxis).

Hospitals	Variables					
	Adherence to choice of surgical antibiotic prophylaxis		Adherence to timing of surgical antibiotic prophylaxis		Adherence to duration of antibiotic use	
	Adherence to guidelines	Non-adherence to guidelines	Adherence to guidelines	Non-adherence to guidelines	Adherence to guidelines	Non-adherence to guidelines
Hospital A	150 (96.2%)	6 (3.8%)	147 (94.2%)	9 (5.8%)	126 (80.7%)	30 (19.3%)
Hospital B	138 (97.9%)	3 (2.1%)	132 (93.6%)	9 (6.4%)	63 (44.6%)	78 (55.4%)
Total	288 (97%)	9 (3.0%)	279 (94%)	18 (6%)	189 (63.7%)	108 (36.3%)

* Choice of surgical antibiotic prophylaxis

$\chi^2=0.788$, $P=0.675$, (N.S.)

* Timing of surgical antibiotic prophylaxis

$\chi^2=0.092$, $P=0.955$, (N.S.)

* Duration of surgical antibiotic prophylaxis

$\chi^2=41.714$, $P<0.001$, (Significant)

Table 11 shows an overview of the data on adherence to surgical antibiotic prophylaxis choice, timing, and duration parameters. As discussed in relation to Table 10, antibiotic prophylaxis was provided in 297 (94.3%) surgical procedures. Data on the choice of antibiotic prophylaxis shows that in hospital A 96.2% of operations received the appropriate antibiotic agent compared to 97.9% in hospital B, which shows no significant statistical difference between both the hospitals. Overall compliance with guidelines on the choice of antibiotic prophylaxis was high (96.6%) in both hospitals.

Regarding compliance with guidelines on the timing of antibiotic prophylaxis, it was observed that 89.1% of cases in hospital A received the prophylaxis at the proper time of at least 60 minutes prior to the incision. In hospital B, from those who received antibiotic prophylaxis, 132 (93.6%) of cases received the prophylaxis at the proper time at least 60 minutes before incision. The mean compliance with timing of prophylaxis was again high (94%) in both hospitals, which means that no statistical difference between both hospitals was found. With respect to duration of antibiotic prophylaxis, compliance was poor in both hospitals. However, hospital A had the highest percentage (80.7%) while hospital B poorly complied (44.6%) with national guidelines. The mean adherence rate was 63% in both hospitals, thus showing that hospital A and hospital B were partially compliant with respect to evidence-based guidelines for duration of antibiotic prophylaxis. No significant difference was found between hospital A and hospital B in terms of choice of antibiotic and timing of prophylaxis. However, there was a significant difference between hospitals concerning the duration of antibiotic prophylaxis.

6.3.5.4 Additional Dosages of Surgical Antibiotic Prophylaxis

Table 12: Redosing of Prophylactic Antimicrobial Agents

Hospitals	Administered	Not administered
Hospital A	65 (39.4%)	100 (60.6%)
Hospital B	90 (60%)	60 (40.0%)
Total	155 (49.2%)	160 (50.8%)

$\chi^2=13.34$, $P<0.001$, (Significant)

Table 12 shows data about intraoperative and postoperative re-dosing during surgical procedures. In terms of additional doses of antibiotics, the above table indicates that prophylaxis was administered in single doses in 160 procedures (50.8%) and postoperative dose was administered for 155 patients (49.2%). In hospital A, an additional dose of antibiotic was administered for 65 (39.4%) procedures postoperatively compared with the 90 (49.2%) patients who received additional doses of antibiotics in hospital B.

6.3.5.5 Antibiotic Prophylaxis and the Length of Operation

Table 13: Antibiotic Prophylaxis in Prolonged Procedures

Duration of operations	Hospital A		Hospital B	
	Dosing interval		Dosing interval	
	Antibiotic Prescribed	Antibiotic not prescribed	Antibiotic Prescribed	Antibiotic not prescribed
Less than 1 hour	60 (90.9%)	6 (9.1%)	66 (89.2%)	8 (10.8%)
1 to 2 hours	74 (98.7%)	1 (1.3%)	64 (98.5%)	1 (1.5%)
3 to 4 hours	19 (90.5%)	2 (9.5%)	11 (100%)	0 (0.0%)
More than 4 hours	3 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Total	156 (94.5%)	9 (5.5%)	141 (94.0%)	9 (6%)

$\chi^2=9.74$, $P=0.021$, (Significant)

Table 13 details the use of antibiotic prophylaxis and the length of surgical procedures. The results listed in Table 13 demonstrate that in both hospitals patients ($n=175$; 55.5%) who underwent long operations (≥ 2 hours) were more likely to receive antibiotic prophylaxis. It is also apparent that all patients that underwent elective surgery lasting for more than 3 hours received antibiotics (100%).

This indicates that prolonged administration of antibiotics beyond 24 hours is common in the case of long operations. There was a statistically significant association between both hospitals in terms of antibiotic use and length of surgical procedure.

6.3.5.6 Antibiotic Prophylaxis by Wound Classification

Table 14: Antibiotic Prophylaxis Administration by Wound Classification

Wound classes	Hospital A		Hospital B	
	Dosing interval		Dosing interval	
	Administered	Not administered	Administered	Not administered
Clean surgery	122(95.3%)	6(4.7%)	86(91.5%)	8(8.5%)
Clean-contaminated surgery	9(75%)	3(25%)	28(96.6%)	1(3.4%)
Contaminated surgery	25(100%)	0(0.0%)	27(100%)	0(0.0%)
Total	156(94.5%)	9(5.5%)	141(94.0%)	9(6.0%)

$\chi^2=0.870$ P= 0.647, (N.S.)

The data in Table 14 exhibits adherence to antibiotic guidelines according to wound classification. Of the total patients, 70.5% underwent a clean surgical operation, 13% underwent a clean-contaminated surgical operation, and 16.5% underwent a contaminated surgical operation. According to national surgical antibiotic prophylaxis guidelines (MOH 2016), prophylaxis should be given in clean and clean-contaminated cases. In hospital A antibiotic prophylaxis was given in 95.3% of clean cases, 75% in clean-contaminated cases, and 100% in contaminated cases. In the case of hospital B antibiotic prophylaxis was given in 91.5% of clean cases, 96.6% in clean-contaminated cases, and 100% in contaminated cases. The mean adherence rate for both hospitals was 67.7%. This demonstrates that the misuse of surgical antibiotic prophylaxis was commonly practiced in both hospitals.

6.4 Section 3: Intraoperative Infection Prevention and Control in the Operating Theatre

6.4.1 Patient Skin Preparation in the Operating Room

Table 15: Antiseptic Skin Preparation

Hospitals	Variables					
	Application	Antiseptic agents				Overall adherence
	Apply preoperative antiseptic skin preparation	Povidone iodine, and spirit alcohol antiseptic	Povidone iodine	Spirit alcohol agent	Miscellaneous	Adherence level
Hospital A	165 (100%)	60 (36.4%)	59 (35.8%)	21 (12.7%)	25 (15.1%)	165 (99.4%)
Hospital B	150 (100%)	56 (37.3%)	45 (30.0%)	21 (14.0%)	28 (18.7%)	150 (100%)
Total	315 (100%)	116 (36.8%)	104 (33.0%)	42 (13.3%)	53 (16.9%)	315 (100%)

The data in Table 15 exhibits levels of adherence to patients' skin preparation. Guidelines posit that an appropriate antiseptic like alcohol-based solution, chlorhexidine, or povidone iodine should be used for preoperative skin preparation and should be applied in concentric circles prior to surgery (CDC 2011). In general, skin antisepsis of the incision area was performed in 315 (100%) surgical operations, and was not done in one case. Appropriate antisepsis of the incision site was performed in the case of 315 (100%) patients, with povidone iodine and spirit alcohol antiseptic (n=116; 36.8%), povidone iodine (n=104; 33%), spirit alcohol agent (n=42; 13.3%) and Miscellaneous (n=53; 16.9%) the main agents used. Preoperative antisepsis was complied with by both hospital A and hospital B with a percentage of 99.7%.

6.4.1.1 Preoperative Skin Preparation Cleaning Technique

Table 16: Level of Adherence to Skin Preparation Cleaning Technique

Hospitals	Adherence to guidelines n (%)	Non-adherence to guidelines n (%)
Hospital A	25 (15.2%)	140 (84.8%)
Hospital B	69 (46%)	81 (54%)
Total	94 (29.8%)	221 (70.2%)

$\chi^2=35.714$, $P<0.001$ (Significant)

The data included in Table 16 shows the level of adherence to skin preparation technique. All skin preparation should be started from the incision site to the periphery area to prevent contamination of the incision area and thus avoid SSIs (CDC 2011: Category II). Skin preparation which proceeded from the dirty area to the clean area was observed in 140 (84.8%) cases in hospital A, in comparison with 81 (54%) cases in hospital B. Hospital A used an aseptic technique to clean the incision area for only 15.2% of cases, whilst adherence to aseptic techniques in hospital B was 46%. Overall, adherence to skin preparation cleaning was reported in 94 of the procedures (29.8%) in hospital A and hospital B. The data in Table 17 thus indicates that hospital A and hospital B poorly complied with current recommendations.

6.4.2 Amount of Operating Room Door Openings

Table 17: Amount of Door Openings by Length of Operation (n=315)

Length of operations	Hospital A	Hospital B				
	Amount of door openings during surgery	Amount of door openings during surgery	Mean	Sum	Range	Std. Deviation
1 hour or less	721	653	18	5672	1±67	13.77
1 hour and more	3774	1875				
Total	4495	2528				

The data included in Table 17 highlights OR traffic patterns (Number of door swings) during surgery. The guidelines recommend keeping OR doors closed, except as required for moving equipment, personnel, and patients (CDC 2011: Category IB). A total of 7023 door openings were recorded in 315 cases. The average number of times doors opened in hours was 18 (ranging from 1±67, SD=13.77). Data analysis indicates that door openings increased in direct proportion to surgery length. In hospital A, in the case of surgery lengths of more than 1 hour, door openings were recorded 4495 times compared to 2528 in hospital B. This proves that doors were opened too many times in long surgeries, which indicates that more equipment was required to be brought in from outside the OR during long operations. The mean adherence rate was 56.4% in hospital A and 70% in hospital B. The overall adherence rate in both hospitals were low (62.9%).

6.4.2.1 Identified Reasons for Door Openings in the Operating Room

Table 18: Occurrence and Percentage of Categorised Reasons

Category	Occurrence	Percentage (%)	Duration of door openings in hrs
Equipment supplies	187	19.4%	7 hrs
Communication	228	23.7%	6 hrs
Paperwork	192	20%	5 hrs
Collect sample	31	3.2%	0.5 hrs
X-Ray scan	30	3.1%	2 hrs
Unknown	291	30.3%	17 hrs
Total	959	100%	37.5 hrs

The data in Table 18 presents a typology of reasons for door openings in the two sample groups. Reasons for door openings were categorised as following: paperwork, communication, supplying equipment, taking an X-ray, sample collection, and other/unknown reasons which the researcher could not discern. The main identifiable reason by category for door opening was the unknown category, which constituted 30.3% of all door openings, followed by organisational communication, which comprised (23.7%) of door openings, whilst doors opening for paperwork was observed in 20% of operations. Equipment supplies were also a major reason for door openings accounting for 19.4%. Moving X-ray instruments and collecting samples in and out of the OR during surgery together accounted for 6.3% of door openings. It is crucial to flag-up that in 30.3% of cases the researcher could not identify why the door had been opened.

6.4.3 Number of Personnel Present During Surgical Procedures

Table 19: Number of Personnel in Operating Room

Variables	Number of personnel observed	Mean	Range	Median	Std. Deviation
Total number of personnel during surgery	2330	7	5 ± 10	7.00	1.571

Table 19 exhibits the total number of staff present during surgical procedures. It is recommended that the number of personnel entering the OR should be limited to necessary personnel, to minimise transmission of bacteria from one OR to another (Category II). The average number of personnel in the OR during an operation was 7 (range 5 ± 10 , median = 7). In some surgical procedures, the number of personnel reached 15, indicating that there was a lack of compliance to traffic flow in the OR. In hospital A, the mean adherence rate was 56.3% (more than 7 people counts as non-adherence), whilst the adherence rate was 69.3% in hospital B. Overall adherence was 62.5% in both hospitals.

6.4.3.1 Complexity of the Surgery and Surgical Team Size

Table 20: Relationship Between the Complexity of the Surgery and Number of People Present

Hospital	Surgical category	Total number of personnel by type of surgery			Mean	Range
		5-6 people	7 people	8-15 people		
Hospital A	General surgery	16(26.2%)	7(11.5%)	38(62.3%)	7	10
	Orthopaedic surgery	27(30.7%)	31(35.2%)	30(34.1%)		
	Specialist	8(50%)	4(25%)	4(25%)		
Hospital B	General surgery	36(45%)	31(38.8%)	13(16.2%)		
	Orthopaedic surgery	16(25%)	20(31.2%)	28(43.8%)		
	Specialist	1(16.7%)	1(16.7%)	4(66.6%)		
	Total	53(35.3%)	52(34.7%)	45(30%)		

$\chi^2=3.63$, $P=0.458$, (N.S.)

The data presented in Table 20 details the total number of personnel by each surgical category in both hospitals. The surgical team was designated as all of those present during surgical procedures, which included surgeons, scrub nurses, circulating nurses, anaesthetists, medical students, and other specialists for each procedure. The team size ranged from 5 to 15 people, with a mean of 7 team members assigned to a single procedure. In hospital A, the maximum number of people (8-15) were observed in 38 (62.3%) general surgeries, in comparison to 30 (34.1%) orthopaedic surgeries. On the contrary, in hospital B the maximum number of people (8-15) were observed in 28 (43.8%) orthopaedic surgeries, compared with 13 (16.2%) in general surgeries. The mean adherence rate was 70% in both hospitals. Consequently, there was no evidence of a statistically significant association between the complexity of the surgery and number of people present in the OR in both hospitals.

6.4.3.2 Operation Length and Surgical Team Size

Table 21: Relationship Between Length of Surgery and Number of People Present

Hospital	Operation duration	Total number of personnel by type of surgery		
		5-6 people	7 people	8-15 people
Hospital A	Less than 1 hour	29(43.9%)	11(16.7%)	26(39.4%)
	1 to 2 hours	19(25.3%)	22(29.3%)	34(45.3%)
	More than 3 hours	3(14.3%)	9(42.9%)	12(15.3%)
Hospital B	Less than 1 hour	34(45.9%)	24(32.5%)	16(21.6%)
	1 to 2 hours	18(27.7%)	27(41.5%)	20(30.8%)
	More than 3 hours	1(9.1%)	1(9.1%)	9(81.8%)
	Total	53(35.3%)	52(34.7%)	45(30.0%)

$\chi^2=24.60$, $P<0.001$, (Significant)

Table 21 exhibits the number of people present during surgery in relation to the length of surgery. The mean number of people present per procedure was 7 (see Table 20). Data analysis indicates that in hospital A, the highest number of team members ($n=34;45.3\%$) was observed in operations lasting between 1 to 2 hours. Table 21 also shows that in hospital B the total number of team members was highest in long operations (more than 3 hours). Hence, there was a significant difference between hospital A and hospital B.

6.4.3.3 Adherence to Traffic Flow in Operating Room

Table 22: Overall Level of Adherence to Traffic Flow in Operating Room

Hospitals	Level of adherence to traffic flow in operating room	
	Adherence to guidelines	Non-adherence to guidelines
Hospital A	93 (56.4%)	72 (43.6%)
Hospital B	105(70.0%)	45 (30.0%)
Total	198 (62.9%)	117 (37.1%)

$\chi^2=6.25$, $P=0.012$, (Significant)

Table 22 provides data on overall levels of adherence to recommended practices for traffic flow of staff during surgical procedures. In this respect, hospital A complied poorly (56.4%), whilst hospital B complied in 70% of cases. There was a statistically significant difference between the hospitals.

6.4.4 Jewellery in the Operating Theatres

Table 23: Wearing Jewellery in Operating Theatres

Hospitals	Wearing jewellery in operating theatre		Mean	Sum
	Yes	No		
Hospital A	161 (97.6%)	4 (2.4%)	2	707
Hospital B	139 (92.7%)	11 (7.3%)		
Total	300 (95.2%)	15 (4.8%)		

The data in Table 23 demonstrates the proportion of staff wearing jewellery (rings, wrist watches and bracelets) during surgical procedures. CDC (2013) (Category II) Recommendations state that Jewellery should be removed because bacteria are present on the skin beneath jewellery in higher numbers than on uncovered skin. 707 people were observed during 315 procedures, with a mean

of 2 team members in each operation. In hospital A, 161 (97.6%) personnel wore jewellery compared with 139 (92.7%) in hospital B. Indeed, jewellery was worn by many HCWs in almost all surgical procedures, and thus compliance rates in both hospitals were poor. In hospital A the mean adherence rate was 2.4%, whereas hospital B scored 7.3%, which indicates that hospital A and B failed to comply with current guidelines.

6.4.5 Using Mobile Phones and Computers in Operating Theatre

Table 24: Using Mobile Phones and Computer Keyboards During Surgery

Hospitals	Using Mobile Phone		Using Computer Keyboard	
	Yes	No	Yes	No
Hospital A	73 (44.2%)	92 (55.8%)	152 (92.1%)	13 (7.9%)
Hospital B	78 (52%)	72 (48%)	122 (81.3%)	28 (18.7%)
Total	151 (47.9%)	164 (52.1%)	274 (87%)	41 (13%)

Table 24 includes evidence pertaining to the use of mobile phones and computer keyboards during surgical procedures. The analysis indicates that mobile phones and computer keyboards were used routinely in ORs by staff who failed to clean their hands the requisite amount of times between each use. Specifically, this study found that mobile phones were used in 151 (47.9%) of cases, whilst computer keyboards were used on 274 (87%) occasions. The compliance rate regarding using mobile phones was thus poor in both hospital A and hospital B. Whilst In hospital A, the mean adherence rate for using mobile phones in ORs was 55.8%, in hospital B it was only 7.9%. Similarly, both hospitals failed to comply with guidelines on use of computer keyboards. The mean adherence rate for using computer keyboards in ORs was 7.9% in hospital A, and 18.7% in hospital B, which indicates that hospital A and hospital B both failed to comply with recommended practices.

6.4.6 Wearing of Protective Surgical Attire

Table 25: Correct Scrubbing, Gowning, Wearing Sterile Masks, Donning of Gloves and Surgical Caps/Hoods (n=2330 Surgical Team Personnel)

Procedures	Hospital A	Hospital B
	Adherence to guidelines (n= %)	Adherence to guidelines (n= %)
Item 1: Wear a surgical mask that fully covers the mouth and nose	978 (76.6%)	746 (70.7%)
Item 2: Mask changed between surgeries	350 (27.4%)	240 (22.7%)
Item 3: Wear a cap or hood that fully covers hair on the head and face	858 (67.2%)	779 (73.9%)
Item 4: Donning of sterile gowns.	1276 (100%)	1054 (100%)
Item 5: Wearing sterile gloves before skin preparation	1273 (99.7%)	1048 (99.4%)
Item 6: Gloves worn when handling equipment	1276 (100%)	1054 (100%)
Item 7: Wearing surgical scrubs before surgery	1276 (100%)	1054 (100%)
Item 8: Use appropriate antiseptic agent to perform preoperative surgical scrub	1276 (100%)	1054 (100%)

Data in Table 25 shows levels of adherence and non-adherence with respect to wearing appropriate surgical attire. Surgical attire includes wearing gowns, sterile surgical gloves, masks, and caps that cover hair during surgery. Adherence to surgical attire protocols means: (1) wear a surgical mask that fully covers the mouth and nose when entering the OR (Category IB); (2) change mask in between surgeries; (3) wear a cap or hood that fully covers hair on the head and face when entering the OR (Category IB); (4) use surgical gowns in the OR (Category IB); (5) wear sterile gloves if a scrubbed surgical team member (Category IB); (6) put on gloves (Category IB); (7) wear surgical scrubs prior to surgery (Category IB); (8) and use appropriate aseptic procedures (Category IB).

Items 1 and 2: Adherence to surgical facemask use was monitored during surgical procedures. In hospital A, out of 1276 HCPs, 76.6% of surgical team staff did wear surgical face mask that fully

covered their mouth and nose when entering the OR, whilst 27.4% of them also changed their masks between surgeries. In hospital B, out of 1054 HCPs, 70.7% of surgical team staff wore proper surgical face masks, although only 22.7% of them changed their masks between surgeries. Eye and face protection adherence was moderately poor in both hospitals; hospital A had the highest percentage (76.6%), hospital B had a mean compliance rate of 70.7%, with a median of 73.9% in both hospitals.

Items 3 and 4: Data analysis in Table 25 underscores that all HCWs (100%) did wear sterile gowns inside ORs, however adherence to wearing caps/hoods that fully cover hair on the head and face was poor. Hospital A complied partially with a percentage of 67.2%, hospital B followed with a percentage of 73.9%. Overall adherence for both hospitals was 70.2%.

Items 5 and 6: The data in Table 25 indicates that wearing gloves when handling equipment was fully complied with in both hospital A and B with an overall percentage of 100%.

Items 7 and 8: With respect to scrubbing, hospital A and hospital B complied excellently with an overall percentage of 100%. In addition, the data in Table 25 also shows that 100% of HCWs adhered to international guidelines on the use of appropriate antiseptic agents to perform preoperative surgical scrubs, such as chlorhexidine and povidone iodine.

6.4.7 Cleaning of Operating Theatre Between Surgeries

Table 26: Using Disinfectant to Clean the Area

Hospitals	Number of elective surgeries	Cleaning of OT between surgery		Use of a detergent-disinfectant solution
		Cleaned	Using antiseptic agent	Using regular soap and water
Hospital A	315	165 (100%)	0 (0.0%)	165 (100%)
Hospital B		150 (100%)	1 (0.7%)	149 (99.3%)
Total		315 (100%)	1 (0.3%)	314 (99.7%)

There is no direct evidence to support routine disinfecting of environmental surfaces or equipment between operations in the absence of contamination or visible soiling (CDC 2011). The data presented in table 26 shows that normal detergent was used for cleaning OR floors in between surgeries. Wiping the OR floors with antiseptic solution occurred on 1 occasion (0.3%) in hospital B and 0% in hospital A. Overall, adherence to cleaning of ORs with soap was exemplary (100%), with almost all the ORs being cleaned with soap and water.

6.4.8 Sterile Draping of Surgical Site

Table 27: Level of Adherence to Sterile Draping Technique

Hospitals	Accordance with guidelines n (%)	Non-accordance with guidelines n (%)
Hospital A	154 (93.3%)	11 (6.7%)
Hospital B	150 (100%)	0 (0.0%)
Total	304 (96.5%)	11 (3.5%)

The data in Table 27 shows the level of adherence to using surgical drapes before incision. Sterile draping should be used to cover patients and surrounding areas with sterile cloths to maintain a sterile field during operations (CDC 2011: Category IB). Use of the appropriate sterile drapes around the site was observed in 154 (93.3%) of surgeries in hospital A, compared with 150 (100%) cases in hospital B. A total of 304 (96.5%) sterile drapes were applied appropriately, whilst only 11 (3.5%) drapes were not applied in accordance with guidelines. This indicates that compliance with sterile drapes were significantly high in both hospitals, with an overall percentage of 96.5%.

6.4.9 Postoperative Surgical Dressing

Table 28: Application of Sterile Dressing to the Incision Site

Hospitals	Apply postoperative sterile wound dressing
	Yes
Hospital A	165 (100%)
Hospital B	150 (100%)
Total	315 (100%)

Table 28 indicates the application of postoperative dressings to incision sites, which recommendations state must be protected, if not primarily closed, with a sterile dressing for 24 to

48 hours postoperatively (CDC 2011: Category IB). With regards to the use of appropriate sterile dressing, both hospitals achieved 100% compliance.

6.4.10 Maintaining the Sterile Field in the Operating Room

Table 29: Maintaining the Sterile Field

Hospitals	Variables	
	Maintaining the sterile field	Not maintaining the sterile field
Hospital A	155 (93.9%)	10 (6.1%)
Hospital B	138 (92.0%)	12 (8.0%)
Total	293 (93.0%)	22 (7.0%)

The data included in Table 29 displays the number of occasions that HCWs breached the sterile field. Maintaining the sterile field in the OR is critical and, ultimately, the responsibility of every surgical team member, which means that those who are scrubbed remain close to the sterile field and unsterile personnel should be away from the restricted area. In addition, all scrubbed personnel must face the sterile field at all times, and only sterile instruments should be kept in that area (Category I). In Hospital A, there were 10 occasions when the sterile field was not properly maintained, and in hospital B there were 12 occasions when the sterile field was not correctly maintained. It is thus observed that on 22 occasions surgical team staff breached the sterility field during set-up and maintenance of the sterile field. It was also observed that on specific occasions some staff turned their back to the sterile field, whilst at other points unsterile items were placed inside the sterile field. Finally, some scrubbed staff kept moving away from the sterile field into unrestricted areas, which increased the risk of contamination. Regarding the maintenance of the sterile field, the mean adherence rate was high as hospital A and B scored a combined total of 93.0%.

6.4.11 Surgical Gloves

Table 30: Sterile Gloves and Glove Perforation

Surgeries	Hospital A				Hospital B			
	Double gloving		Incidence of glove perforation		Double gloving		Incidence of glove perforation	
	Yes	No	Yes	No	Yes	No	Yes	No
General surgery	1(1.6%)	60(98.4%)	3(4.9%)	58(95.1%)	2(2.5%)	78(97.5%)	3(3.7%)	0(96.3%)
Orthopaedic surgery	86(97.7%)	2(2.3%)	2(2.3%)	86(97.7%)	64(100%)	0(0.0%)	5(7.8%)	59(92.2%)
Specialist surgery	4(25.0%)	12(75.0%)	0(0.0%)	16(100%)	1(16.7%)	5(83.3%)	0(0.0%)	6(100%)

$\chi^2=29.433$, $P<0.000$, (Significant)

Table 30 shows data pertaining to wearing two pairs of gloves (double-gloving). Double gloves are currently recommended for use by surgeons in some guideline recommendations. In hospital A, data analysis shows that double gloving was used once (1.6%) in general surgery, on 86 (97.7%) occasions during orthopaedic surgery, and in 4 (25%) cases during specialist surgery. In hospital B, double gloving was used twice (2.5%) in general surgery, 64 (100%) times in orthopaedic surgery, and on 5 (83.3%) occasions in specialist surgery. With respect to using double gloving during invasive procedures, hospital A and hospital B thus highly complied with hospital guidelines, although there was a statistically significant difference between both clinical settings. In addition, data shows that glove perforation occurred on 5 (7.2%) occasions in hospital A, compared with 8 (11.5%) occasions in hospital B.

6.5 Section 4: Relationship Between Category of Surgery and Adherence to Specific Aspects of Surgical Site Infection Preventive Practices

6.5.1 Length of Hospital Stay by Category of Surgery

Table 31: Length of Preoperative Hospital Stay by Category of Surgery

Surgeries	Hospital A		Hospital B	
	Adherence	Non-adherence	Adherence	Non-adherence
General surgery	49(80.3%)	12(19.7%)	67(83.8%)	13(16.2%)
Orthopaedic surgery	76(86.4%)	12 (13.6%)	55(85.9%)	9(14.1%)
Specialist surgery	13(81.2%)	3(18.8%)	6(100%)	0(0.0%)
Total	138(83.6%)	27(16.4%)	128(85.3%)	22(14.7%)

$\chi^2=1.0333$, $P=0.597$ (N.S.)

The data reported in Table 31 examines the relationship between category of surgery and length of hospital stay prior to surgery. In hospital A, adherence rates to recommendations on length of hospital stay were high in the case of orthopedic surgeries (n=76; 86.4%), compared to general surgeries (n=49; 80.3%) or specialist surgeries (n=13; 81.2%). In contrast, in hospital B, adherence rates to preoperative length of stay recommendations amounted to 67 (83.8%) of general surgeries, 55 (85.9%) of orthopedic surgeries and 6 (100%) in the case of specialist surgeries. There were no statistically significant differences found between hospital A and hospital B. This study thus shows that length of hospital stay was not influenced by surgical category. The interval between admission to the hospital and operation is an important element of hospital utilization by patients undergoing surgery (McCorkle 1970). It is necessary that patient should have surgery within 24 hours of admission to hospital to prevent postoperative wound infection. Patients who have longer preoperative hospitalisations are more likely to develop SSIs (Gupta and Agrawal 2015). Therefore, preoperative length of hospital stay should be reduced to minimum (Gupta and Agrawal 2015). The results of this study show that 15(4.8%) of patients were admitted two days before surgery and 34(10.8%) of patients admitted 3 days and more before surgery.

There are several reasons associated with prolonged preoperative stay in both hospitals. Firstly, Oman is a country with remote villages and towns in the mountains, and thus admission to hospital can be delayed and a number of people present later and with more advanced conditions than those in urban populations (e.g. a ruptured appendix). It has been observed that the length of hospital stay is extended in complex cases, such as old-age patients with co-morbidities. In Oman, it is estimated that 95% of patients have a family history of diabetes and that this is primarily due to strong hereditary factors and changes in modern lifestyles (Al-Sinani et al., 2014). Furthermore, it was found that some patients stay longer in hospital preoperatively to receive antibiotics prior to surgery for the treatment of other non-specific infections. It was also observed that there were some problems with operation scheduling. On some occasions, it was observed that there was an unnecessary delay or changes in surgical schedules, which increased the duration of pre-surgical hospitalisation. Frequently, most surgeons requested additional preoperative investigations prior to surgery, which required the patient to stay two or more days in the hospital. In many other instances, some patients were hospitalised over the weekend prior to their operation without any investigations being performed due to the unavailability of consultants or senior surgeons. Therefore, these patients had to stay at least two to three days in the hospital to have the necessary investigations and receive approval by the consultants. Both governmental hospitals were required to consider patients' requests to be admitted earlier if they had difficulty with transportation, because some patients often travelled from long distances.

6.5.2 Traffic Flow by Category of Surgeries

Table 32: Adherence to Recommended Practices for Traffic Flow in Operating Room by Category of Surgery

Surgeries	Hospital A		Hospital B	
	Adherence	Non-adherence	Adherence	Non-adherence
General surgery	23(37.7%)	38(62.3%)	67(83.8%)	13(16.2%)
Orthopaedic surgery	58(65.9%)	30(34.1%)	36(56.2%)	28(43.8%)
Specialist surgery	12(75%)	4(25%)	2(33.3%)	4(66.7%)
Total	93(56.4%)	72(43.6%)	105(70.0%)	45(30.0%)

$\chi^2=1.033$, $P=0.597$ (N.S.)

Table 32 shows the relationship between the category of surgery and adherence to recommended practices for traffic patterns in ORs. In hospital A, the highest levels of adherence to recommended practices for traffic patterns (door openings and number of personnel) was reported in 58 (65.9%) orthopaedic surgeries, compared with 23 (37.7%) general surgeries and 12 (75%) specialist surgeries. In hospital B, level of adherence to traffic patterns was highest among general surgeries (83.8%), compared with (56.2%) in orthopaedic surgeries. The results thus show no association between category of surgery and adherence to recommended practices for traffic patterns in ORs.

6.5.3 Preoperative Antiseptic Bathing by Category of Surgery

Table 33: Adherence to Preoperative Showering or Bathing with Antiseptic Solution by Category of Surgery

Surgeries	Hospital A		Hospital B
	Adherence	Non-adherence	Non-adherence
General surgery	28(45.9%)	33(54.1%)	80(100%)
Orthopaedic surgery	46(52.3%)	42(47.7%)	64(100%)
Specialist surgery	10(62.5%)	6(37.5%)	6(100%)
Total	84(50.9%)	81(49.1%)	150(100%)

Preoperative bathing: $\chi^2=1.538$, $P=0.464$ (N.S.)

Preoperative bathing with antiseptics: $\chi^2=9.828$, $P=0.043$ (Significant)

The data in Table 33 exhibits the association between category of surgery and adherence with antiseptic bathing. Although there was a generally high percentage of compliance with preoperative bathing in most specialised operations, hospital B failed to comply with this recommendation by obtaining an average score of 0%, while hospital A obtained a score of 50.9%.

6.5.4 Preoperative Hair Removal by Category of Surgery

Table 34: Adherence to Preoperative Hair Removal by Category of Surgery

Surgeries	Hospital A		Hospital B	
	Adherence	Non-adherence	Adherence	Non-adherence
General surgery	7(11.5%)	38(62.3%)	16 (20%)	33(41.2%)
Orthopaedic surgery	17(19.3%)	40(45.5%)	12(18.8%)	29(45.3%)
Specialist surgery	3(18.8%)	8(50%)	0(0.0%)	5(83.3%)
Total	27(16.4%)	86(52.1%)	28(18.6%)	67(44.7%)

$\chi^2=4.317$, $P=0.365$ (N.S.)

The data reported in Table 34 investigates the relationship between category of surgery and adherence to preoperative hair removal guidelines. In hospital A, the mean adherence rate was 7

(11.5%) in the case of general surgeries, 17 (19.3%) in orthopedic cases and 3 (18.8%) with respect to specialist surgeries. In hospital B, the mean adherence rate was 16 (20%) in the case of general surgeries, 12 (18.8%) in orthopedic cases and 28 (18.6%) with respect to specialist surgeries. There was no significant association between hair removal and category of surgery. This indicates that hair was removed using razors in almost all the cases.

6.5.5 Preoperative Patient Skin Preparation by Category of Surgery

Table 35: Antiseptic Skin Preparation by Category of Surgery

Surgical area	Adherence to skin preparation with antiseptic agents	
	Adherent	Non-adherent
General surgery	141 (100%)	0 (0.0%)
Orthopaedic surgery	151 (99.3%)	1 (0.7%)
Specialist surgery	22 (100%)	0 (0.0%)
Total	314 (99.7%)	1 (0.3%)

$\chi^2=1.076$, $P=0.584$ (N.S.)

The data shown in Table 35 explores the association between category of surgery and adherence to preoperative skin preparation guidelines. Adherence to patient skin antiseptics was observed in 100% of general surgeries, 99.3% of orthopedic surgeries and 100% in specialist surgeries. What this indicates is that almost all skin preparation procedures were performed using either chlorhexidine, povidone iodine or alcohol antiseptic. Further, the combination of chlorhexidine, povidone iodine and alcohol was observed in most of elective surgeries. This result thus confirms that the use of antiseptic solutions for skin preparation is not associated with the category of surgery.

6.5.6 Skin Cleaning Technique by Category of Surgery

Table 36: Adherence to Preoperative Skin Cleaning Technique by Category of Surgery

Surgeries	Hospital A		Hospital B	
	Adherence	Non-adherence	Adherence	Non-adherence
General surgery	12(19.7%)	49(80.3%)	48(60%)	32(40%)
Orthopaedic surgery	11(12.5%)	77(87.5%)	17(26.6%)	47(73.4%)
Specialist surgery	2(12.5%)	14(87.5%)	4(66.7%)	2(33.3%)
Total	25(15.2%)	140(84.8%)	69(46.0%)	81(54.0%)

$\chi^2=1.538$, $P<0.463$ (Significant)

The data in Table 36 presents adherence to preoperative skin antiseptic technique. The results indicate that in hospital A the surgical site was cleaned in concentric circles, starting from the incision site and moving to the periphery area, in 12 (19.7%) general surgeries and 11 (12.5%) orthopaedic surgeries. In conjunction with this, in hospital B cleaning of the incision site by moving towards the periphery area in concentric circles was observed in 48 (60%) of general surgeries, 17 (26.6%) of orthopaedic cases, and 4 (66.7%) specialist surgeries. This demonstrates a lack of adherence to skin cleaning technique in most surgeries, especially in orthopaedic surgical procedures. Aseptic technique during skin preparation is recommended for all patients, and thus results show no significant association between cleaning technique and category of surgery in either hospital A or hospital B.

6.5.7 Relationship Between Category of Surgery and Adherence to Antibiotic Prophylaxis

Table 37: Adherence to Antibiotic Prophylaxis by Category of Surgery

Variables	Hospital A & B		
	Surgical Areas		
	General surgery	Orthopaedic surgery	Specialist surgery
Item 1: Adherence to antibiotic choice	125 (88.5%)	143 (94%)	20 (93.8%)
Item 2: Adherence to antibiotic timing	125 (89.3%)	137 (89.4%)	16 (31.2%)
Item 3: Adherence to antibiotic duration	96 (69.1%)	70 (46.8%)	14 (64.6%)
Item 4: Overall adherence to antibiotic prophylaxis guidelines in hospital A	45 (73.8%)	73 (83%)	12 (75%)
Item 5: Overall adherence to antibiotic prophylaxis guidelines in hospital B	53 (66.2%)	13 (20.3%)	4 (66.7%)

Item 1: $\chi^2=5.19$, $P=0.268$ (No statistically significant difference was demonstrated).

Item 2: $\chi^2=8.11$, $P=0.087$ (No statistically significant difference was demonstrated).

Item 3: $\chi^2=11.26$, $P=0.024$ (No statistically significant difference was demonstrated).

The data in Table 37 illustrates adherence to all parameters of the local hospital guidelines, including choice of antibiotic, timing of first dose and duration of antibiotic prophylaxis according to type of surgery.

Items 1:

Adherence to the appropriate choice of antibiotic was observed in 125 (88.5%) of general surgeries, 20 (93.8%) of specialist surgeries and 143 (94%) of orthopaedic surgeries. No statistically significant difference was demonstrated.

Item 2:

The results in Table 37 also show that adherence to timing of the first antibiotic dose was concordant with antibiotic guidelines for 297 (94.2%) of the procedures. 125 (89.3%) of the general surgical patients received their antibiotic prophylaxis dose in 60 minutes prior to skin incision, compared

with 137 (89.4%) in orthopaedic cases. Furthermore, 16 (31.2%) in the specialist surgery group were given antibiotic prophylaxis at the appropriate time. **No statistically significant difference was demonstrated.**

Item 3:

Among patients who were prescribed antibiotics, only 96 (69.1%) who underwent general surgery received antibiotic for a total duration of 24 hours, compared to 70 (46.8%) who underwent orthopaedic surgery. Moreover, in the case of 14 (64.6%) of specialist surgeries the antibiotic was discontinued in 24 hours as per the recommended guidelines. Consequently, there was a significant relationship between different types of surgery and the duration of antibiotic prophylaxis. This indicates that surgeons in general surgery were more likely to discontinue antibiotics in 24 hours of incision than other surgical specialists. **No statistically significant difference was demonstrated.**

Items 4 and 5

Overall adherence to all three parameters of antibiotic prophylaxis guidelines were reported in 200 (63.5%) of elective surgeries in both hospital A and hospital B. This shows that adherence to antibiotic prophylaxis recommended practices for all parameters were not fulfilled in all 315 elective surgeries. The findings indicate **no statistically significant difference was demonstrated** between the type of surgical procedures and adherence to choose and timing parameters of antibiotic prophylaxis, and **no statistically significant difference was demonstrated** between the type of surgery and duration of antibiotic prophylaxis.

6.5.8 Wearing of Surgical Attire by Category of Surgery

Table 38: Adherence to Scrubbing, Gowning, and Donning of Gloves Standards by Category of Surgery

Surgical area	Correct scrubbing, gowning and donning of gloves	
	Adherence	Non-adherence
General surgery	123(87.2%)	18(12.8%)
Orthopaedic surgery	140(92.1%)	12(7.9%)
Specialist surgery	19(86.4%)	3(13.6%)
Total	282(89.5%)	33(10.5%)

$\chi^2=2.10$, $P=0.349$ (N.S.)

The data in Table 38 documents adherence to scrubbing, gowning and gloving by category of surgery. Surgical team members participating in a surgical aseptic procedure should be scrubbed, gowned and gloved. Adherence with scrubbing, gowning and donning of gloves standards was observed in 123 (87.2%) general surgeries, compared to 140 (92.1%) orthopaedic surgeries. No significant results were found.

6.5.10 Disinfecting Operating Theatre Surfaces by Category of Surgery

Table 39: Adherence to Cleaning and Disinfecting Operating Room Floor by Category of Surgery

Surgical area	Cleaning done	Use of disinfectant solution for cleaning between surgical procedures	
	Yes	Yes	No
General surgery	141	1(0.7%)	140(99.3%)
Orthopaedic surgery	152	0(0.0%)	152(100%)
Specialist surgery	22	0(0.0%)	22(100%)
Total	315	1(0.3%)	314(99.7%)

$\chi^2=1.23$, $P=0.538$ (N.S.)

The figures in table 39 reflect adherence to guidelines concerning the cleaning and disinfecting of OR surfaces between surgeries. The results show that cleaning was done with respect to all surgical procedures, and cleaner disinfectant was used in only one case. According to the GCC guidelines, any area with visibly soiled with blood or body fluids should be cleaned with an antiseptic solution between patients. There was no relationship found.

6.5.11 Wearing of Cap/Hood that Fully Covers Head Hair by Category of Surgery

Table 40: Adherence to Wearing Cap/Hood by Category of Surgery

Surgical area	Level of adherence to head cover	
	Adherence	Non-adherence
General surgery	24 (16.6%)	117 (83.4%)
Orthopaedic surgery	15 (9.9%)	137 (90.1%)
Specialist surgery	3 (13.6%)	19 (86.4%)
Total	42 (13.3%)	273 (86.7%)

$\chi^2=3.24$, $P=0.198$ (N.S.)

The data in Table 40 documents adherence to wearing a cap or hood which fully covers hair on the head or face when entering the OR (Category IB). The results show that 24 (16.6%) of the general surgical personnel who wore surgical caps did fully cover the hair on their head and face in ORs, compared with 15 (9.9%) surgical personnel in orthopaedic surgeries, whilst personnel in specialist surgeries 3 (13.6%) also showed a low level of adherence. There was no association obtained between category of surgery and adherence to wearing cap/hoods that fully cover hair on the head and face. This indicates that most of the surgical team personnel did not adhere to recommended practice in terms of wearing of a surgical cap.

6.5.12 Relationship Between Length of Operation and Doors Opening During Surgery

Table 41: Relationship Between Length of Operation and Doors Opening

Duration of operation (n=376 hrs)	Hospital A & B			
	Doors opening (n=7023)			
	Number of cases	Percentage (%)	Number of doors opening during surgery	Duration of doors opening in hrs
Less than 1 hour	140	44.4%	1843	13.8 hrs
1 to 2 hours	140	44.4%	3844	22.7 hrs
3 to 4 hours	32	10.1%	1185	7.5 hrs
More than 4 hours	3	1.1%	151	2.5 hrs
Total	315	100%	7023	46.5 hrs

$\chi^2=422.4$, $P<0.001$ (Significant)

Table 41 reports the relationship between length of operation and doors opening. A total of 7023 door swings were recorded in 315 elective cases. Around 1843 door openings were observed in operations lasting less than 1 hour, compared to 3844 doors opening reported in operations lasting between 1 to 2 hours. In 35 operations lasting 3 hours and more, the doors swung open on 1336 occasions. This indicated that there was an association between length of operation and doors opening during surgery.

6.5.13 Wearing Eye Shields

Table 42: Use of Eye Safety Protectors when there is a Potential for Eyes to be Splashed with Blood or Other Secretions

Surgeries	Hospital A		Hospital B		
	Adherence	Non-adherence	Adherence	Non-adherence	Mean adherence for both hospitals
General surgery	61(100%)	0(0.0%)	79(98.8%)	1(1.2%)	140(99.3%)
Orthopaedic surgery	82(93.2%)	6(6.8%)	61(95.3%)	3(4.7%)	143(94.1%)
Specialist surgery	16(100%)	0(0.0%)	6(100%)	0(0.0%)	22(100%)

Table 42 shows that protective eye shields and goggles were worn in specific circumstances. For example, when there is the potential for an aerosol to be created during orthopaedic surgeries. The mean adherence rate was 96.4% in hospital A, compared with the mean adherence rate of 97.3% in hospital B. The overall mean adherence rate was 96.8% in both hospitals.

6.6 Chapter Conclusion

This chapter presented quantitative data pertaining to preoperative and intraoperative infection control practices for the prevention of SSIs. The results demonstrated that the surgical team personnel included in this study exercised partial adherence to specific SSI prevention measures that are recommended preoperatively and intraoperatively by international and national guidelines. Failures of adherence occurred in preoperative bathing with antiseptic agents, non-recommended hair removal of patients with razors, keeping doors open during surgical procedures, the number of personnel in the OR, which was higher than necessary for surgical procedures, duration of antibiotic prophylaxis, use of skin antiseptic technique, wearing of jewellery during surgical procedures, using mobiles and computer keyboards in theatres, improper wearing of surgical attire, and poor adherence to aseptic practices to maintain the sterile field in the OR.

Having said this, some perioperative infection control measures were also successfully adhered to, such as choice and timing of antibiotic prophylaxis, preoperative skin antiseptic, wearing gloves during skin antiseptic preparation, sterile draping technique, as well as with respect to postoperative sterile dressing. In conclusion, lack of adherence to guidelines was clearly identified, and, thus, it is strongly suggested that there is a need to improve adherence to recommended practices to prevent SSIs, as well as in terms of monitoring practices to improve the quality of care for surgical patients. Overall adherence to aspects of perioperative surgical procedures are illustrated in Appendix 20 and Appendix 21. The next chapter presents the findings from the qualitative interviews with 30 HCWs working in surgical wards and OTs.

Chapter Seven:

Findings of the Qualitative Study

7. Chapter Seven: Findings of the Qualitative Study

7.1 Introduction

In the previous chapter, observations of clinical practice were conducted to determine adherence to international and national guidelines for the prevention of SSIs. This chapter will delineate the main analytical themes and findings which emerged out of the thematic content analysis of the interviews and observational field notes. As noted in Chapter Four, all interviews were conducted in accordance with a structured-interview guide to ensure that all topics of interest were covered during the interview. The interview guide was developed in accordance with the CDC international guidelines and a review of the core literature by Durando et al. (2012). Therefore, the interview guide was based on the results of the first phase of the research, and sought to both ask surgical team staff about adherence to recommendations for the prevention of SSIs, and to identify the key factors affecting non-adherence.

The interviews were completed in the workplace of HCWs. The interviews were conducted in English because the majority of HCPs in Oman are from different countries, and, as such, English is their common, although not necessarily native, language. In fact, all HCPs primarily, or regularly, use English in the workplace in all health facilities in Oman. The researcher used codes for all participants rather than using names. For example, surgeons were referred to as (SA), operating theatre nurses (OTN) and surgical ward nurses (SWN). Observational field notes were collected to provide additional rich data outside of the checklist. These field notes were made immediately following the observation to capture data on initial thoughts and practices. The data were then selected and categorised into themes, which were subsequently further divided into subcategories. Quotations from the interviewees have been used as evidence to support their opinions and views and to enrich the data analysis. Moreover, extracts from HCWs' interviews were cited to capture the meaning of the themes and summaries. All audiotape recorded interviews were transcribed by the researcher

in the form of a verbatim transcript, which was later analysed using NVivo 10 software and analysed using the framework analytical method developed by Braun and Clarke (2014) (see Chapter 4, Section 4.4.2.8). The verbatim reports were transcribed on the day of the interview, whilst some field notes were added to the relevant sections of the transcripts to support the data collected.

The analysis produced many themes around preoperative patient preparation, intraoperative surgical procedures, general measures of intraoperative antisepsis, and perceived factors affecting non-adherence to SSI prevention guidelines. The data from closed questions and open-ended questions were integrated together to identify similarities and differences in the data set.

7.2 Findings from the Demographic Data of the Study Participants

Structured interviews were carried out in two Governorate hospitals. For the structured interviews, a random sampling method was used to recruit the 30 HCWs who participated in the study (see Chapter 4, Section 4.4.2.4). A random sampling method was adopted to reduce selection bias and make sure that every member of the surgical team staff had an equal chance of being selected, which helped to achieve representativeness, that is, the degree to which the sample accurately represents the entire population (Teddle and Yu 2007). As discussed in Chapter 4, the sample was selected using a computer programme. Moreover, although there are not established standards in qualitative research regarding sample size, the literature does suggest that 20 to 30 interviews are sufficient for reaching data saturation (Mason 2010). Structured interviews were conducted with surgical team members who were employed in a variety of roles, such as perioperative surgical procedures and providing pre-and intraoperative care to patients who underwent elective surgery, thus meaning that they are in a good position to prevent SSIs. The thematic saturation was reached after interviewing 30 HCWs. Demographic data are presented in Table 46 below.

Table 43: Personnel Interviewed from a National Sample of Surgical Teams

Participant role	No of healthcare professionals	Area of work	Years of experiences and number of personnel
Surgeons	10	General surgery specialist (n=5) Orthopedic surgery specialist (n=5)	1-5 years (0) 6-10 years (3) 11-15 years (5) 16-20 years (2)
Operating theatre's nurses	10	Senior registered nurse (n=9) Unit in charge (n=1)	1-5 years (2) 6-10 years (4) 11- 15 years (3) 16-20 years (1)
Surgical ward nurses	10	Senior registered nurse (n=8) Unit in charge (n=2)	1-5 years (2) 6-10 years (3) 11-15 years (3) 16-20 years (2)
Total of HCWs		30	
Range of experience			1–20 years
Working experiences divided into 4 groups			
* 1-5	*6-10	*11-15	* 16-20 * > 20
Reference Codes for Interviewees		* SA-A refers to surgeons in hospital A * SA-B refers to surgeons in hospital B * OT-A refers to theatre staff in hospital A * OT-B refers to theatre staff in hospital B * SWN-A refers to surgical ward nurses in hospital A * SWN-B refers to surgical ward nurses in hospital B	

Table 46 depicts the total number of HCWs who participated in the study. Thirty HCWs were approached, 10 of whom were surgeons, 10 were registered surgical ward nurses, and 10 were operating theatre nurses. The above table shows that most HCWs have working experience of 11 to 15 years (36.7%), followed by 6-10 years of experience (30.3%), 16-20 years (13.3%), whilst a minority of HCWs (n=4; 10%) had experience of 1-5 years. the experience of HCPs ranged from 1 to 20 years. This indicates that the majority of HCWs (37%) had more than 11 years of experience working in either in surgical wards or OTs. However, in the study, four HCWs had 5 years or less experience in surgical procedures.

7.3 Themes and Categories

The following eight themes emerged out of the data: (1) HCWs' perceptions of knowledge about guidelines; (2) translating perioperative infection control guidelines into practice; (3) preoperative strategies for the prevention of SSI; (4) adherence to perioperative protocols; (5) intraoperative measures for the prevention of SSI; (6) the effectiveness of the guidelines on clinical practice; (7) aseptic practices in ORs; and (8) factors affecting nonadherence to guidelines. Some subcategories were collapsed and incorporated with other findings related to the same issues. These were grouped together to provide more information, which is assumed to reflect the same point in the theme. Consequently, the theme becomes a unifying idea that characterises the experiences of HCWs, in turn providing a holistic insight into the whole data set (Gale et al. 2013). Subsequently, the initial categories that were identified during the analysis of the interview transcripts were merged into 4 main themes with additional sub-themes. The 4 main themes are (1) knowledge of and access to clinical practice guidelines; (2) integration and translation of evidence-based guidelines in clinical practice; (3) preoperative and intraoperative infection control strategies used to prevent SSIs; and (4) barriers to implementation of EBP. In the following sections, findings from interviews with HCPs are presented by theme and category, alongside extracts from the HCWs themselves which provides evidence to support their viewpoints. The following sections delineate the four themes, together with their associated categories, which are then synthesised to show their connectivity in an integrated whole.

7.3.1 Theme 1: Knowledge of Infection Control and Accessibility of Clinical Practice Guidelines

One of the four themes generated from the data concerned knowledge of SSI prevention guidelines. This theme includes three categories: sources of knowledge about the guidelines, awareness of, and familiarity and agreement with, the guidelines, as well as the accessibility of the guidelines themselves.

7.3.1.1 Sources of Knowledge about the Guidelines

According to the respondents, data regarding perioperative recommended practices were obtained through a range of sources. The respondents in this study pointed out that the primary sources of information for HCPs were clinical experiences, academic studies, scientific journals, educational courses, textbooks, hospital training, self-learning and experts' opinion. The following excerpt attests to this discussion.

"I came to know about these guidelines from different sources. First, my information of the guidelines was based on my previous academic studies, clinical practice in the hospital, self-learning at home, and I have learnt about the guidelines from my colleagues and from different references such as scientific studies, internet, textbooks and from Al Shifa electronic healthcare information system (hereafter abbreviated as HIS) in Oman, which provides clinical information and guidelines needed for patients' care (Operating Theatre Nurse: Hospital B).

Similarly, it was observed that the infection control committee started a new programme for all HCWs, aimed at educating surgical team staff about pre- and intraoperative infection control practices, as noted in the following fieldnote.

“Both hospital A and hospital B have established a new education programme for physicians, surgeons and staff nurses to educate them about the prevention and control of SSI and most of healthcare professionals have attended some short courses and on-job-training related to perioperative infection control practices in their clinical institutions. Moreover, some nurses have attended more intensive infection control courses and one or two seminars in infection control in their healthcare facilities”
(Fieldnotes, Surgical Team Staff: Hospital A and Hospital B).

Although a relatively high number of surgical team staff claimed to use clinical practice guidelines as a source of information for their clinical decision-making when preparing patients for elective surgery, it was found that HCWs were using local hospital guidelines and GCC guideline for the prevention of SSIs, as shown in the following extract.

“Yes, I follow the standards in Al Shifa electronic healthcare information system, which includes local and national infection prevention and control policies and guidelines”
(Operating Theatre Staff: Hospital A).

However, the following fieldnotes revealed that some HCWs decision-making relied on discussions with their colleagues and observations of the behaviour of senior staff, which led to non-adherence to clinical practice guidelines.

“I observed on several occasions some nurses and junior surgeons following senior surgeons’ opinions when caring for surgical patients in the operating room. For example,

one nurse asked the surgeon about the best sterile solution for preoperative skin cleansing while she prepared the patient for surgery. The surgeon advised her to use normal saline, which was the wrong choice of antiseptic agent. It was noted that some of the healthcare workers in the operating theatre did not understand what they were doing and why they were doing it” (Fieldnotes: Operating Theatre Staff: Hospital B).

Despite this observed lack of knowledge regarding the EBP guidelines among some surgeons, this study has shown that some education about perioperative procedures was conducted inside OTs, which became a learning environment in which consultant surgeons could serve as guides to junior surgeons and nurses. The consultants even provided specific sessions about surgical procedures and infection control practices for other staff to maintain and improve standards of surgical care. Overall, it was found that the consultants were generally a good source of information for other staff, as documented in the following extract below.

“On several occasions, I observed that some consultants were discussing case-studies and providing instructions to other people in the operating room to improve practices. The discussion was focused on preoperative patient preparation, intraoperative infection control practices and the challenges that may be encountered by HCWs in clinical practice” (Field notes, Operating Theatre Staff: Hospital A and Hospital B).

However, one important point to note concerning previous extract is that this finding supports the argument that HCPs’ performance is based on their knowledge attained from hospital training education programmes, self-learning and clinical skills, as suggested in the following excerpt.

“Our source of knowledge on infection control comes from continued education programmes in the hospital, from personal reading at home and from years of experience in the hospital” (Surgeon: Hospital B).

Further analysis of some frequently reported statements showed that some HCWs had been taught by their preceptors at hospital about the best practices to prevent infection. In addition, preceptorship training and reading of textbooks about infection control were the two main sources used to understand recommended practices for preventing SSI, as illustrated in the following extract.

“When I was a novice I asked my preceptor to teach me about the main infection control practices that should be followed for the prevention of infection, as well as reading some textbooks to improve my knowledge of infection control” (Surgical Ward Nurse: Hospital B).

The analysis of the data also revealed that some surgical team staff obtained all their information on perioperative procedures from other sources, such as academic studies, literature and hospital policy and guidelines, as evidenced by the following response from one surgeon, who notes:

“Basically, we came to know about these guidelines from academic studies, scientific articles, and our institution’s policies and protocols regarding SSIs which are available on the hospital website, and we adhere to the local clinical policies” (Surgeon: Hospital A).

Similarly, a large number of HCWs purported to use local clinical practice guidelines as a source of information for decision-making, and as a means through which to improve their knowledge about perioperative infection control practices. In the following extract, a surgical ward nurse observes that:

“The local infection policies and guidelines about infection control were kept in the nursing office. I went through it and I read about infection control procedures and how to prepare the patients for operation” (Surgical ward Nurse: Hospital A).

From the perspective of some of the interviewees, the principal source of knowledge about guidelines stemmed from training in infection control procedures, which were carried out annually by infection control teams in both hospitals. Although this was a significant annual infection prevention update for all surgical team staff, not everybody had the ability to attend these clinical training opportunities. This is significant as HCPs argue that hospital training forms a critical component of adhering to the recommended practices, as mentioned in the following statement:

“We are having almost every year an infection control programme. But not all Healthcare workers have an opportunity to join this education and training programme, so I think we must have some training and courses related to infection prevention and control standards to be able to implement and adhere to the guidelines” (Surgical Ward Nurse: Hospital A).

In addition to the point about training in extract above, a proper orientation for new surgical team staff was also recommended by the participants to help improve their knowledge about and adherence to guidelines. Specifically, it was suggested that all HCPs should be well educated about recommended infection control standards and new published studies regarding infection control practices. The operating theatre nurse in following quote argues that:

“Orientation programmes should be provided for all healthcare workers who are working in special areas like operating rooms[...]. They should be more oriented towards infection control policy and new studies that are published [...]. They should be familiar

with new published things regarding infection control” (Operating Theatre Nurse: Hospital B).

Finally, the data suggests that senior consultants have the responsibility to teach and train the junior doctors in the clinical setting. The following excerpt demonstrates that senior surgeons are responsible for other doctors.

“Sometimes senior surgeons are taking a long time training other junior doctors about these measures” (Surgeon: Hospital A).

7.3.1.2 Awareness, Familiarity and Agreement with the Guidelines

There were high levels of awareness about SSI preventive guidelines among surgeons, and an equally high awareness of guidelines among nurses. The extracts below demonstrate that most HCWs believed that they were aware and agreed with the guidelines.

“Yes, here in the hospital [name of hospital], we do have protocols regarding SSIs, so we are following these guidelines strictly, and all these guidelines should be implemented by all team members” (Surgeon: Hospital A).

“The main thing is to implement all guidelines, standards and hospital policies in all OTs to reduce infection. In addition, implementing the guidelines would help us to maintain patient safety [...] we have guidelines and all surgical team members are aware about them (Operating Theatre Staff: Hospital B).

As illustrated in following extract, for those who demonstrated awareness and agreement with guidelines, one of them stated that there was a disjuncture between evidence-based guidelines and current practices.

“Yes, we have national guidelines [...] and we follow these guidelines and recommendations; however, there is difference between our clinical practices and national guidelines” (Operating Theatre Nurse: Hospital B).

Despite improvements in infection control practices, there were still some HCWs who did not know of the existence of guidelines. The results of this study suggest that it is not always the case that staff are aware of and familiar with guidelines, indeed in some instances it appears they may not have been in place in clinical practice. In the interview excerpts below, staff posit that there were no guidelines for clinical practice, whilst others discuss writing some personnel notes about infection control practices to prepare patients for elective surgery.

“[...] We have a lack of awareness about these recommendations because there are no guidelines in our unit. There are no specific guidelines” (Operating Theatre Nurse: Hospital A).

“Unfortunately, I am unaware of these guidelines, but I did write down and make some short notes on how to prepare the patient for laparoscopy surgery. For example, I wrote some notes about antibiotic prophylaxis and how to clean the umbilical area before surgery [...]” (Surgeon: Hospital B).

Furthermore, adherence with SSI prevention guidelines vary among HCWs. The participants expressed that surgical team staff should be conscious of the recommended perioperative procedures, and that these procedures should be implemented to prevent infection. There a suggestion that good awareness of the guidelines and teaching newly employed HCWs was recommended by participants as a means through which to improve knowledge of and adherence to guidelines. The following excerpt from an interview with a surgeon substantiates this point, as they argue that:

“To reduce infections, all HCWs should be aware of the guidelines and they should follow these guidelines in their daily clinical practice. Further, all new staff should have additional education and training programmes about practical guidelines for infection control in health care facilities” (Surgeon: Hospital A).

In addition to this, it was found that the majority of HCWs agreed with existing clinical recommendations because it reflected international guidelines, which are based on auditing and scientific research. As one can discern in the following extract, it was argued that if surgical team staff follow these guidelines then they would be able to improve surgical outcomes.

“We do agree with the guidelines because basically it reflects international standards, and are based on auditing and research, so if we strictly follow these guidelines we would be able to improve the outcomes of surgical interventions” (Surgeon: Hospital A).

Other HCWs agreed that the infection control recommended practices would help to optimise patient outcomes. Indeed, HCWs felt a responsibility for patients’ care, noting that surgical team staff need to comply with infection control standards to maintain patient’s safety and reduce the rates of infection postoperatively.

“Yes, of course I agreed with the guidelines to maintain patient’s safety and to minimise SSI, and I believe if we are applying these guidelines we would be able to reduce SSI” (Operating Theatre Nurse: Hospital B).

There were a variety of discussions related to awareness and familiarity with the guidelines. Although the majority of HCWs claimed to be aware of the guidelines, some argued that certain surgical team staff have absolutely no idea about current guidelines for preventing SSIs.

“ [...] Some surgical staff members are not aware about standards, and they do not have enough knowledge about infection control practices (Surgical Ward Nurse: Hospital B).

Consequently, some HCWs purported that a good awareness of these guidelines is essential for reducing HCAs, as discussed below.

“It is important that all staff and all people in the hospitals should be aware of and follow these guidelines to reduce hospital infections” (Surgical Ward Nurse: Hospital B).

7.3.1.3 Accessibility of the Guidelines

The accessibility of the guidelines are essential for helping to prevent SSIs. There were some positive experiences reported by HCWs concerning having access to the guidelines, while others stated that they were not provided with clear guidelines in their clinical practice, and thus they did not seem to be well distributed throughout the hospital. The following extracts are representative of this view.

“Yes, we have access to the local and national GCC guidelines in Al Shifa in our hospital (Operating Theatre Nurse: Hospital A).

“There are no specific or clear guidelines for surgical team staff to prevent SSIs. As I mentioned previously, the lack of distribution of these guidelines is the main problem, which affects our adherence to the guidelines in practice” (Operating Theatre Nurse: Hospital B).

These findings were supported by another surgical ward nurse, who stated that there were no guidelines in the wards. It was therefore suggested that guidelines should be provided for all surgical ward nurses.

“ I think there are some barriers for non-adherence. For example, the guidelines are inaccessible, so it is important to distribute the guidelines for all nurses and it should be reachable for all” (Surgical Ward Nurse: Hospital A).

The findings indicate that there were conflicting opinions between operating theatre nurses and surgeons with respect to the availability or otherwise of guidelines. For example, in the following excerpt one surgeon argues that the guidelines are available, and that they are evidence-based and concordant with international guidelines.

“The local guidelines which have been developed in the hospitals are based on international criteria and EBP, so the guidelines which were distributed here are as good as international guidelines and, basically, they go in the same direction” (Surgeon: Hospital A).

Despite the availability and accessibility of the guidelines for preventing SSI, some of the participants in this study reported a lack of knowledge about existing infection control guidelines. This was problematic given that the researcher found that infection control standards were available on the MOH website, as described in the field notes:

“In both hospitals, the health services have established a new programme called Health Care Information system (Al Shifa). All CDC and GCC guidelines and protocols related to infection control procedures or general practices are available on the Al-Shifa Health Care Information system’s website. But it is observed that some healthcare workers nevertheless have a lack of knowledge about these recommendations” (Fieldnotes; Surgical Team Staff: Hospital A and B).

Based on the above findings, it is evident that most HCWs have acquired their knowledge about perioperative procedures from a range of resources, and, moreover, the data indicates that most of the HCWs were aware of infection control guidelines. Having said this, although awareness of the guidelines amongst surgeons and nurses was high, some HCWs were simply not aware of the infection control measures and practices due to the paucity of clear guidelines in the surgical wards and OTs. The next section addresses the second theme concerning the integration of evidence-based guidelines in practice.

7.3.2 Theme 2: Integrating Evidence-Based Guidelines in Practice

The second theme that emerged from the analysis of the qualitative data pertains to integrating evidence-based guidelines in practice. This was categorised as: (a) adaptation and use of clinical practice guidelines; (b) accountability of surgical team staff; and (c) the effectiveness of the implementation of guidelines in clinical practice.

7.3.2.1 Adapting Clinical Practice Guidelines in Surgical Departments

Different infection control guidelines are used in clinical practice, which are evidence-based. These differences are reflective of international, national and local guidelines. According to some staff, it is feasible to implement local guidelines that are endorsed by each hospital. One operating theatre nurse notes how:

“In our hospital, we are using local guidelines and national guidelines, which are based on international and GCC-CIC guidelines” (Operating Theatre Nurse: Hospital B).

The following extract illustrates how local guidelines are available in the hospital, and that these are adapted from international guidelines which provide many principles that can be applied for the prevention of SSIs. One surgeon states that:

“We have our local guidelines in the hospital, which are adapted from international guidelines. These guidelines provide comprehensive recommendations for the prevention of SSIs” (Surgeon: Hospital B).

These guidelines are appropriately adapted and strictly followed by HCPs for preventing SSIs, as mentioned in the following excerpt:

“Yes, actually here [the name of hospital], we do have strict protocols regarding SSI, because the load and the number of surgeries carried out here are quite significant, so we have to strictly follow these guidelines, which were implemented by all health team staff [...]” (Surgeon: Hospital A).

Furthermore, the successful adaptation of existing perioperative infection control guidelines for local use is essential to prevent infection. National guidelines used in the hospital recommend some preventive measures to reduce the risk of SSIs. These recommendations include preoperative bathing, wearing of surgical attire, preoperative skin cleaning, and use of sterile techniques during cleaning of the incision site. One operating theatre nurse reports:

“I use international evidence-based guidelines to prepare the patient for surgery before incision. This preparation includes some preventive measures, such as using aseptic techniques during surgery, bathing, good personal hygiene, wearing of hospital gown, checking the operating site, skin preparation, and reducing preoperative length of hospital stay (Operating Theatre Nurse: Hospital A).

Furthermore, there are other perioperative standards and recommended practices for preventing SSIs. It is recommended that some effective preventive measures be used before and during operations, as shown in the following extract:

“Yeah, we follow the national guidelines which are available in Al Shifa Health Care Information System [...]. These guidelines include encouraging the patient to take a Hibiscrub bathe on the morning of the day before surgery, making sure that jewellery and dentures, as well as garments are removed [...] check vital signs and give preoperative antibiotic prophylaxis to the patient and then, once the medication is given, asking patients to wear hospital gowns [...]” (Surgical Ward Nurse: Hospital A).

Moreover, whilst the majority of HCWs supported the use of evidence-based guidelines, some expressed concern about applying local guidelines arguing that they needed to be updated and reviewed. The participants were clear that they want clinical practice guidelines that are based on evidence, as one can discern in the following statement by an operating theatre nurse:

“Yes, we are implementing the evidence-based guidelines. However, the guidelines in our hospital should be updated and reviewed on a continuing basis to ensure that the recommendations are up to standards. These guidelines should be reviewed based on recent survey and the new recently published studies” (Operating Theatre Nurse: Hospital B).

However, the findings demonstrate that there were no evidence-based guidelines regarding prevention of SSI to be adapted in their clinical practice, as some participants argued that there are no specific guidelines to improve their acceptance and adherence towards.

“Actually, there are no guidelines here in the OT. There are no specific guidelines. There is no specific guideline for preoperative and intraoperative infection control practices to improve our adherence to, so all people here just follow their clinical skill and experience” (Operating Theatre Nurse: Hospital A).

7.3.2.2 Accountability of Surgical Team Towards Improving Patient Perioperative Care

Importantly, there was a view that HCWs are, ultimately, responsible and accountable for their actions. Indeed, the importance of shared accountability was explicitly endorsed by some HCWs, who emphasised that teamwork is essential for improving adherence to guidelines. Some surgical team staff felt that such an approach has been a major facilitator with respect to implementing effective infection control prevention. This position is eloquently stated in the following extract by a surgeon, who argues:

“Yes, I would say that all healthcare teams need to be involved together [...]. If all people in surgical teams including the surgeons, physicians, laboratory technicians, microbiologists, clinical pharmacists, staff nurse and other staff work together it would improve the outcomes of patients care and improve adherence to guidelines” (Surgeon: Hospital A).

In addition to this, HCWs posited that they must enhance the use of research-based evidence through more efficient development and implementation of practice guidelines in their departments.

“We should use evidence-based guidelines because it is proven that these guidelines would help to reduce the rate of SSIs” (Surgeon: Hospital A).

More importantly, carrying out regular audits of practice to evaluate existing guidelines is critical for improving acceptance and adherence to guidelines for perioperative procedures.

“We are doing audits for specific surgical procedures like trauma, total arthroplasty, arthroscopy and other spine surgeries. In addition, we are evaluating the incidence of SSI

and comparing it with international standards. We are doing regular audits to improve our practice” (Surgeon: Hospital A).

Other surgical team staff pointed out that they had no information about any auditing or surveillance programmes in their clinical practice; in fact, as one can see in the excerpts below, the majority of them stated that there were no audits being done in their departments concerning prevention of SSIs.

“I am not sure, I have never seen any infection control audits being performed to monitor preoperative and intraoperative infection control practices in our hospitals” (Surgeon: Hospital A).

“There are no auditing programmes in our hospitals to evaluate SSI control practices” (Operating Theatre Staff: Hospital B).

7.3.2.3 Effectiveness of the Clinical Practice Guidelines Implementation Strategy

Most of the surgical team staff were convinced that the evidence-based recommendations are effectively embedded in their clinical practice. The findings of the study indicate that surgeons and other staff perceive the guidelines to be effective, as indicated in following extracts.

“I think it is effective because I worked in many places and when we compare the rates of infection in our hospital to other hospitals, I found that our rates of infection were lower than I have seen before in many places [...] and I think infection control guidelines are well implemented and maintained here to prevent SSIs” (Surgeon: Hospital A).

“Implementation of the guidelines is essential for preventing SSIs and maintaining patient’s safety. I believe if we apply these guidelines then Insha’Allah [By God’s will] we will reduce SSI” (Operating Theatre Staff: Hospital B).

In addition, data analysis also underscores that implementation of clinical practice guidelines are essential for making clinical decisions about perioperative patient's care. A surgeon in the following excerpt claims:

“The evidence-based guidelines help to reduce the risk of SSI during pre- intra- and postoperative care. These guidelines are also used as a tool to judge our performance and compare our results with others” (Surgeon: Hospital A).

7.3.2.4 Interventions to Improve Guideline Adherence Among Surgical Team Staff

There were a variety of solutions offered by all HCWs with respect to improving adherence to guidelines in general. However, most of the discussion about improvements centered on acquiring more knowledge and skills related to infection control practices and developing clear guidelines to improve the outcomes of interventions. There was some concern expressed about the need to develop strategies to provide best practice advice about caring for patients through reducing and treating SSIs. As one surgeon noted:

“As I told you we need specific guidelines and policies regarding infection control practices. We need to use these strategies to guide us through preparing the patient before surgery, so we should have performed a short course or had a meeting to discuss these guidelines, especially the use of evidence-based guidelines for the use of antibiotic prophylaxis [...] we want to know what is right and what is wrong, and how to implement international and national guidelines in our hospital” (Surgeon: Hospital B).

Moreover, participants also spoke of the need for adequate human resources, sufficient supplies, more training and updating of the existing guidelines, as ways in which adherence to guidelines could be improved. According to one operating theatre nurse:

“Yes, in our hospital we need to increase human resources, make equipment available, provide more education for HCWs, and update the hospital policies and guidelines, so everybody can follow the guidelines [...] (Operating Theatre Nurse: hospital B).

In summary, it is clear that HCWs used different guidelines based on EBP to prevent infection. In fact, the data shows that the participants claimed that they used guidelines to prevent SSI, although the researcher’s structured observations do not support their perceptions of their actual behaviour. The data also illustrates that there was an acceptance and willingness to follow the recommended practices. Therefore, participants believed that they are accountable for their actions, and that implementing the guidelines were necessary for preventing SSI and thus maintaining patient’s safety. The next section elucidates the third theme concerning the strategies used to prevent SSIs in elective surgery.

7.3.3 Theme 3: Strategies Used to Prevent Surgical Site Infections

This theme is divided into three main categories. The first category describes the preoperative assessment of surgical patients. The second category examines preoperative infection control practices during preoperative care. The third category describes intraoperative infection control practices.

7.3.3.1 Preoperative Patient Assessment

Data gathered from interviews suggests that preoperative patient preparatory procedures depend on the patient’s risk factors, such as the age of the patient and comorbidities. In addition, extrinsic factors like the type of operation and complexity of the surgical procedure also play an integral role. Based on the results from the interviews with HCWs, patient’s preoperative risk factors and further

risks associated with the specific surgical procedure should be assessed before sending the patient to the OT. The following excerpt makes this precise point:

“Usually preoperative assessment depends on many factors, like the type of surgery, patient’ condition, medical comorbidity, patient’s age and time of preoperative preparation, because some patients undergoing complex major surgical procedures are required to be in the hospital at least two days prior to surgery to carry out some examinations; however, for normal patients, one day is adequate for preoperative preparation” (Surgeon: Hospital B).

Likewise, surgeons argued that preoperative preparation begins from the moment the patient agrees to surgery. The following response illustrates that the surgical teams must always ensure that a patient is fit for surgery. The preoperative preparation depends on other aspects like *preoperative* investigations, type of anaesthesia and preoperative medical problems.

“The preoperative assessment starts in the outpatient clinic. First, we check a patient’s medical condition to ensure that they are free of medical comorbidities like diabetic mellitus, hypertension (hereafter abbreviated as HTN), and skin problems or any other medical problems, which may affect tissue healing [...]. Once the surgeon is decided, we send the patient for a pre-anaesthetic check-up clinic to ensure that the patient is fit for anaesthesia and surgery. Later, investigations will be collected and reviewed [...].”
(Surgeon: Hospital A).

However, many more HCWs agreed that a careful preoperative assessment should be done for high-risk surgical patients, especially those who are at risk of hyperglycemia. Therefore, the nurses should check the blood-sugar levels of those patients preoperatively. According to one surgical ward nurse:

“Yeah, it is important if a patient has any medical problem like diabetic mellitus, we should check random blood-sugar levels before surgery and usually if it is more than 10 millimoles/litre, we must start an I.V. infusion” (Surgical Ward Nurse: Hospital A).

7.3.3.2 Preoperative Surgical Procedures

The data indicates that evidence-based preventive measures were correctly applied to control and tackle SSIs. Upon being questioned about preoperative surgical procedures, participants identified a variety of strategies for preventing SSIs in elective surgery. Some of these preoperative and intraoperative factors are addressed by one operating theatre nurse in the extract below.

“To prepare the patient for surgery, we should consider some of the contributing factors to SSIs. These factors include shortening preoperative hospital stays, performing skin preparation using iodine, shaving before surgery, and taking showers or baths 3 hours before surgery [...] displaying appropriate hand hygiene, scrubbing, checking the antibiotic prophylaxis, wearing OT gown and sterile gloves, maintaining sterility field, draping and sterility before surgery, and proper dressing [...]” (Operating Theatre Nurse: Hospital B).

Further, prevention of SSIs relies on changing modifiable risk factors that predispose someone to SSIs. Some of these factors that can be changed to reduce the risk of SSI are discussed in the extract below.

“There are some perioperative preventive measures that should be followed when preparing the patient for surgery including (1) minimising the hospital stay to as short as possible, especially for patients with no medical problems; (2) taking a preoperative shower; (3) shaving immediately before surgery with electric clippers; (4) giving

appropriate antibiotic prophylaxis half an hour before starting surgery [...]; and finally
(5) check the incision site for any infection [...]" (Surgeon: Hospital B).

As surgical team staff play a critical role in the prevention of factors related to surgical procedures during the pre- and intraoperative stage, so the guideline recommendations should be adopted by surgical teams to prevent SSIs, as the participant opines in the following excerpt:

" [...] Based on my knowledge and clinical experience, the patient should take a bath with germicidal soap, be provided with antibiotic prophylaxis, and skin preparation with antiseptic should be performed. Furthermore, nail polish should be removed, surgical attire should be donned, one should scrub using an aseptic technique, using chlorhexidine solution for skin preparation, as well as controlling traffic flow and minimising the amount of people inside the OR and avoiding unnecessary talking inside the OT are all important for preventing infection" (Operating Theatre Nurse: Hospital B).

Proper implementation of these measures is crucial for preventing infection. Therefore, it is also recommended that preoperative length of hospital stay should be kept as short as possible to minimise the risk of HCAs. The data analysis suggests that patients should be admitted one day before surgery to have adequate time for preoperative preparation, to collect further information and, in turn, reduce the risk of infection.

"The preoperative hospital stay should be kept as short as possible. For normal cases and stable patients, admission should be on the day of surgery to minimise the risk of infection, whilst for some major surgeries the patient should be admitted 24 hours before the operation [...]" (Operating Theatre Nurse: Hospital B).

“One of the most important factors for preventing infection is to keep the preoperative length of stay as short as possible in our institution, and I suggest starting a day care surgery” (Surgeon: Hospital A).

7.3.3.2.1 Preoperative Bathing with Antiseptic Agents

The data suggests that most of the participants agreed that all patients undergoing surgical procedures should take preoperative antiseptic baths prior to surgery to prevent infection. The following extract is representative of all HCWs’ opinions.

“We are instructing the patients to take a shower before going to surgery. We are telling the patients before going to surgery to have a nice shower to maintain personal hygiene. We are making sure that they have a nice shower with Hibiscrub to prevent infection, whilst those who are unable to take a bath will be given one on the day of surgery”
(Surgical Ward Nurse: Hospital A).

The data from this study also does not support preoperative bathing with antiseptic solution as a strategy to reduce the risk of SSIs. Some health professionals emphasised that there where was no direct evidence about the benefits of preoperative bathing or showering with antiseptic agents instead of normal common detergent, and the data testifies to the fact that these issues remain controversial among HCWs. As one surgeon opines in the following extract:

“No, we usually do not ask the patient to do this here, we just ask the patient to take a bath with soap and water. I do not prefer this because, as I said, there is no evidence supporting this practice” (Surgeon: Hospital B).

Fieldnotes from observations verified that most of the patients were instructed to take a bath at least one day before surgery, but most of them were not informed to bathe with an antiseptic

solution. Hence, using normal soap for preoperative bathing appears to be a widely adopted practice in both hospitals; however, in hospital B antiseptic bathing was not recommended.

“It was noted that most of the patients received oral instructions to take a bath before surgery. Most of the patients in both hospitals took preoperative shower before surgery, but chlorhexidine solution was used in very few cases in hospital A and none of the cases in hospital B applied chlorhexidine solution during showering. It was noted that there were some factors affecting their practice, such as a lack of certain resources such as, lack of antiseptic agent. It was observed that cultural issues, where some patients refused to take bath before surgery, where the main obstacles to the use of evidence-based practice” (Fieldnotes: Surgical Team Staff: Hospital A and Hospital B).

7.3.3.2.2 Preoperative Hair Removal

With respect to this issue, the data revealed that when hair removal is deemed necessary, it is recommended that hair should be removed before surgery and preferably with electronic clippers in OTs or surgical wards to prevent infection. The data analysis illustrates that hair removal with clippers in the surgical ward is safer, and may reduce the incidence of skin injuries, as described in the following excerpt:

“Yes, I feel that patients should be well prepared in the ward, so shaving should be done in the surgical wards and not in theatre to prevent infection. Only here in the theatre are we are checking if it is done properly, otherwise it should be done in the ward to prevent infection [...] for me I prefer the clippers over razors because using clippers are safer for preventing cuts [...]” (Operating Theatre Nurse: Hospital A).

On the contrary, some HCWs in this study argued that preoperative hair removal with a razor is an acceptable modality through which to avoid cuts and skin injuries. Indeed, some HCWs also believed that there was no strong evidence with respect to the timing of hair removal. The following excerpt from a surgeon supports this view, positing that:

“Hair removal should be done with a razor to avoid scratches, and as you know scratches can increase the chance of infection, so a razor is better for hair removal. As I told you, there is no protocol about the timing of hair removal but some textbooks point out that hair removal should be done on the patient’s table inside the operating room [...] others say in the surgical ward before shifting the patient into the OR. But in our hospital, we do the shaving one day before surgery” (Surgeon: Hospital B).

Depilatory cream also appears to be regarded as the best method of hair removal by some HCWs, who nevertheless still use clippers for all cases. Some surgical team staff suggested that preoperative hair removal should be done immediately prior to surgery in a private area as opposed to the patient’s table inside the OT, thus minimising the dispersal of loose hair. As this operating theatre nurse notes:

“Yeah, I prefer to use depilation cream, but we are using clippers for all cases [...]. I think it should be done immediately before the operation in a private area and not on the surgical table to prevent fallen hair on the surgical field” (Operating Theatre Nurse: Hospital B).

Data from the fieldnotes documents that shaving of the operating site with clippers or razors was largely performed in surgical wards or on the patient’s table inside ORs. Moreover, most hair removal was done using inappropriate methods. In the absence of cream depilation in both

hospitals, most of hair removal was done with razors and it was noted that most HCWs did not comply with the timing and methods of hair removal.

“I observed that the method of hair removal varied between HCWs: most surgeons used razors with respect to general surgery, whilst most orthopaedic surgeons used clippers most of the time. Among those who were shaved, the most shaving was performed in operating rooms by nurses and in a few cases by surgeons” (Fieldnotes: Operating Theatre Staff: Hospital A and Hospital B).

7.3.3.2.3 Use of Antibiotic Prophylaxis in Elective Surgery

The data analysis highlights that antibiotic prophylaxis was frequently used in elective surgery. Specifically, the data shows that the practice of providing antibiotic prophylaxis is well established in elective surgeries. Some of the participants, such as the operating theatre nurse in Extract 57 below, proffer the argument that antibiotic prophylaxis should be given for all major elective cases and for all patients undergoing long operations as indicated in the following excerpt:

“Antibiotic prophylaxis should be given to all patients undergoing major surgeries. In addition, patients who stay more than one hour in surgery should receive antibiotic prophylaxis [...]. All cases such as laparotomy cases, orthopaedic cases, hernia, laparoscopy cases, cholecystectomy cases, patients with renal disease and cardiac cases should receive antibiotic prophylaxis before surgery [...].” (Operating Theatre Nurse: Hospital B).

Fieldnote data corroborates this above point that all patients undergoing elective operation did receive prophylactic antibiotics before surgery. Most of the patients received an appropriate

antimicrobial prophylaxis at the proper time, and the most common antibiotics used were first and second generation cephalosporins. As the researcher's fieldnotes note:

“It was monitored that antibiotic prophylaxis was administered in almost all surgical interventions in 60 minutes prior to surgery; however, it was noted that most of the surgeons liked to prolong antibiotic duration for more than 24 hours. In both hospitals, the most popular antibiotic prophylaxis agents used were cefazolin, cefuroxime and ceftriaxone. However, in some cases, a combination of two types of antibiotic were administered, especially with orthopaedic surgery” (Fieldnotes: Operating Theatre Nurses and Surgeons: Hospital A and Hospital B).

Opinions differed over whether the antibiotics should be administered for all elective cases, or only in those cases with a high risk of infection. Some *participants* held the opinion that antibiotic prophylaxis is required for people undergoing such major surgical procedures as orthopaedic surgery due to the risk of infection, so that it may be better to administer it before the operation, except in the case of minor surgeries, to prevent SSIs. The following excerpt supports this claim:

“Basically, preoperative antibiotic prophylaxis is necessary for major surgeries like orthopaedic procedures because there is a high risk of infection. However, some minor surgeries, particularly clean general surgeries involving K-wire removal may not require antibiotic prophylaxes” (Surgeon: Hospital A).

Furthermore, other surgical team staff also commented that antibiotics should be selected based on the type of surgery. It was claimed that the antibiotic prophylaxis should be administered in one hour of incision, whereas for some cases the antibiotic should be administered prior to incision and repeated intraoperatively if the operation is longer than three hours. However, it should then be discontinued in 24 hours of surgery, as argued by one surgeon in the extract below:

“Based on our guidelines the timing of antibiotic is very important. We give prophylaxis 30 minutes before skin incision [...]. The dose of antibiotics should be discontinued properly in 24 hours of surgery and the choice of antibiotic should be appropriate to the type of surgery. There is a policy in our institution about the use of antibiotics which guides us in administering proper doses. If the surgery is prolonged for more than 4 hours then you need to give another dose of antibiotic prophylactic intraoperatively [...].”
(Surgeon: Hospital A).

Data from the researcher’s fieldnotes revealed that antibiotic prophylaxis was usually given on induction of anaesthesia in both hospitals, because the first dose of antibiotic was given in the ORs or immediately before moving the patients from the ward. However, some surgeons prolonged the duration of antibiotic prophylaxis for many unnecessary cases, especially orthopaedic surgeons.

“It was noted that most prophylaxis was administered in 30 minutes of surgical incision; however, in many cases, the antibiotics were given for more than 24 hours. In some cases, antibiotic prophylaxis was started after skin incision intraoperatively because some surgeons forgot to prescribe antibiotics. Consequently, some failures in the timing of antibiotic prophylaxis administration were reported in many operations, particularly in hospital B, and that this was mainly due to forgetfulness, negligence and a lack of communication between surgical team members” (Fieldnotes: Operating Theatre Staff and Surgeons: Hospital A and Hospital B).

Use of antibiotic prophylaxis in the treatment of surgical patients remains controversial. It was proposed by several surgeons that antimicrobial prophylaxis should be given for certain types of surgical procedures designated as clean procedures and clean-contaminated surgeries. However,

other HCWs believe that antibiotics should be prescribed for contaminated procedures if there is a risk of infection. The following extracts depict these perspectives.

“Antibiotic prophylaxis should be provided for clean-contaminated procedures, as well as some clean procedures if we suspect that an infection could happen after the operation” (Surgeon: Hospital B).

“Actually, we are giving antibiotic prophylaxis for clean-contaminated procedures or contaminated wounds, and sometimes for clean surgery and immunocompromised patients who are at risk of developing infection [...]. Yes, I think we must know exactly which cases require antibiotics and which cases do not, what the exact dose should be, and when the exact time is for giving the antibiotic before surgery. This is very important for antibiotic prophylaxis because some people use a specific antibiotic for certain types of infection, whilst others use different types of antibiotics, so we need to have some clear guidelines for selection, timing and duration of antibiotic prophylaxis” (Surgeon: Hospital B).

All the surgeons perceived their role to be as prominent leaders, and saw themselves as responsible for others; however, they also noted that in some instances everyone should get involved to improve adherence to guidelines, as evidenced in the following excerpt below.

“ [...] The senior surgeon is assuming the role of leader of the surgical team because there are a lot of services involved in caring for the patient. There is not only the surgeon but other physicians, anaesthetists, staff nurses, clinical pharmacists and physiotherapists who should be involved in patient’s care [...]. The surgeons are the ones who are responsible for leading other surgical team staff, and surgeons are responsible for ensuring that all guidelines are being implemented [...]” (Surgeon: Hospital A).

Basically, some also believed that the surgeon is the leader of the team, and thus assumes the role of the decision-maker in the team. However, nurses play another role in terms of antibiotic prophylaxis. Some nurses use a reminder strategy to inform surgeons about the administration of antibiotic prophylaxis. It was found that in some cases, the antibiotic prophylaxis was not prescribed, so nurses were considered to have an assisting role, which mainly consisted of following the instructions of the surgeons and reminding the surgeons to give prophylaxis, as indicated in the following excerpt in which one surgical ward nurse argues that:

“In the surgical ward, our role is [laughing], reminding the doctors to write the prophylaxis antibiotic, most of the time they forget to prescribe antibiotics, so we tell them to write antibiotics for surgical patients [...]. For example, one day a patient was admitted for hernia repair and the antibiotic was not written, so we informed the surgeons to prescribe prophylaxis antibiotic [...]. Our main role is also to comply with, and carry out doctors’ instructions in terms of antibiotic prophylaxis” (Surgical Ward Nurse: Hospital B).

The findings of this study capture some of the frustration of the nurses who felt that their expertise was undermined. Other frustrations that hindered nurses to implement EBP were lack of communications. Some nurses also felt that there is a need for better communication between HCWs in terms of administration of antibiotic prophylaxis. The following quote from one surgical ward nurse testifies to this:

“I would say communication barriers between team members. Sometimes there is no communication between surgeons and nurses in the surgical ward. In some cases, the surgeons will only admit the patient without prescribing prophylactic antibiotics before surgery. The communication between the health care team is missing, so I think it should

be improved to follow the guidelines for the prevention of SSI” (Surgical Ward Nurse: Hospital B).

7.3.3.2.4 Patient Skin Preparation in the Operating Room

The evidence from this study indicates that preoperative skin preparation was performed in all elective surgical procedures prior to surgical incision, using different antiseptic solutions like chlorhexidine, povidone iodine and alcohol antiseptic to minimise the risk of SSIs. The following statement suggests that preoperative skin preparation is essential for preparing the patients for elective surgery.

“Proper skin preparation with chlorhexidine or betadine should be carried out before surgery” (Surgeon: Hospital A).

The results demonstrate that aseptic techniques are essential for skin preparation and for avoiding touching or breaching the patient’s skin area. It was suggested that surgical skin antisepsis should be done appropriately following aseptic techniques when preparing a patient’s skin for surgery. The following quotation from an operating theatre nurse reflects this view:

“Skin cleaning should be done correctly and carried out in accordance to aseptic technique guidelines by cleaning the site from the cleanest area to the dirtiest area, which means from in to out, using betadine antiseptic” (Operating Theatre Nurse: Hospital A).

Fieldnote data shows that skin disinfection before and after wound closure was routinely performed in all surgical interventions with the use of proper antiseptic agents. However, observations conducted during intraoperative care did show that most surgeons failed to follow the aseptic technique while cleaning the incision for surgery.

“Notably, it was observed that skin antisepsis was done in all elective cases, in which some surgeons prefer to use a chlorhexidine agent, whereas others used povidone iodine or an alcoholic solution. Although some of them also used a combination of antiseptic agents, such as chlorhexidine, an alcohol based agent and povidone iodine. The method of application was not correct and most of the surgeons did not follow concentric circles while cleaning the incision area” (Fieldnotes: Surgeons: Hospital A and Hospital B).

It was noted by an operating theatre nurse that selection of antiseptic solutions for skin preparation depends on the type of surgery, using the example that in general surgeries, betadine (povidone iodine) should be used for skin antisepsis. For example, in neurosurgery they use betadine, alcoholic betadine and a methylated spirit solution. The following excerpt is an evidence for the claim:

“It depends on the type of surgery for example, for neuro-cases, surgeons use different antiseptic solutions like betadine, alcoholic betadine and a spirit solution; however, for other general cases they clean the skin with antiseptic betadine. In orthopaedic cases, first they will scrub the incision site with a chlorhexidine agent and after that they will paint it with an antiseptic betadine scrub before surgery” (Operating Theatre Nurse: Hospital A).

Finally, some participants reported that skin preparation in the ward currently used inappropriate procedures. It was found that if skin preparation was done in the surgical ward then the patient would be at a high risk of infection, and thus it was proposed that skin antiseptic should be performed immediately before surgery in the OT. In the excerpts below, several HCPs note that:

“Preparing of the skin site should be done inside the OR, using aseptic techniques to prevent SSI (Operating Theatre Nurse: Hospital A).

“The main thing about skin preparation that Healthcare professionals should stop doing is conducting skin preparation in the surgical ward, because preparing the skin before surgery in the ward can cause a cut in the patient’s skin which may increase the risk of infection, so it is preferable to perform skin preparation in the OT” (Surgical Ward Nurse: Hospital A).

7.3.3.2.5 Wearing Proper Surgical Attire in Operating Room

The following excerpts show that surgical attire was worn in the OTs. Surgical attire includes head cover, surgical masks, gloves, suit, eye shield/goggles and shoes. It was found that the wearing of surgical attire in OTs is important for preventing infection.

“The Healthcare professionals should wear gloves, wear gowns, masks, and sometimes we should wear goggles for patient’s safety and to prevent infection” (Surgeon: Hospital B).

“In the OT we are wearing gowns, double sterile gloves to prevent infection [...] in all orthopaedic operations I prefer to wear two sterile gloves to prevent infection [...]. It is also important to wear goggles, shoe covers, caps and masks before surgery (Operating Theatre Nurse: Hospital B).

Data from the researcher’s fieldnotes shows that surgical attire was worn by all people in OTs, and all staff changed their cloths when coming in and out of the OT. However, there were some people who did not used caps and masks properly during operations.

“In the OTs the wearing of caps, surgical masks, gowns and gloves was done by all health professionals. It was monitored that surgical caps and surgical masks were always worn in all the OTs, but on several occasions Healthcare workers did not use the caps

properly to cover their head hair and masks were not properly positioned. Furthermore, it was observed that the surgical team staff used the same surgical caps and masks for all procedures and did not change their masks between operations. In addition, it was noted that single gloving was used by general surgeons, whilst double gloving was frequently used by all orthopaedic cases” (Fieldnotes: Surgical Team Staff: Hospital A and Hospital B).

7.3.3.2.6 Handling of Surgical Instruments and Sterile Dressing

The following excerpt shows that appropriate handling of surgical instruments during surgical procedures in ORs is significant for avoiding contamination. As one surgeon notes:

“The proper handling of instruments inside the patient, especially the implant, is critical to maintaining the patient’s safety. There is a certain protocol about handling implants, which includes not removing the cover until the implant is inserted into the body [...]”
(Surgeon: Hospital B).

Furthermore, after wound closure, a sterile dressing should be applied to prevent infections. Most of the HCWs agreed that the sterile dressing is necessary to keep the surgery area clean and prevent infection.

“Sterile dry dressing may be applied at the end of surgical procedures to reduce the risk of contamination. If there is any soakage again, the dressing should be changed. We are not dressing daily unless there is a soakage” (Surgeon: Hospital B).

7.3.3.2.7 Traffic Flow in Operating Room

The three excerpts below illustrate that traffic flow has a strongly negative impact on the OR environment. Keeping the doors open during surgery for unnecessary reasons and involving many people in the OR may affect the airflow in the OR, and, thus, increase the risk of infection. Therefore, traffic flow should be restricted and doors should be closed during surgeries, according to the following extracts.

“I very much believe that frequently opening the doors can increase the rate of hospital infection, especially SSI. When surgery starts, the doors should be locked and frequent movement of operating theatre staff should be avoided” (Surgeon: Hospital B).

“Yes, of course I believe that keeping the OR doors open is a major issue. If the doors open many times for unnecessary reasons then it increases the rates of SSIs” (Operating Theatre Staff: Hospital B).

“Yes, there is a chance of airborne bacteria entering the Operating room if the doors are kept opened, so the doors should be kept closed immediately during surgery” (Surgical Ward Nurse: Hospital B).

It is also evident from the excerpts below that surgical team staff working in the OR are subject to distractions and interruptions that can affect their performance. It was found that traffic flow can result in contamination of the sterile field, but also cause distractions to surgical team staff during surgery, as outlined below:

“See, there are two factors. Number 1, if the door is kept opened, this may distract the surgical team because some people will keep moving in and out of the OR [...]. We need a silent place to help the surgeons, anaesthetists and nursing staff to improve their

performance during surgery. Number two, if the door was kept opened for unnecessary reasons then that may invite some dust so it is better to close the doors to avoid infections” (Surgeon: Hospital A).

The data from the fieldnotes confirms that doors were continuously opened during surgical procedures, often remaining so for long periods, whilst most of the time these doors were opened for no obvious reason. In conjunction with this, regardless of the type of operation the number of people involved in each surgical procedure was very high.

“On several occasions, it was observed that doors were kept open for long periods to allow passage of people, equipment, patients, breaks, communication, observations for unknown reasons. and it was also observed that in many cases the number of personnel was greater than 7 people, including surgeons, nurses, anaesthesiologists, residents, medical assistants and other observers (Fieldnotes: Operating Theatre Staff: Hospital A and hospital B).

In summary, the above theme explored the perioperative preventive measures for SSI. As discussed above, the data shows that the participants followed different preventive measures for SSI. These measures included minimising the length of preoperative hospital stay, antiseptic bathing, appropriate hair removal, antibiotic prophylaxis administration, and skin preparation using antiseptic agents and other infection control standards. The data also underscores that HCWs should work as a team to make sure that these measures are conducted properly and in accordance to current guidelines.

7.3.4 Theme 4: Barriers to Guideline Adherence Among Surgical Team Staff

This theme encompasses all the factors that influence HCWs adherence or non-adherence to infection control guidelines. The data analysis identified three dominant barriers underpinning HCWs' non-adherence to SSI prevention guidelines. In this present study, the key barriers to the implementation of guidelines were found to be: organisational related factors, issues related to cultural beliefs, knowledge and behavioural related factors; and guideline related factors. These manifold factors are deemed to be responsible for non-adherence to EBP among surgical team staff. The qualitative phase of analysis identified specific determinants of general non-adherence to guidelines, including organisational issues like lack of resources, workload, emergencies, cancellations and delays of surgical procedures, shortage of staff and poor communication. Additional barriers reported by HCWs included knowledge/ behaviour of the individual, such as disagreeing with guidelines, negligence and forgetfulness. Moreover, patient related factors such as patient's preferences and medical status were the most frequently cited factors for non-adherence. Other barriers included culture related issues, for example patients not wanting to shower or shave. Another set of determinants for non-adherence to guidelines included ambiguity over unclear guidelines, and inadequate distribution of the guidelines themselves. These manifold factors are discussed below.

7.3.4.1 Organisational Related Factors

(a) Poor Organisational Communication

Based on the evidence presented here, the disjuncture between guideline recommendations and delivery of perioperative care are due to several specific barriers. For instance, a lack of proper

communication between surgical team staff is one of the main factors cited by HCWs with respect to poor levels of adherence to SSI prevention guidelines. This is highlighted in the excerpt below.

“There is miscommunication between surgeons and nurses. Sometimes we are facing a problem with communication, especially with surgeons...” (Operating Theatre Nurse: Hospital A).

Therefore, to overcome some of these issues, it was suggested by one surgeon that there is an urgent need to improve the communication between Healthcare professionals, as illustrated in the following extract:

“Number one, improving the communication between the surgical team staff is critical for improving adherence to guidelines for prevention of SSIs [...]” (Surgeon: Hospital A).

(b) Lack of Infection Control Supplies and Inadequate Staffing

The most commonly identified barrier hindering the application of evidence-based guidelines concerned the shortage of staff and lack of supplies. Many of the participants acknowledged that a lack of resources and shortage of staff were the principal factors behind non-adherence to guidelines and they cited lack of supplies is a serious problem and one of the main contributory barriers to failure to adhere with guidelines, as discussed below:

“Actually, the main factors are shortage of staff and lack of equipment. For example, sometimes surgical masks are not available, gloves are not available. gowns are not available [...] we are facing these problems all the time (Surgical Ward Nurse: Hospital B).

“Lack of resources is one of the main factors affecting non-adherence. I mean sometimes some antibiotics are not available in the pharmacy, therefore the patient will miss the first dose of antibiotics. Consequently, the antibiotics would be started after surgery” (Surgical Ward Nurse: Hospital A).

Additional barriers identified by the researcher included problems with the instruments themselves. It was observed on several occasions that some equipment and medical devices were not working properly during procedures, such as in the case of the orthopaedic surgical screws, drills and so on documented in the extract below.

“It was noted that some equipment was not working correctly during surgical procedures, such as in the case of a total knee replacement and anterior cruciate ligament surgery. For example, it was observed on occasions that some surgical instruments like screws and drills were not properly working, hence some of the operations were delayed for more than 40 minutes” (Field notes: Operating Theatre Staff: Hospital B).

(c) Workload

When workload was especially heavy due to the number of operations and limited numbers of staff, HCWs encountered difficulties in adhering to all the guidelines for the prevention of SSI. Lack of time barriers was a further issue identified by health professionals as obstructing their ability to implement evidence -based guidelines in clinical practice. The pressures of the workload as experienced by all HCWs, including nurses and doctors, is captured in the following excerpts:

“Yes, sometimes doctors are working for more than 30 hours continuously from 7 o'clock till next day, so the work pressure for example, may affect adherence to antibiotics guidelines and SSI prevention guidelines” (Surgeon: Hospital B).

“Heavy duty is also one factor affecting non-adherence to national recommendation for prevention of SSI” (Surgical Ward Nurse: Hospital B).

(d) Cancellations and Delays of Surgical Procedures

Furthermore, postponement and cancellation of elective surgical procedures were identified as a major contributory factor towards non-adherence to guidelines, and was viewed as having a negative impact on the efficient delivery of care. As one operating theatre nurse states:

“Sometimes a patient is kept ready for surgery and surgeons will ask us to give the antibiotic on time to the patient before surgery in the OT, but because of some reasons like medical problems, the operation would be delayed or cancelled by the anaesthetists, which may reduce the effectiveness of antibiotic prophylaxis” (Operating Theatre Nurse: Hospital B).

Some claim that cancellations and delays of elective surgical procedures may lead to improper preoperative patient preparation. In the following extract, a participant provides an example to support this view that surgical delays are an issue with respect to non-adherence to surgical antibiotic prophylaxis guidelines, noting that:

“We cannot give antibiotic prophylaxis at the proper time because sometimes we encounter difficulty in complying with the timing of prophylactic antibiotic guidelines due cancellations and delays of surgical procedures, which is out of our hands [...]” (Surgeon: Hospital B).

(e) Emergency Situations

It was found that emergency incidents were key factors contributing to clinical practice and adherence to guidelines. HCWs mentioned specific scenarios that may have influenced the implementation of infection control measures, for example one operating theatre nurse noted how:

“ [...] Sometimes, some patients will be in critical situations; I mean during emergency situations we will not be able to follow the guidelines. Sometimes, we face some problems concerning following the aseptic technique while cleaning and preparing the skin if patients get severe bleeding during surgery, but we are trying as much as possible to follow the guidelines to save patients’ life” (Operating Theatre Nurse: Hospital A).

7.3.4.2 Knowledge and Behavioural Related Factors

(a) Lack of Knowledge and Skills Regarding the Guideline Recommendations

Despite that, most of the HCWs were able to describe most of the perioperative infection control procedures that they performed on a daily basis at their institutions, still evidence stemming from this research indicates that a lack of knowledge and skills is yet another key determinant of non-adherence to standards. Many nurses and surgeons reported limited knowledge and skills regarding evidence-based guidelines, because they received insufficient training and education related to infection control practices to care properly for surgical patients. The following excerpt from the data illustrates this point.

“ Majority of the HCWs are not following these guidelines for the prevention of infection due to lack of knowledge and skills pertaining to infection control practices” (Operating Theatre Nurse: Hospital).

In this study, the surgeons and nurses further complained that they have lack of experience and confidence in caring for patients undergoing elective surgery. HCWs argued that they cannot implement guideline recommendations due to a paucity of training and education. Moreover, one of the surgeons reported finding it hard to follow the guideline recommendations because the measures were not discussed with them, which has impacted on their clinical practice.

“Nobody taught us these guidelines which have affected our clinical decisions. We need to know about these guidelines to make our clinical decisions while caring for the patient” (Surgeon: Hospital B).

This aligns with the view of some HCWs that adherence to guidelines was partially hindered by their initial training in medical school, as documented in the following excerpt:

“There are some people not willing to follow the guidelines because of the old skills they learned at medical school. For example, in a previous training session we learnt that antibiotics should not be provided for minor surgeries, whereas now we are still using our old experiences in terms of antibiotics and providing antibiotics for all cases [...]. We are trying to push those old-school protocols away and we have succeeded in some points” (Surgeon: Hospital B).

It is recommended that educational sessions should be provided for patients and HCPs regarding the recommended practices. The following excerpts support this initiative:

“All people should be part of it, so all people including patients and Healthcare professionals should be educated about these guidelines and their benefits” (Surgeon: Hospital A).

“Yeah, before any doctor or any nursing staff come to the OT, they should be aware

about the infection control guidelines and any new staff should be educated and trained properly (Operating Theatre Nurse: Hospital A).

(b) Forgetfulness and Negligence

A small group of participants reported instances in which HCWs did not adhere to the guidelines due to forgetfulness or negligence. Although not all participants discussed this issue, it is interesting that two HCWs explicitly mention forgetfulness in the following extracts:

"[...] We are following the guidelines but sometimes we have failed to give antibiotics, because sometimes doctors forgot to prescribe antibiotics for the patients" (Operating Theatre Nurse: Hospital A).

"Some doctors may have forgotten to prescribe antibiotic prophylaxis on the computer, so we should review the medical charts to know whether the antibiotic is required for the surgical patients or not" (Surgical Ward Nurse: Hospital B).

According to one surgical ward nurse, one of the reasons leading to non-adherence to guidelines is negligence during clinical practice, as can be discerned in the following assertion:

"[...] From my perspective, I think that personal negligence is also one of the main factors affecting non-adherence to guidelines" (Surgical Ward Nurse: Hospital B).

Alongside this, surgical team staffs' attitude about practice guidelines was identified as a contributory factor in non-adherence to evidence-based guidelines. Several HCWs found that some people among the surgical team staff had more negative attitudes towards clinical practice guidelines. some HCWs still did not want to comply to infection control guidelines. The following

quote serves to illustrate this suggestion that one of the reasons for non-adherence is the attitude of the staff.

“Some people do not believe in the importance of adherence to these guidelines to reduce SSIs, and, thus, it is a matter of belief. Once they believe the importance of these guidelines their behaviour will change” (Surgeon: Hospital A).

7.3.4.3 Cultural Beliefs and Patient Related Factors

(a) Patient Medical Health Status and Patient Preference

Patients’ medical conditions and patients’ preferences are the main factors emerging from this analytical category. The first issue associated with lack of adherence concerns patients’ medical problems. Data analysis revealed that patients with medical problems like HTN and DM are more likely to be admitted 2 to 3 days prior to surgery, to optimise their medical condition and conduct further investigations. The following statements are emblematic of the views of HCWs:

“Sometimes, some patients have uncontrolled DM and HTN, and thus these patients will be admitted a few days before surgery to control their medical problems and ensure it is safe. We are admitting the patient 2 to 3 days preoperatively just to control comorbidity” (Surgeon: Hospital A).

“If the patient has any chronic illness like hypertension and diabetic mellitus, the patient should be admitted 2 days before surgery to get treatment, and once everything is controlled then surgery can proceed. But for normal patients with no medical illness and for whom anaesthesia agrees with, they should be admitted 1 day before” (Surgical Ward Nurse: Hospital B).

The analysis conducted as part of this research also found that patient preferences do not always accord with guideline recommendations. Some HCWs declared that patient preferences was another factor that caused conflict when preparing the patient for surgery. For example, some patients refused to change their personal clothes before surgery, whilst others preferred to be treated by female staff.

“Here, some patients, I do not mean elderly patients as elderly people are very nice, but some young patients are not willing to change their traditional clothes for the operation”
(Surgeon: Hospital A).

“ [...] The second limitation is gender preferences [...]. Most female patients want care provided by only female staff. For example, some female patients prefer to be shaved by female staff [...]” (Operating Theatre Nurse: Hospital B).

Furthermore, some participants asserted that some patients simply refused interventions. The following two excerpts illustrate how the behaviour of patients can influence adherence to guidelines, as discussed in the following statements:

“Some patients refuse a cannula. if patients feel pain, they will often not accept re-insertion of a cannula to provide intravenous drugs, and without a cannula some patients will thus miss some antibiotic doses for 2 to 3 days” (Surgical Ward Nurse: Hospital A).

“There are different factors that may affect adherence to the guidelines. A patient’s preference is one of the main obstacles to the use of evidence-based guidelines for antibiotics” (Operating Theatre Nurse: Hospital B).

Interestingly, cultural issues were also routinely cited by HCWs as barriers to implementing clinical practice guidelines. Specifically, HCWs reported difficulties in implementing all aspects of the guidelines, because some patients refuse to take showers or change their clothes before surgery, as noted in the following excerpts:

“The main problem is patients’ preferences; I mean some patients refuse to take showers or change their own clothes, nor will they agree to be examined by a male member of staff before surgery or listen to our instructions” (Surgical Ward Nurse: Hospital A).

“Sometimes, some patients and their relatives refuse to comply with the guidelines. For example, some female patients refuse to wear OT gowns, because they do not want to expose their body to HCWs, which can increase the risk of infection” (Surgical Ward Nurse: hospital B).

Other cultural issues identified by the researcher include personal values and beliefs. The following field notes describe how patients’ beliefs play an integral factor in terms of non-adherence to guidelines.

“On some occasions, I saw a few patients come to the operating room without changing their clothes for surgery. The surgical ward staff had explained to them the importance of wearing hospital gowns, but they refused to change into an OT gown because some of them believed that hospital gowns do not cover their body sufficiently, and thus they prefer to wear their own clothes. The surgeons then refuse to proceed with the surgery, whereby the clothes are finally changed after getting the patient’s consent in the operating room” (Field notes: Surgeons and Operating Theatre Nurses: Hospital B).

(b) The Professional Culture

The following field notes emphasise how handshaking is widely adopted between HCWs and patients in clinical areas in Oman. Indeed, some HCWs shake hands in the OR without subsequently washing their hands or using alcohol-based hand gel.

“There are no regulations restricting handshakes in the health care setting; therefore, it was observed most of the patients preferred to shake hands with their health care providers in surgical wards and OTs without washing their hands. In addition, I saw some people greeting each other with different forms of greeting, such as nose-to-nose shaking” (Field notes, Surgical Team Staff: Hospital A and B).

The surgical team staff claim that handshaking is a cultural custom, one that nonetheless increases the risk of infection among surgical patients. It was also noted that handshaking is a familiar greeting between patients and their visitors, one which may keep the patient at risk of infection, as noted in the following excerpts:

“We cannot prevent the spread of infection because during visiting time all visitors are coming to visit their patients, and, due to cultural issues, we cannot stop them from seeing the patient. When the visitors come to visit the patient, they say Assalam Alaikum [Peace be upon you] and shake hands with other patients and care givers, which may increase the risk of infection [...]” (Surgical Ward Nurse: Hospital A).

In addition, the following excerpt indicates that some of those interviewed expressed greater concern about lack of adherence to guidelines. According to one HCW, nurses always experience some interpersonal conflict with surgeons in the hospital. The below statement supports this view:

“There are some problems with the surgeons. Sometimes if I follow some specific guidelines and I am sure that I am doing the right things, the surgeons would not accept it [...] Surgeons always disagree with me and they do not listen to our instructions, so there are some conflicts between us” (Operating Theatre Nurse: Hospital A).

Furthermore, some surgeons’ disruptive behaviour in the OT underlay non-adherence to the guidelines. This study documented how some surgeons raised their voice and shouted at operating theatre nurses. The operating theatre nurses expressed that they wanted to be respected and accepted as having the requisite knowledge and skills, and made to feel that they are equal to the other members of the team, but surgeons did not listen to them. For example, the following field notes show the sense of mistrust between surgeons and other OT staff.

“On some occasions, observations reported that some surgeons were shouting and yelling at operating theatre nurses because some instruments were not available or not working properly during the operation. Consequently, some of the surgeons said that they do not trust the nurses. An operating theatre nurse felt angry about what happened and left the OR.” (Field notes, Surgeons and Operating Theatre Nurses: Hospital A and B).

7.3.4.4 Guideline Related Factors

(a) Lack of Distribution and Ambiguity of the Guidelines

Improper distribution guideline recommendations have been quoted as a major reason for non-adherence to the guidelines. The majority of the HCWs agreed that lack of the guidelines distribution is one of the reason for non-adherence as shown in the following except:

“ There are not clear or proper guideline recommendations for the prevention of surgical site infection in our department. I highly recommend that you give us a copy of the guidelines in order to implement the principles of infection control to reduce the risk of SSI in our institution because as I said, there is no proper distribution and no clear guidelines” (Operating Theatre Nurse: Hospital A).

It is crucial to note that lack of agreement about guidelines was an important issue identified by HCWs as one of the factors influencing non-adherence to guidelines. The HCWs expressed specific doubts about the credibility of the evidence used for the recommendations in the guidelines. The following excerpts express the opinions of some surgeons and surgical ward nurses:

“I disagreed with the local guidelines because they are not comprehensive and not evidence-based. The guidelines are not based upon up-to-date scientific evidence. It requires keeping evidence-based guidelines up-to-date” (Surgeon: Hospital B).

“I partially agreed with these guidelines because they reflect local guidelines” (Surgical Ward Nurse: Hospital B).

There were also issues raised concerning the ambiguity of the guidelines. According to HCWs, the lack of clarity in the guidelines caused problems concerning all of the key recommendations in the guidelines; hence, it was argued that if one seeks to raise current levels of adherence, then clear guideline needed to be provided to all HCWs. As an operating theatre nurse observes:

“Yes, there are guidelines but surgical team are not adhering to guidelines which may increase the rate of SSIs, and that will affect the patient’s outcomes and will increase the length of postoperative hospital stays. This is all because there are no clear polices and guidelines for surgical team staff” (Operating Theatre Nurse: Hospital A).

7.3.4.5 Cultural and Linguistic Diversity in Health Care

The following extracts and fieldnotes suggest that staff either believe or pretend to believe that the behaviour of families visiting hospitals is a major contributing factor to cross-infection. Most SSIs are established when tissue is open in OTs and infection is less likely to occur subsequently when patients are in the ward. This means that some staff do not know the risks of SSI and are deliberately attributing them to families to rationalise that their own infection prevention conduct is not at fault.

The following fieldnote emphasises how handshaking is widely adopted between HCWs and patients in clinical areas in Oman. Indeed, some HCWs shake hands in the OR without subsequently washing their hands or using alcohol-based hand gel.

“There are no regulations restricting handshakes in the health care setting; therefore, it was observed that most of the patients preferred to shake hands with their health care providers in surgical wards and OTs without washing their hands. In addition, I saw some people greeting each other with different forms of greeting, such as nose-to-nose shaking” (Field notes, Surgical Team Staff: Hospital A and B).

The surgical teams claimed that handshaking was a cultural custom, albeit one that increased the risk of infection among surgical patients. It was also noted that handshaking is a familiar greeting between patients and their visitors, which leaves the patients at risk of infection, as noted in the following extract:

“We cannot prevent the spread of infection because during visiting time all visitors are coming to visit their patients, and, due to cultural issues, we cannot stop them from visiting the patients. When the visitors come to visit the patients, they say Assalam

Alaikum [Peace be upon you] and shake hands with other patients and care givers, which may increase the risk of infection [...]" (Surgical Ward Nurse: Hospital A).

The majority of HCWs in Oman come from different backgrounds and countries, which may create cultural conflict among the team, as observed in the following fieldnote:

"It was observed that many surgical team personnel who are working in OTs are from different nationalities and cultural backgrounds. Most of them are from non-Arabic speaking backgrounds. It was noted that the mix of languages and cultural differences between the surgical team created some challenges for some HCWs in ORs. On some occasions, it was observed that expatriates could not speak with Omani patients. Therefore, they sought help from their colleagues to interpret" (Field notes: Surgical Team Members: Hospital A and Hospital B).

Culture is integral to healthcare providers' behaviour. Surgeons' power and roles creates an imbalance in OTs, in that surgeons ordinarily do not listen to and respect the role of nurses. The following fieldnote serves as an illustrative example of a surgeon displaying unprofessional behaviour:

"On one occasion it was observed that one nurse was assisting a surgeon in hair removal in the OR. During the preparation, another surgeon entered into the OR without wearing a surgical mask. The nurse saw the surgeon and asked him to leave the OR and wear a mask. The nurse was surprised about this unprofessional attitude and asked the surgeon to follow the infection control standards. At the beginning, the surgeon refused to listen to the nurse and got angry. He said there is no problem because he was not involved in this patient's surgery, but the nurse insisted that he should leave the room. Finally, he

agreed to wear the surgical mask and enter into the OR” (Field notes: Surgical Team Members: Hospital A and Hospital B).

The findings also indicate that some female Muslim patients were reluctant to change their traditional clothes and preferred to cover up their body. Therefore, female patients’ clothes were removed after anaesthesia in the OR, as stated in the following fieldnote:

“On a few occasions it was observed that some female patients were brought to the OT with their traditional clothes on, because they refused to wear OT gowns. Thus, their dress was removed after anaesthesia before surgery” (Field notes: Female Patients: Hospital B).

In Omani culture, the dress code derives from the requirements of the Islamic religion, where female Muslim doctors, nurses and patients must wear head scarves and long dresses, as highlighted in the following fieldnote:

“It was observed that for cultural and religious reasons most of the female Muslim healthcare professionals and patients wore scarves (hijab) around their head and OT gowns with long sleeves to cover their arms during surgical procedures” (Fieldnotes: Female Healthcare professionals and Surgical patients: Hospital A and Hospital B).

Another example centres on the fact that very few Omani female nurses and doctors exposed their forearms for hand washing and scrubbing procedures prior to surgery and instead liked to wear long sleeves which may become contaminated, as observed in the following fieldnote:

“Despite the hospital rules and infection control policies, it was observed that some female staff were hesitant to expose their forearms in the OR and some female nurses continued

to wear uniforms with long sleeves” (Field notes: Female Doctors and Nurses: Hospital and Hospital B).

Moreover, in the OT some female nurses did not like to care for male Omani patients due to cultural sensitivity, especially if they were close relatives. One female nurse refused to be involved in such procedures, because she felt embarrassed dealing with her own relatives, as shown in the fieldnote below:

“On one occasion it was observed that a female Omani nurse was not comfortable taking care of a patient who was a close relative, and that whenever such occasions arose, they request to move to another OR” (Field notes: Nurses: Hospital A and Hospital B).

Respecting a patient’s culture is very important within the OT and all surgical patients should be treated with respect. However, some HCWs were not operating as culturally competent professionals and made jokes in front of patients, as illustrated in the following fieldnote:

“While an anaesthetist was preparing antibiotic prophylaxis in the OR and was explaining to the patient about the antibiotic, another anaesthetist entered the room, which made both of them speak and make jokes in their own language and ignore the patient” (Field notes: Anaesthetists: Hospital B).

7.3.4.6 Linguistic Diversity

Communication and interaction between HCWs and patients represented a major problem, because many expatriates did not speak Arabic and were unable to communicate with Arabic speaking surgical patients inside OTs, as observed below:

“It was observed that many expatriate health professionals spoke English or their own language and were unable to speak Arabic during preoperative care. Therefore, some

nurses failed to communicate with patients before surgery due to language barriers”
(Field Notes: Nurses: Hospital A and Hospital B).

7.3.4.7 The Power of Surgeons in the Operating Room

Within both hospitals, it was observed that most surgeons represented themselves as being the leader in the OR and that they were solely responsible for making clinical decisions. The following fieldnote demonstrates this lack of trust among the team:

“On some occasions, observations reported that some surgeons were shouting at operating theatre nurses, because some instruments were not working properly during the operation. It was observed that one orthopaedic surgeon commented that he does not trust the nurses. Therefore, the circulating nurse felt angry about what was said by the surgeon and left the OR” (Field notes, Surgeons and Operating Theatre Nurses: Hospital A and B).

7.3.5 Chapter Summary

In conclusion, this chapter examined four main themes, centred on: knowledge of and access to clinical practice guidelines; integration and translation of evidence-based guidelines into practice; strategies used to prevent SSIs; and factors affecting non-adherence to guidelines. Overall, the results indicate that HCWs obtained their knowledge about guidelines from different resources, such as hospital training, clinical practice and academic studies. However, there some HCWs revealed that there were no available guidelines in surgical departments. The results of this qualitative study have thus proven the importance of adherence to guidelines for the prevention of SSI. The study has also indicated incidents of non-adherence to certain recommendations of evidence-based guidelines for SSI prevention, as well as identifying that there have been initiatives

aimed at improving adherence to SSI prevention protocols. Despite the extensive efforts by most HCWs to prevent infection, there are still manifold factors affecting non-adherence to guidelines. Thus, it is suggested that education programmes be provided, that numbers of surgical team staff should be increased, and that levels of awareness about guidelines to prevent SSIs among surgical team staff should be improved. In Chapter 8, the findings of both the quantitative and qualitative analyses will be synthesised to provide an in-depth and holistic report about the key findings of the study.

Chapter Eight:

Discussion and Conclusion

8. Chapter Eight: Discussion and Conclusion

8.1 Introduction

The principle aims of this study were to monitor current preoperative and intraoperative procedures for the prevention of SSIs, and evaluate the potential disjunction between clinical practice and current international and national guidelines. Moreover, this study aimed to delineate some of the barriers to integrating EBP amongst HCWs in two Governorate hospitals in Oman. Data from direct observation and structured interviews were integrated and compared for the purposes of understanding the participants' insights on their practices. In this chapter, the researcher integrates the findings garnered from observations, fieldnotes and structured interviews in order address the research objectives and questions. The results of the study are then compared with the findings of previous studies discussed in Chapter Three. Each recommendation is categorised in accordance with existing scientific evidence and the ranking of evidence outlined earlier in Chapter Four. In this chapter, the researcher uses The ACE Star theoretical framework as a guide for interpreting the findings (for details see the discussion in Chapter Four: Section 4.3). As aforesaid, this study is unique in the sense that it is the first study which has sought to evaluate adherence to international recommendations for the prevention of SSIs in Oman.

By using quantitative statistical analysis and qualitative thematic analysis of interview transcripts, this thesis aims to answer two specific research questions:

- What is the level of adherence of HCWs to international and national guidelines for preventing SSI during elective surgery in surgical wards and OTs in Oman?
- What are the factors determining the uptake and utilisation of SSI prevention guidelines during elective surgery in Oman?

8.2 Objectives of the Study

1. To assess the length of preoperative hospital stays in patients undergoing elective surgery.
2. To evaluate the appropriateness of antibiotic prophylaxis selection, the timing of administration and duration of specific surgical procedures in two hospitals.
3. To assess the application of preoperative antiseptic skin preparation in relation to SSI prevention guidelines.
4. To evaluate whether hair removal is carried out in accordance with SSI prevention guidelines.
5. To determine adherence to preoperative showering or bathing in elective surgery in relation to SSI prevention guidelines.
6. To monitor the OTs' traffic pattern (doors opening during surgery and number of OT personnel present during surgical procedures).
7. To investigate factors underpinning non-adherence to SSI preventive guidelines.

8.3 Main Findings and Interpretation

8.3.1 Preoperative Preventive Measures

Aim 1: To Assess the Length of Preoperative Hospital Stay in Patient Undergoing Elective Surgery

In this section, the data were collected through a structured observational checklist, interview schedule and reviewing of patient's medical records, designed in accordance with the standards recommended by the international guidelines for the prevention of SSI (CDC 2011). The first research objective concerning evaluating the length of preoperative hospital stay is discussed below.

Some studies have posited that the preoperative length of hospital stay is problematic because it constitutes a significant risk factor for infection, as well as being positively correlated with SSIs (Sang et al. 2013; Patel et al. 2011; Sutariya and Chavada 2016). Resultantly, guidelines recommend minimising the preoperative length of hospital stay (Category II), while still allowing sufficient time for pre-surgery preparation (CDC 2011; GCC 2013). In terms of this study, preoperative length of stay was defined as the number of days spent in hospital from the day of admission until the day of the operation (Sang et al. 2013). For most patients undergoing elective surgery, preoperative patient preparation starts immediately upon admission. In this study, it was observed that preoperative assessment does start immediately after admission, however the length of hospital stay depends on manifold factors, including type of surgery, patient's medical status, patient's age, and type of pre-anaesthesia. This study has highlighted that most of the patients undergoing elective surgery in hospital A and hospital B were admitted at least one day before their operation (72.7%), which is in accordance with existing international guidelines. There were a few exceptions to this, such as in those cases who were admitted two days before surgery so as to have adequate time for examinations and preoperative patient assessment. Preoperative hospital stays lasting two days and longer amounted to 15.6% of cases, which could lead to colonisation by antimicrobial resistant microorganisms and thus increase patients' susceptibility to infection by providing an increased opportunity for ultimate bacterial colonisation (Sachin et al. 2012). The mean adherence rate in terms of preoperative hospital stay in hospital A was 83.7%, whilst the mean adherence rate in hospital B was 85.3%. In addition, when a comparison was conducted between members of occupational groups, this study demonstrates that extended preoperative hospital stays were most common among general surgeries in hospital A, whereas in hospital B it was general surgeons that were more likely to adhere with guidelines compared to other specialists.

The data from the fieldnotes demonstrated that most of the patients were admitted one day before surgery, whilst patients with certain health problems such as anaemia, cardiac problems and DM were admitted at least two days before surgery, because this group of patients required further consultation to make sure that they were fit enough for anaesthesia and surgical procedures. This may explain why there was a relationship between prolonged preoperative hospital stays and patients' clinical conditions, such as HTN and DM, which may require further investigation. Among Omanis, the prevalence of HTN is 40.3%, DM (12.3%), Obesity (24.1%), total cholesterol (33.6%), anaemia in males (20%), whilst 32.2% of non-pregnant females also have anaemia (Al Riyami et al. 2012). Further evidence shows that 45% of patients undergoing heart surgery have DM in Oman (Almashrafi et al. 2016). Other studies reflect similar findings, which serves to demonstrate that comorbidities linked with an increased length of stay include DM, cardiovascular disease and chronic obstructive pulmonary disease (hereafter abbreviated as COPD) (Vogel et al. 2005; Ganesh et al. 2005; Harris et al. 2001).

The above findings concur with the data collected through qualitative interviews. During the interviews, HCWs stated that patients undergoing elective surgery should be kept in the hospital for as short a time as possible before surgery to prevent infection. It was argued that surgical patients should be admitted one day before surgery to have enough time for preparation, examinations and to optimise and manage their medical condition. On the other hand, some HCWs reported that patients should be admitted on the day of surgery if there were no potential complications. However, for some high-risk surgical procedures, 1 day is insufficient for performing pre-surgical assessment and preparing the patient for surgery, and thus high-risk patients should be admitted 2 to 3 days before their operation. The decision to proceed with an elective operation starts with an assessment of perioperative risk (Zambouri 2007). This provides clear evidence that a patient's medical status has a strong influence on HCWs uptake of guideline recommendations, so reducing

the length of hospital stay is necessary for doing all the required examinations during a clinical visit before scheduling the patient for surgery. In the present study, the level of compliance was found to be similar between hospital A and hospital B, because the vast majority of patients were admitted at least 1 day before the operation, which still allowed for adequate preoperative examination before their operation. This is also expedient because the doctor can reduce any delays in the preparation phase by treating complex health problems (Lilio et al. 2011).

The data from both hospitals were included in the analysis, which showed that overall adherence to grade II recommendations on preoperative hospital stay were good with no differences between the two hospitals, which indicates that HCWs from both hospitals were more likely to ask the patient to come at least one day before surgery for preoperative preparation, pre-anaesthesia evaluation and to determine patient factors that may increase the risk of infection. The findings of this study are thus, at least to some extent, consistent with the study by Christoforo and Carvalho (2009), involving patients undergoing different surgeries, which found that almost 92% of patients were admitted on the same day of operation or 1 day prior to surgery, which was in line with international guidelines. However, this finding differs from other studies conducted in Italy, in which researchers found that the level of adherence to category II recommendations on preoperative hospital stay were very low (12%) (Pan et al. 2009). The data from this study does suggest that it is necessary to monitor the length of preoperative hospital stay to avoid any wound infection after surgery.

Aim 2: To Determine Whether Preoperative Showering or Bathing in Elective Surgery Adhered to Surgical Site Infection Prevention Guidelines

In this section, data concerning preoperative showering or bathing were initially captured through observations before being subsequently supported by the results of interviews with surgical team staff. These findings will be discussed in conjunction with previous literature on this issue.

Preoperative care is comprised of a range of preventive measures and infection control practices that should be adhered to prior to surgery. One of these measures is preoperative showering or bathing with an antiseptic agent to prevent SSI. According to CDC (2011) guidelines, prior to any surgical intervention a patient must shower or bathe with an antiseptic agent at least the night before the operation (Category IB).

There is strong evidence on the benefits of preoperative showering with antiseptic agents. Chlebicki et al. (2013) purport that showering with chlorhexidine is frequently recommended as an important preoperative measure to prevent SSIs, however the precise efficacy of this method is unclear. The findings of that study support existing literature by Edmiston et al. (2015), Oliveira and Gama (2015), who explicate that preoperative bathing with an antiseptic agent removes dirt and thus reduces skin microbial colony counts in surgical patients. With respect to this study, results from observations showed that most of the patients had a preoperative shower (90.2%), using either normal soap and/or an antiseptic agent, such as a chlorhexidine based solution. Whilst the study verified that most patients received oral instructions to take a bath before surgery, it was also observed that more than half of the patients in hospital A showered with an antiseptic agent in comparison to none in hospital B.

The data from the fieldnotes supports this finding that most of the patients in both hospitals had a preoperative shower before surgery, but that an antiseptic agent was used in only few cases in hospital A whilst ordinary soap was used by all patients in hospital B. One explanation might be that antiseptic agents were not provided to all patients, or perhaps some patients refused to wash with an antiseptic agent.

In this study, the observational findings were inconsistent with the qualitative data. Most HCWs routinely raised concerns that patients undergoing surgical procedures were required to shower or

bathe with an antiseptic agent at least the night before surgery. After asking HCWs whether patients were required to wash with an antiseptic before surgery, 76.7% of participants recommended this practice; whereas, 23.3% of HCWs reported that washing with an antiseptic agent was not required. Currently, there is a small range of evidence that bathing with chlorhexidine is associated with a reduction in SSI. For example, Eiselt (2009) and Edmiston et al. (2015) found that preoperative bathing with agents such as chlorhexidine has been shown to reduce bacterial colonisation of the skin.

The most frequent cited reasons for non-adherence with clinical practice guidelines provided by HCWs were organisational related factors, such as the lack of resources (e.g., lack of antiseptic agents) and patient preferences. In conjunction with this, cultural issues were also raised as a factor underpinning lack of adherence to guidelines on preoperative antiseptic bathing. For example, it was reported that some patients simply refused to shower or bathe before surgery. Therefore, to improve adherence to the guidelines clinical decision-makers in both hospitals should encourage patients to take antiseptic bathe and provide the requisite supplies in all health facilities so that this is possible. In addition, it is essential that regular sessions are organised instructing HCWs about infection control practices and the benefits of preoperative showering or bathing. This is important, because the overall level of compliance for preoperative antiseptic bathing or showering was very low (<60%) in both hospitals, due, in part, to the fact that more patients still prefer to use normal soap for bathing. When comparing occupational groups, it was found that orthopaedic surgeons were more likely to recommend preoperative bathing with antiseptic solutions in hospital A, whilst there were no observable differences among HCWs in hospital B. These findings are supported by Davis et al. (2008) who found that orthopaedic surgeons were significantly more likely than general surgeons to recommend preoperative bathing to their patients ($P<0.001$). Therefore, it is critical that HCWs follow the guidelines, because it demonstrates that preoperative antiseptic bathing

decreases skin microbial colony counts and prevents bacterial colonisation and infection (CDC 2011).

These findings concord with previous studies by Oliveira and Gama (2015), Mater (2014) and Demir (2009) who all indicated that many surgeons do not recommend preoperative antiseptic bathing, showing that the level of adherence to the use of antiseptic agents for bathing was extremely poor compared with other published literature. Similar work by Davis et al. (2008) found low levels of compliance with guidelines on preoperative antiseptic bathing, as only 23% of surgeons recommended that patients wash with an antiseptic agent before their operation. The findings of this study were in contradistinction to prior research conducted by Durando et al. (2012) who revealed that all the patients undergoing elective operations have a preoperative shower, in most cases using a common detergent, a chlorhexidine based solution, or a trichlorophenol based solution as recommended by guidelines for the prevention of SSIs. The results of this study underscore that greater effort should be made by the surgical team staff in both hospitals to encourage patients undergoing elective surgery to shower or bathe with an antimicrobial agent at least the night before surgery to reduce the risk of surgical infection. This could be achieved by providing sufficient supplies of antiseptic agents in both hospitals, giving the patients instructions about the benefits of using antiseptic agents, as well as instructing HCWs about showering protocols.

Aim 3: To Evaluate if Hair Removal is Conducted in Accordance with Surgical Site Infection Prevention Guidelines

In this section, I present the findings on preoperative hair removal practices based on the analysis of the data which was obtained from observations, fieldnotes and interviews with HCWs. Preparation of patients for surgery also includes removing hair from the surgical site. It is strongly recommended that hair removal should be avoided (category IA), but in those instances in which it

is necessary clippers (category IA) should be immediately before surgery (CDC 2011). Recent studies show that surgical team staff use three methods of hair removal, including razor, clippers, and depilatory creams (Castella et al. 2006; Durando et al. 2012).

The results of this study illustrate that hair removal was performed in more than half of surgical operations, with most of the hair removal being done on the morning of the day of surgery in surgical wards or OTs. Specifically, the present study found that 38.7% of shaving was done in ORs, 23.2% in surgical wards, whereas 4.1% was done at home which does not conform to current recommendations. It was found that adherence to grade IA recommendations was very low in both hospitals, because most of the patients undergoing elective operations had hair removed via inappropriate methods of hair removal. Specifically, hair removal with a razor was used in 48.6% of operations by nurses or surgeons. Using a razor for hair removal can irritate the skin and lead to micro lesions (Tartari et al. 2017). Consequently, microorganisms can progressively colonise the affected skin and thus significantly increase the risk of SSIs (Tartari et al. 2017). Overall, compliance with the recommended method of hair removal was reported in only 16.4% of cases in hospital A and in 18.7% of cases in hospital B. Across the two hospitals, the mean compliance rate was considerably poor for this specific recommendation. In fact, guidelines state that, if hair removal is necessary, clippers and depilatory creams are safer than traditional shaving (Al Maqbali 2016).

In addition, neither hospital A and B complied with respect to the environment in which hair removal should take place. Indeed, it was found that 61.9% of preoperative hair removal was done in surgical wards or inside ORs, which is a direct contravention of international and national guidelines. It is suggested that hair removal should take place outside of the OR (Tokarski 2014). These results agree with the study by Durando et al. (2012) who found that hair removal was done with a razor

by nurses in the hospital ward on the day before the surgery, which, once again, is not consistent with international recommendations.

When comparing the surgeons by surgery type, it was observed that clippers were used in 41.5% of general surgeries compared to 52.8% of orthopaedic surgeries, which indicates that most of the surgeons used razors. Some studies claim that using razors to shave the operation site may result in skin surfaces sustaining abrasions that are a key foci for infection; hence, to achieve the best patient outcomes the evidence recommends not removing the hair, whereas in the event that it has to be done it should be done using clippers (Owens and Stoessel 2008). However, other studies suggest not shaving the surgical site whatsoever to reduce the rate of SSI (Al Maqbali 2016).

These findings were supported by the fieldnotes that were generated through direct observation of clinical practice. The data showed that hair removal was necessary in nearly all cases and that most of the preoperative hair removal was performed using razors, and thus loose hair in the surgical sterile field was observed on several occasions inside ORs, which can increase the risk of infection. Therefore, it is recommended that preoperative hair removal should be done outside the OR to restrict the dispersal of loose hair, in turn, reducing the potential for contamination of the sterile field and surgical wound (AORN, 2013; Pfiedler Enterprises 2012). The fieldnotes further suggest that most of the patients were informed not to shave the area of incision, and that if it was necessary to do so then it should be removed by nurses in the surgical ward or by OT staff inside ORs, which goes totally against the guidelines. This finding was reinforced by the interview data, which illustrated that only 53.3 % of surgeons prefer to do preoperative patient hair removal in the OR, whereas 36.6% of HCWs suggested that hair removal should be done in surgical wards, and very few HCWs (6.6%) confirm that shaving should be performed in a private area to maintain the sterile field in the ORs.

When asked about whether preoperative patient hair removal was done using clippers, only 56.6% of HCWs stated that preoperative patient hair removal was done by clippers, whilst 36.6% of them said that they used razors for shaving patients prior to surgery. The qualitative study indicated that most of the HCWs support hair removal procedures before surgery, preferably using clippers rather than razors in OTs, whereas some HCWs recommended razors for hair removal. The comments of the surgical team staff provide real insight concerning the data that hair removal with clippers is appropriate for preventing skin injuries, and, indeed, most of them believe that clippers are the best method through which to avoid any cuts on the patient's skin and surgical site. However, it was noted that some patients felt discomfort after using clippers. Moreover, it was argued that razors should be used because chemical cream has a negative impact on patient's skin, which can cause allergic reactions. Indeed, depilatory creams are infrequently used because of potential irritation to the skin (Spry 2009).

Interestingly, even though the evidence supporting this recommendation is strong and the correct procedure can be easily performed, a lack of adherence with this practice has been reported in other studies. For example, Durando et al. (2012) reported that in all of the surgical departments in the San Marino University hospital in Genoa, hair removal was performed in 36.4% of surgical operations, with a razor used in 92% of cases, clippers used in 6.1% of surgeries, and depilatory cream in the remaining 1.9% of cases. In a similar study in Brazil, it was observed that hair removal was performed on 27.7% of the surgical patients inside OR, (80.0%) with razor and 20.0% with a clipper (Oliveira and Gama 2015). From this perspective, it was noted that preoperative hair removal was not in accordance with international and national guidelines (Oliveira and Gama 2015).

Similar findings have been reported in other studies conducted in Italy. Castella et al. (2006) asserted that non-adherence with infection control standards for hair removal was identified in terms of both

the timing and methods used for hair removal, whereas this study reports that in 60% of cases hair removal was done the day before the operation, and 75% of cases used razors. Castella et al. (2006) purported that a lack of staff and a scarcity of resources, such as clippers, were the principal barriers to implementing evidence-based guidelines. In this sense, compliance rate to this practice by the HCWs was poor. This serves to illustrate that preoperative hair removal is a problematic issue worldwide. A number of issues were raised by the participants in the interviews for this study, which, ultimately, influenced their adherence to guidelines on hair removal. These ranged from disagreement with guidelines to patient's preferences and a general lack of resources. For example, a scarcity of clippers and cream depilation had rendered some HCWs not able to follow EBP. Therefore, it is recommended that HCWs be provided with the necessary supplies and facilities to improve adherence to current guidelines.

In this study, overall adherence to the recommended methods of hair removal was reported in 17.5% of cases, whilst adherence with appropriate timing of hair removal and recommended methods of hair removal were performed appropriately in 38.7% of cases. Consequently, these findings highlight that surgical team staff in both hospitals failed to comply with hair removal protocols, due to the fact that most HCWs used non-recommended methods of removal mainly in surgical wards or inside OTs. Thus, one can conclude that there is a pressing need to initiate a no shaving policy prior to surgery in Oman, unless it is deemed absolutely necessary, in which case it should be done using the recommended methods, at the proper time, outside the OT to prevent airborne dispersal of hair and potential contamination of the sterile field (Spry 2009).

Aim 4: To Evaluate Adherence to Guidelines for Surgical Antibiotic Prophylaxis

In this section, data regarding antibiotic prophylaxis administration were obtained from direct observations and medical and nursing charts, prior to being supported by the results of interviews

with surgical team staff. As aforesaid, compliance rates with surgical antibiotic prophylaxis guidelines were assessed in line with the full criteria (antibiotic agent, timing, and duration of prophylaxis) outlined in the published guidelines of the MOH (2016), Oman. For further details of the criteria used for assessment of adherence to local guidelines see Chapter Six, Section 6.3.5.1.

Earlier studies found low levels of compliance with respect to the selection of appropriate antibiotics, timing of administration, and duration of prophylaxis (Castella et al. 2006; Davis et al. 2008; Pan et al. 2009). Therefore, it is vitally important to observe the guideline recommendations for administration of a correct antimicrobial prophylaxis. The current study is unique in that it is the first-time research has sought to report the rate of adherence to prophylaxis guidelines at two Governorate hospitals in Oman.

In this study, three different parameters of appropriateness of prophylactic antibiotic agent, such as choice of agent, the timing of administration and the duration of antibiotic prophylaxis, were assessed in 315 operations. Regarding the prophylactic antibiotic agents, 94.3% of patients received an antibiotic prophylaxis that was recommended by the MOH guidelines. Regarding the choice of antibiotic, in this study the most frequently used antibiotic prophylaxis agent used for surgical patients was cefazolin, which corroborates with other studies in which cephalosporin antibiotics were the preferred choice in most surgical procedures (Castella et al. 2006; Durando et al. 2012; Oliveira and Gama 2015). In this study, it was observed that cefazolin was used for surgical prophylaxis in 53.7% of cases, followed by cefuroxime (15.6%), ceftriaxone (12.7%), and amoxiclav (Amoxicillin + clavulanic acid) which was used in 9.2% of cases. In contrast, gentamycin (1.4%), vancomycin (0.3%), metronidazole (1%) and ciprofloxacin 0.3% were used less frequently. Similar findings have been reported in other studies. Regarding the choice of antibiotic prophylaxis, Durando et al. (2012) reported that cefazoline was used in 33.3% of cases. In addition, Oliveira and

Gama (2015) revealed that the most common third generation cephalosporins, such as cefazoline, metronidazole and ceftriaxone, were commonly used for elective interventions to prevent postoperative wound infection. These findings were also supported by the MOH (2016) and Oliveira and Gama (2015) who found that cephalosporins provide good penetration in surgical wounds, and thus are both safe and effective against many Gram-positive and Gram-negative microorganisms.

These findings were supported by the observational fieldnotes, which document that prophylactic antimicrobials were used in most elective operations, and that cefazolin, ceftriaxone and cefuroxime were most commonly provided to surgical patients. It was also observed that the majority of antibiotic prophylaxis was administered in 60 minutes of anaesthesia in ORs. Hence, overall compliance to recommendations about choice of antibiotic prophylaxis was considerably good (>80%) in both hospitals. The findings of this study explain very good adherence to national guidelines in terms of the choice of antibiotic prophylaxis.

Furthermore, the compliance rate with guidelines on the timing of administration of the first dose of prophylaxis was reported at 88.6%. It is also worthwhile to note that HCWs administered the prophylaxis to many of the patients intravenously during the induction of anaesthesia. The mean adherence rate pertaining to the timing of antibiotic administration ranged between 88.6% to 89.1% in hospital A and hospital B respectively, with no difference in the level of adherence found between both hospitals. This was further supported by the fieldnotes which showed that, in most of the operations, the prophylaxes were given at the appropriate time, although on some occasions it was noted that antibiotics were prescribed during the intraoperative stage or even postoperatively. One way to explain this is that some surgeons may have forgotten to prescribe prophylactic agents before surgery, or, alternatively, there may have been a breakdown in communication between HCWs in OTs. Thus, other HCWs, including nurses and anaesthetists, should remind surgeons to

ensure proper timing of prophylactic antibiotic administration. This measure concurs with several of the respondents' views, who stated that in most operations antibiotic prophylaxis was given at the appropriate time in 60 minutes of incision; however, in a few cases some doses were given intraoperatively or postoperatively. Similar studies determined that this recommendation was met by most surgical team staff (Durando et al. 2012). Indeed, Durando et al. (2012) observed that antibiotic prophylaxis was provided properly at the time of anaesthesia induction in 75.5% of cases, whilst timing was earlier than recommended in 3% of cases.

With respect to the duration of prophylaxis, 60% of patients received antibiotic prophylaxis according to guideline recommendations on the duration of the antibiotics. It was observed that the prolonged duration of antibiotics was a key problem within both hospitals. The most common violation of the evidence based guidelines is prolonged duration of the prophylaxis (Gardlund 2007). The mean adherence rate in hospital A was 76.4%, while hospital B had the lowest compliance rate of 42%. Such levels of non-adherence may be due to a lack of communication between surgical team staff, negligence, or an inappropriate hand-over from the wards to the OTs concerning the duration of surgical antibiotic prophylaxis. Overall compliance with recommendations on antibiotic prophylaxis duration was considerably intermediate (60%).

When taking into consideration all three of the parameters, the researcher concluded that the adherence rate of HCWs with current guidelines on antibiotic prophylaxis was 63.3%. When comparing the three parameters of appropriateness of antibiotic prophylaxis among surgical teams, it was reported that there were no significant differences between different occupational groups in hospital A and hospital B in terms of the choice and timing of antibiotic prophylaxis. Having said this, it was found that general surgeons were more likely to comply with antibiotic prophylaxis duration recommendations. This indicates that there is a major misconception among HCWs about the need

for prolonged antibiotic prophylaxis, as evidence consistently fails to support longer duration of antibiotic prophylaxis (Bratzler et al. 2005). During the interviews, when the participants were asked about antibiotic duration eight HCWs stated that antibiotics should be discontinued in 24 hours. To resolve this disjunction, it is proposed that pharmacists are granted a bigger role in both the administration and monitoring of antibiotics in order to address the prophylaxis adherence problem (Ng and Chong 2012). In addition, it is essential for surgeons to be aware to consider the appropriate antibiotic choices, dose and duration based on reliable guideline recommendations for antibiotic prophylaxis (Rafati et al. 2014).

Other interesting findings concerning antibiotic prophylaxis centred on the fact that the majority of patients in clean-contaminated and contaminated surgeries received antibiotic prophylaxis before surgery. In this study, when comparing surgical classes, it was found that in hospital A, 48.7% of patients in clean surgeries received antibiotics, whilst only 21.2% of patients in clean-contaminated surgeries were provided prophylaxis. Although in hospital B, 45.4% of clean cases were provided antibiotics compared to 24.1% of clean-contaminated cases. Evidently, antibiotic prophylaxis is useful in clean-contaminated procedures, whereas antibiotic prophylaxes are not strictly required for certain clean surgical procedures. However, CDC (2011) reported that, although not recommended, HCWs nonetheless prefer to provide prophylaxis in clean surgeries. Considering this recent evidence, the results of the qualitative component of this study clearly demonstrate that implementation of antibiotic guidelines continue to be problematic among HCWs. For example, the majority of the respondents (80%) in hospital A stated that they used antibiotic prophylaxis routinely in surgery, 36.4% of which were clean surgeries, clean-contaminated (18.2%), and in 24.2% of contaminated surgeries. Similarly, in hospital B 86.6% of HCWs agreed that antibiotic prophylaxis should be given routinely for all major elective cases, including clean, clean-contaminated, and contaminated cases. This was incongruent with evidence indicating that prophylactic antimicrobials

are not justified for clean procedures, except those involving prosthetic replacements (Ng and Chong 2012).

Further, some respondents also posited that longer surgical procedures have been associated with an increased use of antibiotic prophylaxis in elective surgery. The qualitative interviews yielded evidence that HCWs advocate that patients who undergo invasive surgical procedures like orthopaedics cases, which have a higher risk of infection, are more likely to receive antibiotic prophylaxis. There are also those who believe that antibiotic prophylaxis is essential for some elective procedures, such as bone surgery, gastrointestinal surgery, cholecystectomy, hernioplasty and mesh fixation, whilst other professionals believe that antibiotics should even be given in the case of some minor surgeries, such as K-wire fixation, Carpal tunnel syndrome, and implant removal, which goes against current recommendations. The dose of prophylaxis is recommended to achieve the bactericidal concentration of the drug, and to maintain therapeutic levels of the antibiotic in the serum and tissue throughout the operation and, for a few hours at most, after the surgical incision is closed (Castella et al. 2006; Davis et al. 2008).

There are many studies that have been conducted across various countries evaluating adherence to surgical antibiotic prophylaxis standards. The findings of this study are consistent with Durando et al's. (2012) research that showed antibiotic prophylaxis was administered in 68.8% of surgical procedures. The authors concluded that, when both the indication and choice of antibiotic were evaluated, prophylaxis was judged to be appropriate in 35.5% of the procedures, at least acceptable in 44.8% of the procedures, and incorrect with respect to 55.2% of the procedures. Further, they asserted that in more than 50% of the operations for which Italian guidelines did not recommend prophylaxis, it was nevertheless provided.

It is important to consider the factors underpinning non-adherence to prophylaxis guidelines. Indeed, during the interviews many of the surgical team staff pinpointed several barriers, including a lack of communication between HCWs, patient's preferences, disagreement with guidelines, forgetfulness, negligence, workload issues, emergency situations, lack of awareness about the guidelines, and postponement and surgical delay. It was also noted that a lack of consensus among the surgeons about the guidelines and a lack of awareness about the appropriate guidelines were designated as the main factors influencing practice in OTs. This was consistent with prior research in other institutions that also identified workload, low priority, and inconvenience as the main perceived barriers to following antibiotic guidelines (Tan et al. 2006). Other authors have posited that lack of awareness about guidelines and poor distribution of protocols are the primary obstacles (Ng and Chong 2012). Similarly, Van-Kasteren et al. (2003) and Dabbagh and Hajy (2013) argued that overall adherence to all antibiotic parameters is hard to achieve, due to the fact that many revised versions of guideline are distributed in hospitals in a relatively a short period of time which can cause confusion among HCWs, notwithstanding cultural factors, and the training and educational background of HCWs. Therefore, to overcome these barriers and improve adherence to guidelines, HCPs should be trained accordingly, and clinical pharmacists should be more involved in the administration and monitoring of antibiotics. In conclusion, this study presented that compliance to evidence-based guidelines for antibiotic prophylaxis must be improved to prevent SSIs.

Aim 5: To Assess the Application of Preoperative Skin Preparation Based on Surgical Site Infection Prevention Guidelines

The objective of this phase of the study was to explore and describe perceptions of professional nurses and surgeons working in surgical departments towards preoperative patient skin antisepsis. According to CDC (2011) guidelines, appropriate antisepsis of the incision site should be done using the most common skin preparation agents, such as chlorhexidine or povidone-iodine with alcohol

(Category IB) or a combination of both solutions, which should be applied in concentric circles moving toward the periphery (Category II).

The findings presented in this study have demonstrated that preoperative skin preparation is one of the modifiable factors utilised by HCWs to reduce the risk of SSIs. In both hospitals, the mean adherence rate to surgical site disinfection recommendations was 99.7%, consisting of a combination of povidone iodine (Betadine) and alcohol-based antiseptic solution in 36.8% of operations, alcohol-based antiseptic solution (13.3%), povidone iodine alone (33%) and miscellaneous (24.5%). Preoperative skin preparation with antiseptic solution was thus fully complied with by hospital A and hospital B. Overall adherence to guidelines on skin preparation was high in both hospitals (>80%).

Fieldnotes indicated that skin disinfection was done immediately prior to surgery, using antiseptic agents such as chlorhexidine, povidone iodine and alcohol-based solution, or a combination of two antiseptic solutions. It was observed that most orthopaedic surgeons were more likely to use a combination of two antiseptic solutions for skin preparation compared to general surgeons, whereas general surgeons in both hospitals were more likely to follow the aseptic technique while cleaning and painting the incision site from incision to periphery area and according to the manufacturer's protocols.

The quantitative findings concur with the qualitative findings, which highlight that skin antisepsis is an important preventive measure for decreasing the incidence of SSIs in elective surgery. HCWs in the study testified that skin preparation with antiseptic agents like chlorhexidine, povidone iodine and other alcohol-based products are essential for preventing infections. The respondents go on to argue that preoperative skin preparation was conducted for all patients using different antiseptic agents. However, HCWs prefer to use chlorhexidine as the main agent for antiseptic skin cleansing.

In this light, it was suggested that skin antisepsis should be carried out properly using aseptic techniques, such as cleaning the incision site from the clean area to the dirtiest area. Multiple studies have shown high levels of adherence to skin antisepsis. For example, Durando et al. (2012) found that appropriate skin antisepsis of the surgical site was performed in 97.4% of surgical operations, using iodoform in 75.1% of cases or chlorhexidine in 17% of cases. Davis et al. (2008) also lend support to these findings, stating that all the surgeons surveyed were using appropriate antiseptic agents (chlorhexidine, povidone-iodine or alcohol-based solution) for skin preparation.

In this study, skin preparation was carried out using an aseptic sponge holder, however skin preparation cleaning technique was not in accordance to guidelines with respect to most surgical procedures. In hospital A, the mean adherence rate was 15.2%, whilst in hospital B the mean adherence rate was 46%. This demonstrates that surgeons in hospital B partially adhere to skin cleaning protocol, whereas hospital A does not comply with guidelines. Overall compliance in both hospitals was considerably poor as it pertains to this recommendation (<60%). In previous investigation, Pan et al. (2009) reported that the preoperative antiseptic skin preparation was applied in concentric circles moving toward the periphery area in 41% of surgery. This explains that adherence with this recommendation for the skin preparation was generally poor. Whilst there is insufficient evidence on which to recommend one technique over another, it is recommended that skin cleansing should be done from the centre of the incision site towards the periphery area in concentric circles (CDC 2011). In this study, the appropriate preoperative skin cleansing technique was observed in only 29.8% of procedures, which indicates that most surgeons were not applying intraoperative antiseptic skin preparation in concentric circles. It appears, therefore, that cleaning techniques could be improved by educating HCWs about the importance of adherence to skin application techniques while preparing the incision site for surgery to prevent infection.

8.3.2 Intraoperative Infection Control Practices

Aim 6: To Assess Adherence to Traffic Patterns in Operating Rooms

In this section, the objective is to describe and evaluate the traffic patterns in ORs. The data were collected through observations and supported by interviews with surgical team staff and previous literature. The traffic flow patterns will be discussed in terms of total numbers of door openings during surgery, number of surgical team staff present in ORs, as well as the causes of door openings in an attempt to reduce traffic flow in the ORs.

OR traffic flow has been a contributing factor to SSI, as it increases bacterial counts in the OR (Panahi et al. 2012; Parikh et al. 2010). A high number of personnel present in the OR and a high number of door openings during operation correlates with a higher rate of SSIs (Gardlund 2007). Therefore, Infection control standards stipulate that doors should be kept closed all times unless necessary for allowing the passage of equipment and patients (Category IB), whilst the number of personnel allowed to enter any OR should be kept to a minimum level (Category II) (CDC 2011; GCC-CIC 2013). In the current study, it was observed that the door was kept open for most surgical procedures. The main reasons for door openings included equipment supplies, paperwork, sample collection, supplies, communication, breaks or staff changes and observations. Furthermore, the OR doors were opened for no obvious reasons in 30.3% of operations. Overall compliance was considerably poor for this recommendation (62.9%). Hence, these results highlight the importance of properly equipping ORs with all necessary instruments before starting surgical procedures. This recommendation is further supported by the observational fieldnotes, which showed that doors were opened frequently for equipment supplies, observations, collecting samples and communication between surgical team staff. In addition, it was noted that medical students, anaesthesiologists and circulating nurses and observers were the most common people who opened the doors during procedures. Considering this finding, the number of medical and nursing students

should be limited during procedures. When a comparison was performed between different occupational groups, it was found that adherence rate was higher during orthopaedic procedures than in general procedures in hospital A, whereas in hospital B the mean level of adherence was high for general surgeries compared with orthopaedic surgeries.

Other studies have produced similar findings. For example, Durando et al. (2012) found that doors in the ORs remained open for more than 50% of the duration of 254 operations (36.3%), which shows that traffic flow in ORs was also inappropriate in their sample. These findings are like those of Oliveira and Gama (2015), who found that increased traffic flow was a major problem in a surgical centre in a large hospital in Belo Horizonte, Brazil. The authors stated that doors remained open for the entire duration of 16 (88.9%) surgical procedures and remained open for 90% of one (5.6%) other surgery.

Concerning the number of surgical team staff present in the OR, one should stress that the evidence presented in this study was based upon the monitoring of 2330 HCPs in 315 procedures. The study shows that team size ranged from 5 to 10 people, with a mean of 7 team members assigned to a single procedure. The mean number of people present in the OR was what is to be expected for a typical operation (6 or 7 persons). In this study, the people who did not directly contribute in the surgery were thus counted as non-adherent. The present study confirms that the number of individuals present in complex surgeries like orthopaedic cases ranged from between 8 to 15 persons in 49.6% of cases, compared to 43.6% for general surgeries. One explanation for this is that some complex and long operations may necessitate more resources and surgical team staff (i.e. X-ray technicians, implant representative from a company, more surgeons, surgical assistants, and observers) compared to relatively short procedures. Alternatively, the fact that both hospitals are referral and teaching centres means that one would expect to find more medical and nursing

students around for training. In this respect, the results were congruent with other studies by Oliveira and Gama (2015) who reported that the average number of people found in the OR was nine professionals (ranging between 5 to 15) regardless of the size of the surgery, because in more complex operations it was observed that there was a need for more people. In a similar study, Durando et al. (2012) reported that more than 90% of the surgeries were done with less than 10 HCWs present in the OR. Overall adherence to traffic patterns in hospital A was 56.4% compared with 70.0% in hospital B, which indicates that insufficient attention was paid by staff to maintaining appropriate levels of traffic flow in ORs, which may increase the risk of airborne contamination (CDC 2011).

The analysis of the qualitative data collected from the interviews with HCWs points towards their awareness that doors should be kept closed except for the passage of patients and supplies to prevent infection. On general wards, some surgeons and nurses stated that doors swung open during surgery can interfere with the airflow inside ORs and cause a distraction. Thus, doors should be kept closed during surgery. Furthermore, it has also been found that lack of adherence to traffic flow has caused disruption to OR ventilation, increased the bacterial count in the OR and contamination over the wound (Allo and Tedesco 2005; Panahi et al. 2012).

To improve adherence to current recommendations, it is necessary that all ORs should be equipped with the requisite supplies before surgery begins. Proper education of surgical team staff is also integral to improving their awareness about, and compliance with infection control principles in OTs. Finally, limiting the number of personnel to only those active in the procedures should also help to decrease traffic flow during procedures (Panahi et al. 2012).

8.4 Additional Fieldnotes and Observations in Operating Theatres

8.4.1 Adherence to Standard Principles of Operating Rooms

In this study, additional fieldnotes were generated during observations concerning issues related to preventive measures during intraoperative practice. Appropriateness was judged according to the frequency, percentages and levels of adherence or non-adherence to respective guidelines. The analysis of this data revealed several additional aspects of SSI prevention in which HCWs were not in adherence with current international and national recommendations.

8.4.1.1 Wearing of Jewellery in Operating Room

Infection can be transferred during surgical procedures from the hands of the surgical team staff to the incision site. Therefore, it was deemed that the wearing of jewellery and accessories by surgical team staff during operations should be monitored. According to GCC (2013) guidelines, HCWs in OTs must remove all bracelets, rings, watches, earrings, and similar jewellery, prior to entering restricted areas. Such measures are supported by CDC (2011) guidelines which also state that surgical team staff should not wear hand or arm jewellery in OTs (Category II).

The results from this study indicate that jewellery (earrings, necklaces, wrist -watches and bracelets) was worn in 97.6% of the surgical procedures conducted in hospital A and 92.7% in hospital B. There was thus little difference between the two hospitals, and, indeed, overall compliance was considerably poor as it pertains to this specific recommendation (<60%). This was corroborated by the observational fieldnotes, which highlighted that most HCWs in OTs, especially the female members of staff, wore accessories during operations.

It is clearly stated that jewellery should be removed because bacteria are present on the skin beneath jewellery in higher numbers than skin not covered (e.g. there is more bacteria under a ring than on the finger of the corresponding hand) (Fagernes and Lingaas 2009). More specifically, these

are Gram-negative bacteria which are potentially pathogenic (Trick et al. 2003). Also, sharp jewellery could potentially get caught on the patient and cause harm, or puncture a sterile glove which places the HCW at risk of exposure to blood/bodily fluids (Khodavaisy et al. 2011). Therefore, to minimise transmission of disease the HCWs should remove all rings, watches, and bracelets (Khodavaisy et al. 2011). The current findings are consistent with another study in Italy, which reported that jewellery was worn by 11.6% of surgeons, 22.1% of instrument nurses, 56.1% of anaesthesiologists, and 45% of other personnel in the OR (Castella et al. 2006). Further, low levels of adherence to guidelines have been observed in other studies. For example, it was found that 15 (62.5%) out of 24 OTs surveyed in Turkey wore jewellery (Demir 2009). However, these results are in contradistinction to other research, which found that none of the HCWs wore hand and arm jewellery in cardiac surgery units in Italy (Pan et al. 2009). From these results, it appears that there was lack of adherence with the guidelines in both hospital A and hospital B, which increases the risk of wound contamination. Therefore, there is a pressing need to encourage surgical team staff to comply with the guidelines by removing all their jewellery prior to entering the OT to reduce the risk of infection.

8.4.1.2 Use of Personal Mobile Phones and Computer Keyboards in Operating Rooms

Mobile phones have been proven to operate as vehicles for the transmission of pathogens to patients in ORs (Badr et al. 2012; Elkholy and Ewees 2010; Ulger et al. 2009; Zakai et al. 2016). Gram-negative bacteria are essential HCAI pathogens, whilst HCWs' mobile phones were found to carry ceftazidime resistant Gram-negative isolates (Ulger et al. 2009). Therefore, it is critical to limit the use of mobile phones and computer keyboards within ORs. According to the findings of this study, most HCWs used the computer during 87% of surgical procedures, whilst usage of mobile phones in ORs was observed in 47.9% of procedures. It was observed that mobile phones were used on several occasions for taking photos of the incision site and communicating intraoperatively. In hospital A, mobile phones were used in 44.2% of operations and in 52% of operations in hospital B. The mean

adherence rate for using mobile phones in the OR was 55.8% in hospital A and 48% in hospital B. There was found to be no difference between hospital A and hospital B, because lack of compliance with recommendations were extremely poor in both hospitals. According to these results, then, it is evident that mobile phones and computer keyboards were used routinely in clinical practice in both hospitals, which increases the risk of infection in ORs. Thus, it is important to develop preventive policies and measures to minimise the use of mobile phones and computer keyboards inside ORs.

The fieldnotes generated from observations identify several occasions in which mobile phones were used inside the OR for communication, playing games and taking photos of the surgical site. Some anaesthesiologists also used portable devices, such as iPads and laptops inside ORs in hospital A. In addition, it was observed that some HCWs used hospital computers during surgery without hand washing. Gunasekara et al. (2009) and Ulger et al. (2009) showed that personnel items such as mobile phones, computer keyboards and wrist-watches in the OR may serve as vehicles for the transmission of HCAs among surgical patients. Therefore, it is vital to encourage good adherence to hand washing practices, and routinely disinfect personal items brought to OTs (Gunasekara et al. 2009). One potential limitation of the data is that the researcher is not always able to discern if the mobile phones were being used for personal or professional reasons, and if they were being used for professional reason whether it was essential or otherwise. From this perspective, it is recommended that surgical team staff in both hospitals should be fully informed about this issue, as well as the importance of adhering to hospital policies. As no previous studies concerning adherence recommendations on mobile phone and computer keyboard use in ORs has been found, this study can be said to have generated new knowledge and insights in terms of this issue.

8.4.1.3 Wearing of Surgical Attire

Previous studies have advocated that the wearing of surgical attire and protective equipment in the OR are necessary requirements for the prevention of infection (Oliveira and Gama 2015). These protective barriers help HCWs to minimise the risk of exposure of the HCWs skin or mucous membrane to potentially infectious materials (Abdulraheem et al. 2012). According to CDC (2011) guideline recommendations, HCWs should wear surgical masks that fully covers their mouth and nose, as well as wear a cap/hood that fully covers the hair on their head and face when entering the ORs (Category IB).

Other practices related to the wearing of surgical attire were all found to be not in accordance with recommendations, which is consistent with previous studies. Surgical attire generally includes surgical facemasks, gloves, eye protectors, gowns, shoe covers, caps and hair covers essential for preventing the spread of infection in ORs. A difference in compliance with some preventive measures was noted between hospital A and hospital B pertaining to the wearing of surgical attire. According to CDC (2011), surgical team staff should wear a surgical mask that fully covers their mouth and nose when entering the OR if an operation is about to begin or already under way, or if sterile instruments are exposed (Category IB). Moreover, surgical masks should be changed between surgeries if the mask becomes wet, moist or torn (GCC 2013). In this study, adherence levels with wearing an appropriate surgical mask that fully covers the mouth and nose and wearing head caps/hood that fully cover head hair and face were similar across both hospitals. The percentage of HCWs who wore a mask correctly in hospital A amounted to 76.6%, compared to 70.7% of HCWs in hospital B, even when it was visibly soiled. However, surgical masks were not changed between procedures, and this was monitored in 72.6% of cases in hospital A and 77.3% of cases in hospital B.

In addition, the international guidelines recommend some preventive measures when entering ORs, including wearing a cap/hood to fully cover hair on the head and face when entering the OR (Category IB) and wearing of surgical gowns and drapes that are effective barriers when wet (Category IB) (CDC 2011). Notably, surgical gowns were worn by 100% of HCWs present in ORs in hospital A and hospital B, which is indicative of good adherence to this specific recommendation. However, a cap/hood was worn correctly in 67.2% of surgeries in hospital A and 73.9% of surgeries in hospital B. The findings of this study also report that the mean adherence rate for wearing sterile gloves before skin preparation ranged from 99.4% to 99.7% in both hospitals, whilst eye shields were used by only 3.8% of professionals. According to CDC (2011) guidelines, sterile gloves should be worn before any aseptic procedures (Category IB). However, the use of protective gear like eye shield or goggles are not worn routinely during surgical procedures because this is not encouraged by the guidelines (CDC 2011; Oliveira and Gama 2015). These findings were reinforced by the qualitative interviews with HCWs, who stated that all professionals wore barrier precautions, such as gowns, gloves, surgical masks and surgical caps in ORs. In addition, one person stated that they wore an eye shield/goggles during surgery to protect themselves, and maintain the patient's safety. According to some interview respondents, there were several factors that affected the implementation of guidelines in their clinical practice, including organisational factors such as lack of resources (e.g. surgical caps and masks). This finding goes some way to explaining why the researcher observed the same surgical caps and masks being routinely worn by many operating theatre nurses and surgeons in the ORs.

Other studies from across the globe have evaluated practices relating to wearing of surgical attire. Castella et al. (2006) reported good adherence for wearing correct caps/hoods that fully cover head hair, as well as in terms of wearing masks correctly so that they covered the nose and mouth. However, it was noted that 37.9% of HCWs did not change their masks between surgeries. The

authors also found that surgical gowns were worn by only 98% of those personnel present in ORs across 49 hospitals in Italy. Further, Castella et al. (2006) purported that eye shields were worn by 26.3% of surgeons, 41.4% of nurses and 10.4% of anaesthesiologists. On the contrary, other studies in Brazil have reported good adherence to the proper use of surgical gowns, use of proper surgical masks and surgical gloves. On the contrary, an observational study by Oliveira and Gama (2015) found that there was a need to improve adherence to the correct use of eye protectors/goggles and wearing of surgical caps (Oliveira and Gama 2015).

In fact, it is recommended that eye shields/ goggles should only be used for those surgeries in which aerosol contamination is a likely occurrence, such as, for example, in orthopaedic surgeries where drills are used. Overall adherence to surgical attire recommendations was good and consistent with the guideline recommendations in hospital A and Hospital B. However, the study has recognised a need to improve usage of surgical masks and caps. It is proposed that OTs need to be carefully monitored, in conjunction with audits being conducted to evaluate perioperative procedures. Indeed, audit and feedback are broadly used as a key strategy through which to improve professional practices (Ivers et al. 2012).

8.4.1.4 Cleaning and Disinfection of Environmental Surfaces

Although the CDC (2011) guidelines state that when visible soiling or contamination with blood or other body fluids of surfaces or equipment occurs during an operation, disinfectant solution should be used to clean the affected areas before the next operation. Yet, there is no evidence to support special cleaning after contaminated or dirty operations. Cleaning of surfaces in OTs was observed in all surgical procedures, but a disinfectant solution was used in only 1 (0.3%) of the operations. In fact, it was found that there were no disinfectant solutions available in either hospital for cleaning and disinfecting environmental surfaces in ORs. This is in contradistinction to a previous study

conducted by Demir (2009) in Turkey, which illustrated that cleaning of the environment using disinfectant solution was important for reducing the bioburden of microbes and for removing dirt. Demir (2009) found that after observing this recommendation in 24 OTs, 100% of them used disinfectant agents for visible soiling or contamination. In this study, it was observed that cleaning of environmental surfaces was performed in all surgical procedures, however disinfectant solution was not used even in those instances in which there was visible blood/fluids, which indicates a need to implement the use of antiseptic agents for cleaning environmental surfaces in the case of visible contamination (Category IB) (CDC 2011; Quinn et al. 2015).

8.4.1.5 Surgical Draping

A further factor which is associated with SSI is the sterile draping of surgical patients before surgery. According to CDC (2011) guidelines, using surgical drapes is an effective barrier through which to prevent contamination (Category IB recommendation). Surgical draping refers to procedures used to create a barrier between the surgical sterile field and potential sources of bacteria during operations (Chan et al. 2012). Draping of the skin around the incision site aims at hindering bacteria that will reappear on the patient's skin during operation from contaminating the wound (Gardlund 2007). The incision site should be prepared by applying an antiseptic solution like a chlorhexidine agent or povidone iodine, and it should be performed in concentric circles to maintain the sterile field. The findings of this study emphasise that sterile surgical draping was applied in almost all surgical procedures in hospital A and hospital B, however 3.5% of cases were deemed not to be in accordance with guidelines. Similar studies reported that almost 100% of the responding surgeons use disposable surgical drapes, and that these drapes are usually changed during the procedure (Diana et al. 2010). The findings of this study report that the mean adherence rate in both hospitals was 96.5%, which testifies to the fact that sterile draping was used in almost all surgeries.

8.4.1.6 Applying Dressing to Incision Site and Maintaining a Sterile Field

In terms of postoperative aseptic surgical dressing, postoperative surgical dressing was carried out in all surgical procedures using aseptic techniques, with a mean of adherence rate of 100%. Guidelines for EBP on postoperative incision care recommend putting a sterile dressing on the incision after surgery, which should be kept on for at least for 48 hours postoperatively (CDC 2011: Category IB). Finally, the observational component of the study found that maintaining a sterile field was successfully done in almost all (93%) of surgical procedures, which indicates good adherence to current guidelines. Having said this, there were occasions in which HCWs were observed reaching into the sterile field and touching sterile drapes during surgery. Further, the present findings demonstrate that some surgical team staff were entering restricted areas of the surgical site without fully covering their head and facial hair, which may increase the rates of SSIs. Once again, no studies evaluating adherence to these specific recommendations could be found among the literature.

8.4.1.7 Wearing of Double Gloves and Gloves Perforation

Using double gloves is recommended as a means through which to maintain both the physical integrity of the gloves, and to reduce the risk of glove perforation (NICE 2006). Moreover, sterile gloves provide an important protective barrier between patients and surgeons. Wearing surgical gloves is proven to be an effective measure for preventing pathogen transmission and reducing the risk of SSIs, in turn, and contributing to the safety of HCWs and patients (Braun 2016). The results of this study found that, in both hospital A and hospital B, most of the orthopaedic surgeons (93%) did wear double gloves during surgical procedures to protect both themselves and their patients. Yet, having said this, double gloves were worn in very few cases (1.6%) of general surgeries. In both hospitals, the mean adherence rate was 93.0% which indicates a high adherence rate. It was observed that orthopaedic surgeons prefer to use double gloves instead of single gloves, to avoid any glove preformation during operations. Whilst the overall level of glove perforation observed

was 7.5% in hospital A and 11.5% in hospital B, these were different to the findings of a previous study. Oliveira and Gama (2015) found that double gloving was used in different general surgeries, such as inguinal hernia, laparotomy, and cholecystectomy. In their study, the authors reported that double gloving was used by 18.6% of HCWs, of whom 13% suffered perforations. In this study, the mean adherence rate was very high because most orthopaedic surgeons used double gloving in orthopaedic surgeries, which are typified by an excessive use of sharp scalpels, screws, prosthetic implants, and prolonged duration.

Unfortunately, there was no further data from this study able to provide a comparison between the extent to which HCWs in both hospitals adhered to other infection control principles for the prevention of SSIs, such as hand hygiene. In conclusion, the implementation of these measures to prevent SSI varies greatly among HCWs in the two hospitals. One could argue that this is due to a certain level of ignorance about evidence-based recommendations in both hospitals.

8.5 Barriers to Guideline Adherence Among Surgical Team Staff

Aim 7: To Investigate the Factors Affecting Non-adherence to Evidence-Based Guidelines for the Prevention of SSIs

Adherence to recommended guidelines is not always optimal, and this is often due to manifold factors acting as barriers to implementing EBP in HCWs' clinical practice. Therefore, one of the objectives of this study was to assess these factors that are responsible for non-adherence to EBP for the prevention of SSIs among surgical team staff. There are several studies which have attempted to analyse and investigate barriers to implementing clinical practice guidelines in healthcare settings, however the literature search process identified that there were no previous studies that had assessed barriers to implementing SSI prevention guidelines in Oman. This specific aspect of the research was investigated through observations and interviews with HCWs in OTs and surgical wards.

Using the best and most up-to-date evidence-based guidelines to inform professional practice is critically important for enhancing the quality of care and outcomes of patients (Veeramah 2015). However, despite the benefits of embedding EBP in clinical practice, actually implementing evidence-based guidelines remain a significant challenge for many HCWs (Veeramah 2015).

Many factors are responsible for non-adherence to the principles of SSI preventive measures among HCWs. In this present study, major barriers to implementing guidelines were most often found to be related to organisational factors, cultural issues, knowledge and behavioural related factors, and guideline-related factors. The main barriers identified in the qualitative phase of the research included organisational related issues, including lack of resources, workload issues and staff shortages. Additional barriers reported by HCWs centred on behavioural related issues of individuals, including disagreement with guidelines, negligence and forgetfulness. In conjunction with this, patient related factors including patient preferences and medical conditions were commonly identified determinants of non-adherence. Indeed, patient preferences have previously been reported to play a role in implementing recommended practices (Squires et al. 2007). For example, a patient may not wish to take antibiotics or may refuse to wear an OT gown in surgery. Another recognised barrier is culturally related issues, such as a patient not wanting to shower or shave. A further reason yet still for non-adherence to guidelines concerns the ambiguity of the guidelines and the inadequacy of guideline distribution. In addition, some HCWs stated that some surgical team staff were not suitably trained about perioperative infection control practices, which can also be detrimental to their practices.

With respect to the available literature, these findings are generally in accordance with a previous study conducted in Iran, which highlighted that the most common barrier to implementation of evidence-based guidelines was a lack of cooperation on the behalf of physicians, a lack of human

resources and workload issues (Khammarnia et al. 2014). In addition, the authors also noted individual related factors affecting non-adherence, such as insufficient time to read the evidence-based guidelines, educational level, job experience and a lack of knowledge (Khammarnia et al. 2014). Overall, Khammarnia et al. (2014) reported that a lack of human resources, staff shortages and heavy workload were the most common determinants underpinning non-implementation of EBP.

Another aspect of cultural issues concerns the lack of clear communication between different surgical team staff. In Oman, employees are made up of a variety of different nationalities, including expatriate nurses working in hospitals, which means that there can be some difficulties in communication. Indeed, previous research informs us that communication can often act as a barrier among health professionals (Voogdt-Pruis et al. 2011). Moreover, it was also found that language barriers are an important obstacle when it comes to implementing international and national guidelines. For example, the observational aspect of this study showed that some surgical team staff have a problem with the English language. Such observations are supported by studies conducted in other institutions, which similarly show that insufficient familiarity with the English language was a significant barrier to implementing EBP (Chiu et al. 2012; Khammarnia et al. 2014; Weng et al. 2013). Moreover, some nursing staff stated that the lack of clarity about the current local guidelines could result in different practices, and thus, as such, it should be based on EBP. Jahansefat et al. (2016) found that the unclarity of recommendations is one of the main barriers to implementing evidence-based guidelines for the prevention of VAP. Furthermore, one could assume that most surgical team staff have no personal access to electronic databases, which, once again, could have affected their adherence to recommended practices. This problem has been reported in previous studies. For example, Heselmans et al. (2009) reported that 50.5% of physicians were unlikely to have access to electronic databases.

Previous studies also inform us that key barriers to embedding guideline recommendations in clinical practice include, for example, a lack of supplies, carelessness, heavy workload, lack of skills, lack of evidence-based guidelines, inadequate training of HCWs (Koh et al. 2008; Mater 2014; Oliveira and Gama 2015). With respect to non-adherence to guidelines on UTIs, Lugtenberg et al. (2010) found that lack of applicability of the guidelines, lack of agreement and discomfort were the main barriers. Whilst other studies have identified a lack of awareness, lack of acceptance of guideline recommendations, forgetfulness, staff shortages, disagreement with the evidence-based recommendations, lack of time, lack of knowledge, health status of patients, patient preferences and lack of education material as the predominant determinants of non-adherence to guidelines (Clark 2003; Espeland and Boerheim 2003; Janssen et al. 2013; Jun et al. 2016; Koh et al. 2008).

It is worth noting that there are many other studies across the globe aimed at both investigating barriers to guideline implementation, and describing the attitudes of HCWs towards surgical antibiotic prophylaxis. Indeed, three studies found that adherence to all parameters of surgical prophylaxis was problematic. The studies by Abdel-Aziz et al. (2013) and Van-Kasteren et al. (2003) posit that barriers towards implementation of surgical prophylaxis guidelines, with respect to choice and dose, have been studied and identified as stemming from low-prioritisation, from being perceived as an inconvenience, as well as due to a lack of awareness, disagreement with guidelines, heavy workload, poor organisational communication, non-accountability, misperception of guidelines, regular updating of policies in a short time-span, and the attitude of HCWs. These manifold factors should be taken into consideration when healthcare decision-makers are designing initiatives to enhance adherence of HCWs to evidence-based guidelines. To enhance surgical team staffs' adherence to guidelines, it is vital to establish educational programmes to both address these aforesaid barriers and identify solutions to overcome them. Furthermore, providing the necessary resources and facilities, developing local guidelines and implementing reminders can all help to

facilitate compliance with all preventive measures, such as the use of antibiotics guidelines. Moreover, it is proven that support and encouragement from the hospital management in terms of providing training, auditing and feedback are the most effective facilitators for utilising evidence-based guidelines (Shifaza et al. 2014; Borgert et al. 2015). According to Efstathiou et al. (2011), establishing a system of reminders about the need to implement standard precautions is another important measure for improving compliance with guidelines.

8.6 Cultural and Linguistic Diversity in Health Care

The literature review drew attention to the fact that cultural, linguistic and religious diversity are integral to healthcare facilities. There is a relative dearth of studies which examine cultural issues in OTs, although the influence of cultural diversity among HCWs has been well-established (Johnstone and Kanitsaki 2006; Stronks and Essink-Bot 2010). In the context of Oman, it was shown that the context made little difference because I collected the data in two different hospitals with different elective surgical cases, but the findings were very similar. However, it could be argued that adherence to international and national recommendations for the prevention of SSIs is problematic for some HCWs due, in part, to linguistic and cultural differences. Cruz et al. (2017) observed that delivering culturally competent care represents a challenge to many HCWs due to language diversity and difficulties in communication. It is known that Oman, like other Gulf states, has experienced a shortage of staff, and thus expatriate health professionals are recruited from many different countries: they speak different languages and come from different cultural backgrounds (Felemban et al., 2014). This study found that there are multidisciplinary teams from different cultural backgrounds working in OTs. As a result, it was observed that some HCWs experienced challenges and conflicts with surgical patients and colleagues who were of different nationalities. Therefore, it is essential that surgical team personnel improve their knowledge about Omani cultural traditions.

Lack of cultural awareness and language barriers significantly influence patient care (Felemban et al., 2014). Despite English being the predominant language used in healthcare institutions in Oman, some HCWs continue to talk in their own local language, especially in the case of Omani staff. This fact is supported by my fieldnotes, which showed that many expatriates and most Omani staff used their own language when talking to each other in OTs. Furthermore, it was observed that many expatriates could not communicate properly with patients and their colleagues due to the language barrier, which may have affected their adherence to infection prevention and control guidelines. Zaiton and El-Meanawi (2017) found that cultural and language diversity constituted major barriers for healthcare professionals implementing infection prevention and control measures. They also stated that HCWs from diverse cultural backgrounds, in particular non-native English speakers, encountered difficulties in adhering to infection prevention and control practices. These findings are in line with Travers et al's. (2015) study, which indicated that language and culture were perceived as common barriers and detrimentally impacted upon HCWs' compliance with infection prevention and control (Travers et al., 2015). This study is similar to Almutairi's (2015), which found that nurses encountered problems in performing culturally competent care because of communication barriers between patients and HCWs, which ultimately impacted on patient safety.

In Oman, it was observed in the OTs that the majority of Indian and Filipino staff who work in OTs experienced problems working in the team due to language barriers and, consequently, this may have impacted on their adherence to infection control guidelines. These findings are similar to Barker et al's. (2017) qualitative study in India, which identified that the Hindi language skills of some nurses represented a barrier to complying with infection control. Furthermore, it was observed that many nurses who joined healthcare institutions with limited Hindi speaking abilities struggled to communicate with patients and other healthcare professionals. This is supported by the field notes in this study, which found that many of the surgeons and nurses in Oman were from

different countries and, therefore, experienced a conflict due to language differences. More specifically, it was observed that it was hard for expatriates to communicate with surgical patients who spoke a different language during intraoperative care. However, some of them managed to speak broken Arabic.

Unfortunately, there are no interpreters in health care settings in Oman and so non-native Arabic speakers depend on their colleagues to interpret. Furthermore, Muslims are also influenced by religious observances. According to Karout et al. (2013), religious beliefs are important factors that affect the practices of HCWs. For example, the women in Saudi Arabia stated that Islamic beliefs were critical factors that made them feel comfortable (Karout et al., 2013). In this regard, Karout et al. (2013) found that Saudi women prefer to receive care from female staff, rather than males during gynaecological assessments (Karout et al., 2013). In Oman, the majority of surgical team members come from different cultural and religious backgrounds, and it was observed that the team experienced difficulties in healthcare delivery due to these cultural differences. Without such knowledge of culture, HCWs may experience considerable challenges when working with other culturally diverse healthcare professionals to provide high-quality care (Almutairi 2012). Generally speaking, in Oman, the HCWs in OTs were not fully aware of Omani culture, and thus it is crucial that the surgical team understand these cultural and religious issues to improve surgical outcomes. This is important, because understanding such cultural and religious beliefs would help HCWs to provide competent care (Almutairi 2012). Overall, then, it can be concluded that culture, language and religious barriers are critically important for HCWs in OTs.

8.7 Awareness and Practice of Infection Control Measures amongst Healthcare Workers and Integration of Evidence-Based Guidelines in Practice

This section sets out to assess both the levels of awareness of clinical guidelines and the level of adherence to these same guidelines. The data was collected via structured interviews and observations and the findings that emerged out of the analysis will now be discussed and compared to previous scientific research in this area. As aforesaid, implementation of EBP is essential for improving patient safety and the quality of services (Dalheim et al. 2012). Both the surgeons and nurses indicated that they obtained their knowledge about the guideline recommendations from different sources, including academic studies, textbooks on infection control, by attending short courses on infection control, orientation programmes and self-learning at home. These findings were consistent with previous studies conducted by Majid et al. (2011) and Banning (2005), who asserted that nurses use a range of sources to adopt EBP such as printed information sources, medical sources and textbooks and journals. These results are in accordance with other studies, such as that conducted by Dalheim et al. (2012) and Squire et al. (2007) who identified that HCWs acquired their information related to EBP from different resources, including personal experience, nursing school, doctors' orders, clinical experiences, textbooks, medical journals, and nursing research literature.

The present study also reports that nurses often use hospital policy and procedural manuals on infection control standards as the principal sources of information through which to inform their practice. Other studies have similarly noted that nurses use hospital policy and protocols as a source of information about EBP (Dalheim et al. 2012; Gerrish et al. 2008; Squires et al. 2007). The results of this study also highlight that junior surgeons and nurses were given additional education on certain infection control practices to improve their knowledge and skills related to perioperative

procedures in ORs. These studies thus stand in contrast with Dalheim et al.'s (2012) work, which found that the most commonly reported source of information on guidelines was obtained from discussions with doctors and fellow nurses. Some interesting issues emerge from the qualitative data, such as the fact that some interviewees opined that existing literature makes it possible for HCWs to keep up-to-date about infection control measures. A further important finding is that seeking expert opinion from senior staff is also a crucial means through which HCWs acquire knowledge and skills regarding recommended practices for the prevention of SSI.

Other HCWs rely on their hospital experiences as their main source of knowledge about the guidelines, rather than using the international or national measures to guide their practice. Thus, these results support recent studies which found that HCPs depend heavily on experiential knowledge, rather than on knowledge derived from scientific and professional literature, and, moreover, that one reason for this may relate to the accessibility of current guidelines (Squires et al. 2007). Although most of the respondents (73.3%) expressed an awareness of SSI preventive guidelines, approximately 26.6% of respondents did not have any knowledge about the guidelines. Considering this, some suggested a need for clearer guidelines to enhance staff adherence to SSI preventive strategies. In addition, the HCWs who were aware of SSI preventive measures reported that these guidelines were very useful for reducing the risk of infections in OTs.

These findings are in concert with the results of a study conducted in 2007 on HCWs in Nigeria, where good awareness and knowledge about infection control guidelines were found in 13% of professionals (Abdulraheem et al. 2012). In their study, the authors found that half of the HCWs reported no knowledge of UPs, more than 37% of them had only an average knowledge of Ups, whilst 13% had good knowledge, which indicates a general lack of awareness to the guidelines.

Similarly, a study conducted in France, involving more than 4000 HCWs in 34 institutions, showed that 39.3% of HCWs had good knowledge of infection control standards (Atif et al. 2013).

These responses were congruent with other literature. A study conducted in 2010 with medical doctors, medical technologies and nurses showed that there was only an adequate knowledge and acceptable level of awareness among medical doctors and nurses towards UPs (Vaz et al. 2010). Like many studies in the literature, Chen et al. (2015) pointed out that out of 455 ICU nurses in China, 10.75% nurses had not heard of the guidelines, 57.6% of the nurses indicated an unfamiliarity with the guidelines, whereas 50.7% nurses heard of the guidelines but did not receive training for them. To improve HCWs' awareness of and adherence to the guidelines, continuous educational programmes for surgical team staff should be implemented in hospitals (Wang et al. 2003).

In the present study, nearly 83.3% of the respondents agreed with the guideline recommendations because they reflected international standards, were derived from scientific studies, and proved to be a good source of advice for improving surgical interventions and patient care. In addition, the majority of HCWs believed that implementing such guidelines would help them to prevent SSIs and maintain patient safety. These findings were supported by other studies, such as Jeong et al.'s (2014) work, in which the surveyed participants reported positive attitudes towards guidelines, whilst the majority of respondents (91%) agreed that guidelines are useful tools for improved patient care. In addition, this study also revealed that most of the physicians (73.4%) agreed to practical procedures recommended by guidelines.

The qualitative component of this study further indicates that some participants expressed that there were different sets of guidelines which were used by HCWs to assist in clinical decision-making and improve healthcare for patients. They claimed that the multidisciplinary team used local, national and international guidelines, and read textbooks in their daily clinical practice. This study

has shown that about 70% of participants did follow local guidelines, 6.7% did follow national guidelines, 3.3% did use international guidelines, followed by 3.3% of HCWs who used other sources of evidence-based guidelines like textbooks and journals, while nearly a quarter of them also indicated their uncertainty about guidelines.

In this context, some perioperative team members revealed that they have always been responsible and accountable for providing patient's care and preventing SSIs during surgery. The negative scenarios depicted in the qualitative study demonstrate that some nurses perceived that some surgeons were not accountable for their practice, not to mention that they did not feel listened to and often felt disrespected as they were not involved in clinical decision-making. Previous literature also underscores that involving nurses in clinical decision-making is critical for improving adherence with the guidelines (Majid et al. 2011). Finally, this study found that 83.3% of the respondents agreed that compliance with guidelines was beneficial in decreasing the risk of SSIs, and for maintaining patient safety during surgical procedures. Study participants further reported that implementation of infection control practices in clinical settings is critically important for guiding their healthcare decision-making apropos perioperative patient preparation. As shown in the above section, there was a good level of awareness among surgical team staff towards SSI preventive measures. These findings imply that providing training for HCWs to increase their awareness about the guidelines would be expedient for further embedding EBP in their clinical practice.

8.8 Overall Summary of the Study

This chapter has summarised the main findings of this thesis and provided an interpretation of the findings in relation to previous research in the field. As aforesaid, this study is significant because it is the first to measure the overall level of adherence to preoperative patient preparation and intraoperative infection control practices over a six months period following surgical interventions

in Oman. This research also sought to give voice to the perspectives of HCWs themselves to identify the manifold issues and challenges they face in their everyday clinical practice. Consequently, this study can be unique, as this is the first-time a mixed-methods (observations and structured interviews) approach has been conducted with HCWs in relation to adherence to international and national recommendations for the prevention of SSIs. Hence, it has made a valuable contribution to knowledge production in this emergent field of study.

This study revealed that adherence to recommendations was in accordance with the findings of previous studies that similarly reported less than 100% compliance rates with guidelines. More specifically, the results indicated a lack of adherence to international and national recommendations for the prevention of SSI in Oman, with respect to certain measures, including: preoperative hair removal with the use of razors - which is no longer recommended; preoperative showering without using antiseptic agents; performance of incorrect preoperative skin cleaning techniques while preparing the incision site. Furthermore, the results of this study indicate troubling failures with respect to keeping doors open during surgical procedures, as well as pertaining to the number of surgical team staff in the OR, which was shown to be larger than recommended for most surgical procedures. In addition, the findings of this study demonstrate that HCWs in hospital A and hospital B only partially adhered to antibiotic prophylaxis guidelines regarding the duration of antibiotic prophylaxis, especially in hospital B. Furthermore, other recommendations were not successfully adhered to, including wearing jewellery in OTs, improper use of surgical masks and caps, and using personal mobile phones and other devices in the ORs.

However, it is also important to note that the observations in hospital A and B also highlighted that specific measures were being successfully adhered to in HCWs clinical practice, including: the preoperative length of hospital stay; the appropriate time for hair removal deemed necessary;

antibiotic prophylaxis (choice and timing of administration of prophylaxis); cleaning of environmental surfaces inside ORs between surgeries; applying sterile drapes and maintaining the sterile field; applying the appropriate sterile dressing after wound closure; using an antiseptic agent for skin antisepsis; wearing of eye protectors during invasive procedures; and the proper use of gown and sterile gloves.

Perhaps the most important aspect of the research over and above studying adherence and non-adherence to guidelines, concerns the fact that this study has identified the determinants of non-adherence and the reasons for this in HCWs clinical practice. With this in mind, the study found that there were manifold factors affecting non-adherence to guidelines. The most commonly cited barriers to embedding EBP in practice concerned lack of awareness, patient preferences, lack of guidelines, lack of resources, disagreement with the policies and guidelines, lack of communication, [religion, cultural and linguistic diversity](#) and forgetfulness and negligence. Henceforth, it is proposed that training programmes be implemented to improve the quality of care and maintain patient's safety. Moreover, national surveillance and feedback may help to reduce the rate of infections after surgery.

Methodologically speaking, the study has demonstrated the tremendous benefit to be gained from using a research design which makes use of both observations of clinical practice and qualitative interviews with HCWs. Furthermore, the quality of the findings testify to the fact that synthesising the results obtained through both quantitative and qualitative methods provides a greater understanding of adherence to guidelines, thus allowing the researcher to achieve the study aims and objectives and satisfactorily answer the research questions. The next section considers specific limitations of the study, before moving onto discuss recommendations for practice, education and research in Section 8.10.

8.9 Limitations of the Study

The researcher acknowledges several limitations related to this study. Firstly, given that this study was conducted in two hospitals in Oman, the target population selected for this study might not constitute an adequate representation of the entire population. Therefore, it is important to stress that the findings are not generalisable to any other population except that included in this sample. Secondly, as aforementioned, one must take into consideration that there is a relative dearth of literature in this area. In fact, no studies have hitherto specifically assessed adherence to international and national recommendations in Oman. Further, the results of this study are also based on a small sample size, which includes 315 surgical interventions in Phase 1 and 30 interviews with HCWs in Phase 2 of the study, which indicates that the sample may not be representative of all surgical team staff.

A further limitation could stem from the fact that the presence of the researcher as an observer during procedures could potentially alter the behaviour of the HCWs. The researcher tried to mitigate the effects of this in several ways, which I will discuss now in turn. Firstly, it was evident that the researcher maintained good relationships during these observations and, indeed, staff appeared to be largely accepting of the researcher's presence. Secondly, prior to beginning non-participant structured observations, the researcher introduced himself and the purpose of the observation to all the HCWs who were responsible for patient care in the OTs. Thirdly, the time of observation and the surgical procedures and theatres were routinely observed by the researcher on the day of the observation. The success of the researcher's attempts to mitigate the observer effect can be evidenced in the fact that, although HCWs knew that they were under observation, compliance remained low with respect to key guideline recommendations. This underscores that there was no evidence to suggest that there was an observer effect with respect to the HCWs observed in this study. Therefore, the findings are deemed to be accurate and valid.

Having said this, admittedly there are specific aspects of the study that the researcher would do differently if conducting this research again. During the observations, phase 1 of the study, I would have included more surgical interventions from different hospitals to ensure that the results were applicable to other institutional settings. Furthermore, although the interviews enabled the researcher to understand important issues related to HCWs' experience of perioperative procedures, and thus to identify perceived barriers to implanting evidence-based guidelines, in retrospect the researcher could have done much more to probe the interviewees for additional information. For example, several participants claimed that the guidelines are effective without stating why they are effective or why they failed to adhere to them in their clinical practice. Other interviewer's may have probed them to say more about why they think the guidelines are effective, as well as citing supporting evidence from their practice, perhaps in the form of audits conducted in the hospital. In this study, the observational checklist used to collect data was evaluated for its effectiveness and the interview schedule was piloted for the purposes of bolstering the credibility, trustworthiness and overall quality of the data collected.

8.9.1 Power of Surgeons

Perioperative surgical care is multidisciplinary care. However, in this study surgeons represented themselves as dominant members who had more knowledge and autonomy to control and direct other HCWs. Unfortunately, it was observed that decision-making was mainly carried out by surgeons, who ignored other team members, especially nurses, which, in turn, impacted upon the performance of surgical procedures. Thus, the impact of decision-making related to adherence to guidelines for the prevention of SSIs would affect the whole team's performance. The findings of this study show that nurses had far less power and autonomy compared to surgeons. Jayasuriya-Illesinghe et al. (2016) indicated that surgeons were the leaders and main decision-makers in OTs.

Conversely, nurses adopted an assisting role. The findings of this study showed that nurses did not have a role in decision-making, which, ultimately, influences their performance. Jayasuriya-Illesinghe et al. (2016) stated that existing power dynamics and gender diversity between surgical team members majorly impact on the work culture in ORs. Given that Middle-Eastern culture is very male-dominated, this necessarily influences the interaction between male surgeons and female nurses. Indeed, in Saudi Arabia, many female nurses from non-Arabic speaking countries expressed concern about working in a male-dominated work area (Algahtani 2015). In Algahtani's (2015) study, some nurses raised concern that surgeons did not cooperate with them, because they perceived them as assistants. In this study, some nurses reported that surgeons were moody and created problems for no particular reason (Algahtani 2015). The results of this study also illustrated that surgeons did not let nurses express their feelings or make decisions in ORs and did not like to be questioned about their behaviour in ORs. In this study, it was found, on several occasions, that nurses were unable to express their opinions related to infection prevention and control practices in ORs due to cultural issues, which may have jeopardised patients' safety. Consequently, surgeons could improve team performance through avoiding criticism of other members of the team, alongside encouraging the involvement of other surgical team personnel throughout perioperative care (Stone et al., 2017).

8.9.2 Lack of an Appropriate Audit Culture

The main limitations of this study include the lack of an audit culture and surveillance in OTs. The infection prevention service in Oman is undeveloped compared to western countries and lacks the resources and expertise among local staff to conduct, interpret and act on surveillance data locally and nationally. In the studied hospitals, although there were no audits conducted to investigate adherence to international and national guidelines for the prevention of SSI, there were some audits

performed periodically to ensure compliance with specific infection prevention and control practices, such as hand washing, donning of personal protective equipment (PPE) and techniques for aseptic dressing and procedures. Conversely, there are manifold clinical audits carried out internationally in the UK and USA. These audits focus on auditing hospital associated infections, including ventilator associated pneumonia (VAP), catheter associated urinary tract infection (CAUTI), whilst some infection prevention and control practices include antibiotic use and resistance, surveillance of SSIs and prevention practices, use of standard precautions, monitoring of sterilisation equipment and use of antibiotic prophylaxis. To measure adherence to perioperative infection prevention and control practices, local hospitals are required to undertake audit programs, which should be a part of hospital culture both to improve the quality of care and encourage compliance with the guidelines at a local level, thereby reducing the incidence of HCAs. Indeed, there is a need to develop effective strategies to monitor compliance to perioperative protocols and provide feedback to surgical team members to improve their adherence to the recommended practices. It was found that audits are one of the key mechanisms for assessing adherence to the guidelines and for identifying barriers to guideline adherence (Kastern et al., 2003).

8.9.3 Personal Reflection of An Insider and An Outsider Experience

At the outset of my PhD studies, I situated myself to be both an insider and an outsider, in order to assess what was happening in the clinical practice and to interact with the people in the field. Wilkinson and Kitinger (2013) and Innes (2009) argued that researchers cannot escape being both insiders and outsiders, so it is important for researchers to make good use of these positions. It was significant that I took both an insider and an outsider position to monitor the elective surgical procedures and to explore the HCWs' perceptions of their experiences related to infection control guidelines adherence in the OTs. In this study, the majority of the participants perceived me as an

insider researcher because of my nursing background, whereas others viewed me as an outsider due to my current position as educator. In order to close the gap between the two positions among the participants, I explained to them my role in this study as a PhD student, which in turn helped me to become more engaged with them. Moreover, I wore the OT gown during the observational periods in order to have a similar uniform as the team, which helped many of them to treat me as a member of the team.

Both insider and outsider positions have their own advantages and disadvantages regarding participation in clinical and research contexts. First, being an insider, I observed that there was an increased level of trust in my relationship with the participants and there was a high level of rapport. My insider role status frequently allowed me to be accepted by the surgical team members in the field and therefore, they were more open, which helped me to gather in-depth data. In my own study, for example, on some occasions, some staff asked my professional opinions and sought advice in relation to some clinical practices. Moreover, being an insider helped me to gain more access to information and made it easier to collect information from the participants, particularly with regard to their infection control practices within the OT. It is supposed that access to the information is more easily available to the insider and that data collection is less time consuming compared to the outsider's experience (Mercer 2007). Besides, on many occasions during the observations, many of the participants openly shared their ideas related to their practices during the research and treated me as a colleague, which in turn helped me to acquire more understanding about their routine clinical practices and to extract true data from the participants. Despite that, I think my presence in the OT did change the usual behaviour of the HCWs, and, in my role as researcher, could have influenced their practices. For example, the HCWs interacted with me to point out that their colleagues were not adhering to the guidelines. It could also be argued, however, that my prior nursing background and past experiences with some participants regarding the topic

had an impact on the participants' views and findings. For example, some staff criticised and blamed other staff members to the researcher, whilst others pointed out unprofessional behaviours, e.g. not wearing masks properly and not complying with national antibiotic prophylaxis protocols. Undoubtedly, they were not reluctant to talk about issues raised by the researcher related to their practices.

As my research progressed, I came to realise that I did not have a deep knowledge and understanding of the HCWs' experiences and the routine work in OT. Therefore, some participants accepted me as an outsider for certain reasons. First, I was not familiar with issues related to their behaviour and practices in the field and I did not have power and authority over the surgical team; as a result, many participants accepted me as an impartial observer and non-judgmental outsider within this context. Furthermore, I was not involved in any procedures and activities within the OT: this, therefore, this gave me the advantage of observing the practices as they occurred in the OT. Lastly, in this study, the identity of PhD student made me a more neutral observer and an outsider who was not part of the team. Therefore, I kept introducing myself as such every time I entered the OT.

Likewise, in my study, the interviews were also undertaken with participants as a strategy to explore issues from the perspective of participants. I felt my own position shift somewhat towards the outsider during the collection of qualitative data. I think in most interviews conducted during this study, some participants accepted as an outsider researcher because they knew that the researcher used to work as a lecturer, thus, they were a little hesitant to talk about issues relating to their practices during the interviews. As a result, I asked the participants to be more open during the interviews to help me to gain an in-depth data about their practices. The main problem of being an outsider is that some participants assume that the researcher as an educationist already

understands all the aspects of their practices and the problems they face (Saidin and Yaacob 2016), which might discourage them from providing more information. In addition, as an outsider researcher, undertaking the interviews posed some challenges for the researcher in arranging meetings with the participants. The interviews were scheduled ahead of time including the place of interviews which was selected by the participants, but they kept changing the schedule, which made the data collection process more difficult. From this discussion, it is clear that there are both positive and negative aspects of being an insider and an outsider researcher. It could be concluded that I benefited from being an insider and outsider in terms of data collection, as I got in-depth data about their behaviours and practices that could not be as fully provided if I were just being an insider or an outsider. In this sense, the researcher was both an insider and an outsider simultaneously.

8.10 Recommendations for Practice, Education and Research

8.10.1 Implications for Practice

Infection control is an essential component of procedures for surgical team staff to prevent SSIs. This study has established that most surgical team staff are cognisant of infection control guidelines, but yet some nevertheless continue to ground their decisions and practices upon their prior clinical experience. Considering this observed obstinate behaviour and other findings, this study strongly proposes the following recommendations for practice:

- Auditing of specific areas in which a disjunction between clinical practice and guidelines has been identified by this study spanning across the whole of Oman; an action plan concerning how these gaps in adherence are to be addressed, including the creation of work-place champions, staff mentoring, training and education, and further audits to see whether practice has improved.
- The findings of this study also advocate that increasing levels of adherence to guidelines is essential, and thus it is recommended that surveillance and monitoring

programmes are established to evaluate infection control practices and improve perioperative activities.

- This study draws attention to the paucity of communication between doctors and nurses, and, henceforth, it is strongly urged that initiatives be implemented to enhance communication between surgeons and nurses inside OTs and improve the quality of care for surgical patients. These initiatives could take manifold forms, such as developing a surgical care team communication unit to bring surgeons and nurses together and increase opportunities for improved communication (Gordon et al. 2011). Further, open discussion among HCWs is to be encouraged, perhaps through implementing preoperative and postoperative team briefings, selecting a clinical champion, or via creating interdisciplinary committees or task forces that discuss clinical problem areas. Moreover, engendering an environment in which surgical team staff can openly and safely express their concerns in regularly scheduled meetings can also increase effective communication between HCWs.
- To embed reminders for HCWs inside OTs to help them to comply with recommended practices for preventing infection and avoiding occupational exposure to microorganisms. This could be achieved by developing better forms of sign-posting in practice that inform staff of where precisely guidelines and policies are located.
- Based on this study, recommendations are also proffered to decrease traffic flow in ORs. This requires implementing a range of strategies, including providing enough supplies and equipment to reduce the need to leave ORs, educating OR personnel and limiting the number of people allowed in the OR to only those directly involved in procedures. Finally, using video broadcast systems to monitor OR traffic has also been shown to decrease door openings (Panahi et al. 2012).

8.10.2 Recommendations for Education

Findings from both the quantitative and qualitative constituents of this research suggest that a lack of awareness and familiarity about guidelines was one of the predominant barriers to embedding EBP in surgical team staffs' clinical practice. Henceforth, HCWs should be trained and educated about these issues prior to working in surgical wards or OTs, allied with organising regular in-service education and on-job-training for surgical team staff about perioperative procedures for preventing SSIs and maintaining patient's safety.

8.10.3 Recommendations for Research

Although the importance of these measures is well documented in extant literature and current international and national recommendations, very few studies address actual implementation of EBP in ORs in Oman. Therefore, it is necessary to conduct further studies examining perioperative procedures and evaluating adherence to preventive measures for SSI, so as to gather richer insights into the perspectives and experiences of HCWs. Furthermore, whilst this study has identified several key barriers that are contributing to SSIs, there is an urgent need to assess other modifiable risk factors that contribute to SSIs which were only uncovered during the actual research process itself. For example, there were no details about cultural and spiritual practices and how these might operate as barriers to implementing guidelines. Consequently, further qualitative research is required to investigate these specific issues in greater detail. Finally, the data collected as part of this study derived only from two hospitals, and thus it would be instructive to expand the number of hospitals and obtain data from a larger sample in future research.

8.10.4 Dissemination Research Plan

I believe that the findings of this study are of especial relevance for all HCWs working in infection prevention and control, OTs and surgical wards, and, allied with the fact that this study is the first

of its kind in Oman, it is vital to disseminate my findings as soon as possible. As a first measure, I plan to arrange a meeting with the Director of Nursing at the MoH to discuss the findings and agree a strategic plan for training, education, review of guidelines, further auditing, etc. Next, I will meet with the Director General of education and training to discuss implementing a training programme for health professionals across all hospitals to address the findings of this study. It is appropriate practice to disseminate study findings to as broad a group of people as possible to justify the utilisation of the findings, and, hence, I will discuss the findings with senior doctors, nurses and managers in the two hospitals and with the ministry. These findings are important because the Government in Oman is currently considering how to reduce rates of infection. Given that there are no public health organisations in Oman to report to, I will organise workshops at which I can present my research to key stakeholders and explain to them the importance of this study, as well as informing them that this is the first study examining adherence to international and national recommendations for the prevention of SSIs in Oman. Furthermore, I will disseminate the results within the Oman Specialized Nursing Institute (OSNI) and organise workshops and seminars for staff in order to present the findings, which will raise extent levels of awareness about good practice for preventing SSIs. This study paper will be published in international and national journals, such as American Journal of Infection Control, Journal of Advanced Nursing and Sultan Qaboos University Medical Journal (SQUMJ). Published articles in academic and professional journals remains the most widely accepted method of dissemination for research (Gerrish and Lacey 2010). In addition, the results of the study will be disseminated in a report to the surgical team members in both hospitals involved in this study. Finally, I will also discuss areas for further research, including investigating the incidence and the risk factors for SSI and exploring the impact of religious and cultural practices upon compliance with infection control practices in OTs.

8.11 Chapter Conclusion

This concluding chapter has presented an overview of the entire thesis, as well as establishing that the aims and objectives of the study outlined in Chapter One were successfully achieved. In summary, the findings of this study are of crucial importance for the simple reason that this is the first piece of research which has examined adherence, as well as factors underpinning non-adherence, to guidelines for the prevention of SSIs in Oman. This study has demonstrated that a mixed-methods approach is an appropriate and expedient methodology through which to both empirically investigate adherence to current clinical guidelines, and identify the factors behind non-adherence to guidelines. Overall, the study reports a predominant trend of poor adherence to infection control guidelines, although it is important to note that the study provides new findings that can improve the quality of care provided and enhance surgical team staffs' ability to embed infection control recommendations in their practice. Moreover, the findings suggest that EBP in healthcare helps to provide quality patient care by utilising the best available valid scientific evidence (Fortney et al. 2014). However, some HCWs are striving to integrate it into their daily practice because of the organisational and individual related barriers to implementing EBP (Jordan et al. 2016).

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Appendices

Appendix 1: Summary of Studies Included in the Literature

No	Authors, date and country	Main aims	Study design	Sample	Key results	Conclusion/ comments
	Durando et al. (2012), Italy	<ul style="list-style-type: none"> * To describe existing preoperative and intraoperative procedures for preventing SSIs. * To evaluate adherence to international and national guidelines. 	<ul style="list-style-type: none"> * An observation prospective study in elective surgery. * One-month survey activities were performed by teams of infection control practices. * Data were collected by direct observation, reviewing of medical and nursing charts and interviews with surgical staff and patients in ORs and surgical wards. 	<p>A total of 717 elective interventions were actively monitored with respect to 703 patients who underwent surgery, representing 26.2% of the overall surgical activity (n=2.733).</p> <p>The sample included three different wound classes: class I (clean): 338 (54.1%), class II (clean-contaminated): 270 (37.7%), class III (contaminated): 39 (5.4%), and class IV (dirty): 20 (2.8%).</p> <p>The sample included different surgical areas: general surgery: 151(21.1%),</p>	<p>Form 1: Preoperative patient preparation:</p> <p>All patients had showers, either using common soap (87%), chlorhexidine solution (52.7%) or a trichlorophenol based solution (30.1%).</p> <p>Most of the patients (70%) had showered 8 hours before the operation.</p> <p>Hair removal was performed in 261 (34.4%) surgical operations, using razors in (92%) of cases, clippers in 6.1% of surgeries</p>	<p>Good adherence was reported to the following procedures:</p> <ul style="list-style-type: none"> * Timing of preoperative bathing. * Timing of antibiotic prophylaxis. * Preoperative skin antiseptic. <p>Low adherence was reported to the following procedures:</p> <ul style="list-style-type: none"> * Low adherence to antiseptic bathing.

				<p>orthopaedic surgery: 131(18.3%), ear, nose and throat surgery: 99(13.8%), obstetric and gynaecologic surgery: 89(12.4%), cardiac, vascular, and chest surgery: 63(8.8%), urology surgery: 62(8.6%), neurosurgery: 35(4.9%) and other: 87 (12.1%).</p>	<p>and depilatory cream in the remaining 1.9%.</p> <p>Preoperative hair removal performed with razors by nurses in the ward on the day before the operation.</p> <p>Antibiotic prophylaxis was given for 493 (68.8%) of the procedures.</p> <p>Adherence was reported for correct timing of antibiotics in 75.7% of cases, correct prophylaxis was given 70.3% of the time, and timing was earlier than recommended in 105 procedures (21.3%).</p> <p>Overall adherence to indication and type of drugs was judged appropriate in 35.5% of cases, as at least acceptable 44.8% of the time and inappropriate in 55.2% of cases.</p> <p>The common antibiotics used were B-lactam</p>	<p>* Low adherence to methods and timing of hair removal</p> <p>* Low adherence to indication and duration of antibiotic prophylaxis.</p> <p>* Low adherence to keeping the door open during surgical procedures and the number of people in the OR.</p> <p>Comments:</p> <p>* Data was collected using direct observation, review of medical records, nursing charts and interviews.</p> <p>* Factors affecting non-adherence were not investigated.</p>
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					<p>inhibitors, cefazolin in 33.3% of cases, third generation cephalosporin 27.8% of the time and quinolones in 1.4% of cases.</p> <p>Lack of adherence by the surgical staff to international guidelines, ranging from 20% and 50% depending on specific parameters investigated (choice, timing and duration).</p> <p>Form 2: intraoperative infection control and issues</p> <p>Appropriate skin preparation was done in 97.4% of procedures, using antiseptic agents in 75.1% of cases or chlorhexidine in 17% procedures.</p> <p>The doors of OR remained open for more than 50% of the duration of the surgery.</p> <p>Number of personnel present in the OR amounted</p>	
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					to 10 HCWs, with a mean number of 6 people.	
	Tadros et al. (2013), Canada	* This study examined the epidemiology of an outbreak of MRSA SSI after cardiovascular surgery, and analysed risk factors for MRSA SSIs.	* A retrospective case-control study	A total of 38 people had MSRA, whilst the control group comprised of 76 patients who did not develop a SSI.	<p>Form 1: Preoperative patient preparation:</p> <p>Preoperative antibiotics were administered in 6 (15.8%) cases compared to 9 (11.8%) in the control group.</p> <p>Chlorhexidine preoperative showering occurred in 35(92.1%) of cases compared to 68 (89.5%) cases in the control group.</p> <p>Hair removal was done in 31 (81.6%) cases compared to 53 (69.7%) in the control group.</p> <p>Form 2: intraoperative infection control and issues</p> <p>There was a failure to adhere to keeping the door open during surgical procedures, as well as the number of personnel present in the OR, which</p>	<p>Low adherence was reported in the following procedures:</p> <p>* Lack of adherence with infection control practices was identified in terms of hair removal, improper timing of antibiotic prophylaxes administration, hand hygiene, showering and traffic flow.</p> <p>* The outbreak of MRSA among staff members and patients in the setting stemmed from insufficient compliance with recommended perioperative infection control measures.</p>

					was higher than necessary for operations.	Comments: * This study was based on a small number of cases, which may have impaired the ability to detect significant risk factors. * This study was conducted in a single hospital.
	Castella et al. (2006), Italy	* To evaluate the application of SSI control procedures in general surgery departments in Italy.	The descriptive study entailed 1 week of observation in the general surgery departments, and 1 week of observation in the ORS of 49 hospitals in Piemonte.	A total of 856 patients were observed, 89% of surgical wounds were clean (class I) or clean-contaminated (class II), 133 were laparoscopic procedures, whilst 85 underwent multiple interventions.	Form 1: Preoperative patient preparation: A preoperative shower was provided for 78% of patients. 80% showered with soap and 20% with an antiseptic agent. Preoperative hair removal was conducted for 88% of the patients. 141 (16.4%) patients had hair removed with clippers, 554 (64.7%) with razors, whilst depilatory cream was used in 33 (8%) cases.	Good adherence was reported to the following procedures: * Timing of antibiotic administration * Wearing of appropriate surgical attire Low adherence was reported to the following procedures: * Low adherence to preoperative antiseptic showering

					<p>A total of 433 (60%) cases of hair removal were done the night before surgery, whilst 293 (40%) were conducted on day of surgery.</p> <p>Antibiotic prophylaxis was administered to 526 (63.6%) of the 827 patients, of which a total of 68.4% received the antibiotic at the proper time.</p> <p>Prophylaxis was continued for 24 hours in 104 (48%) operations and for longer than 24 hours in 114 operations.</p> <p>Overall adherence to antibiotic prophylaxis guidelines shows that the choice of antibiotic prophylaxis was appropriate in 56% of operations, acceptable in 27%, and inappropriate in 4.8% of cases.</p> <p>The most commonly used antibiotics were cefazolin</p>	<p>* low adherence to methods and timing of hair removal.</p> <p>* Low adherence to choice, indication and duration of agents.</p> <p>* Low adherence to keeping the door open during surgical procedures, and the number of personnel in the OR.</p> <p>* Wearing protective eye shield.</p> <p>* Wearing of Jewellery inside OTs.</p> <p>Comments:</p> <p>* This study entailed a 1-week observation in surgical wards and 1 week in OTs.</p> <p>* A survey was used to collect the data.</p>
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					<p>(23%), amoxicillin-clavulanic acid (17%) and ampicillin-sulbactam (16%).</p> <p>Form 2: intraoperative infection control and issues</p> <p>During the operation, doors were opened an average of 12 times, and in 3% of operations doors were opened on more than 50 occasions.</p> <p>The number of personnel in the OR during the operation was 6.</p> <p>About 88% of the surgical team members wore a cap/hood and mask correctly so that it fully covered the nose and mouth.</p> <p>About 25% of surgeons and 41% of instrument nurses wore eye shields.</p> <p>Preoperative hand and forearm scrub technique</p>	
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					<p>was deemed correct in 78% of cases.</p> <p>Hand hygiene was performed by 95% of persons present in the OR and hand scrubbing was done by 99.7% of personnel in the OR.</p> <p>A surgical gown was worn by 98% of personnel present in the OR, whilst 1 person wore a t-shirt inside the OR.</p> <p>Jewellery was worn by 11.6% of surgeons, 22.1 of nurses, 56.1 of anaesthesiologists and 45% of other personnel in the OR.</p>	
	Pan et al. (2009), Italy	* To assess the adherence of SSI guidelines in Italian Cardiac surgery units.	A self-administrated questionnaire sent to 24 surgical units which perform 20% of all cardiac	<p>17 of the 24 participating centre's (71%) answered the questionnaire.</p> <p>The questionnaire was sent to whoever oversaw the project at each centre, which was either an</p>	<p>Form 1: Preoperative patient preparation:</p> <p>Hair removal was done in accordance to guidelines, as 41% of cases had hair removed by clippers.</p>	<p>Good adherence was reported to the following procedures:</p> <p>* Adherence to avoiding the wearing of Jewellery.</p>

			surgical procedures in Italy.	infectious diseases doctor or a cardiac surgeon.	<p>Timing of hair removal was in accordance with guidelines in 29% of cases.</p> <p>Administration of antibiotic prophylaxis at proper time (65%).</p> <p>Total number of patients admitted at proper time before surgery amounted to 12%.</p> <p>Form 2: intraoperative infection control and issues</p> <p>Applying preoperative antiseptic skin preparation was appropriate in 41% of cases</p> <p>Adherence to avoiding wearing Jewellery during surgeries was 100%.</p> <p>Limiting the number of personnel inside OR (82%).</p> <p>Wearing of shoe covers (29%).</p>	<p>* Adherence to number of personnel inside OR.</p> <p>Low adherence was reported to the following procedures:</p> <p>* Low adherence was reported to preoperative hair removal</p> <p>* Low adherence was reported for antibiotic prophylaxis administration</p> <p>* Low adherence was reported for preoperative length of hospital stay</p> <p>* Low adherence was reported for skin cleaning technique (In concentric circles).</p> <p>* Low adherence was reported for wearing of shoe covers</p>
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					<p>Special cleaning after contaminated-dirty operations was performed in 12% of cases.</p> <p>Factors affecting non-adherence to guidelines were not investigated.</p> <p>Adherence to hair removal with clipper was reported for 41% of cases, with the appropriate timing of removal being performed in 29% of cases.</p> <p>Length of preoperative hospital stay (12%).</p> <p>Use of sterile technique (94%).</p> <p>Limited number of personnel in the OR (82%).</p>	<p>* Low adherence was reported for disinfecting the OT environment</p> <p>Comments:</p> <p>* Data was collected using Self-administrated questionnaires, which may overestimate adherence to some practices.</p> <p>* 17 of the 24 participating units answered the questionnaire.</p> <p>* Factors affecting non-adherence to guidelines were not investigated.</p>
	Penalver-Mompean et al. (2012), Spain	* Describe existing pre-surgical preparation standards or protocols in a regional public hospital network. Assess existing protocols, consider their	An observational, cross-sectional and descriptive study.	The study comprised of 7 public hospitals in Spain.	<p>Form 1: Preoperative patient preparation:</p> <p>Showering or bathing with antiseptic agents was provided in 3/7 hospitals.</p>	<p>Good adherence was reported to the following procedures:</p>

		formal quality, and the quality of their content with respect to published scientific guidelines.			<p>Hair removal was done before surgery in 1/7 hospitals, with 1/7 hospitals using razors.</p> <p>Compliance with antibiotic prophylaxis administration was observed in all seven hospitals.</p> <p>Form 2: intraoperative infection control and issues</p> <p>Use of an appropriate antiseptic agent for skin preparation was observed in 5/7 hospitals.</p> <p>Compliance with cleaning around the incision site was observed in 1/7 hospitals.</p> <p>Compliance with antiseptic technique was observed in 5/7 hospitals.</p> <p>Removing of Jewellery was observed in all seven hospitals.</p>	<p>* Antibiotic prophylaxis administration</p> <p>* Use of an appropriate antiseptic agent for skin preparation</p> <p>* Preoperative hair removal</p> <p>* Removing of Jewellery</p> <p>Low adherence was reported to the following procedures:</p> <p>* Preoperative bathing</p> <p>* Skin preparation technique</p>
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	Demir (2009), Turkey	The purpose of the study was to describe the current infection control practices for SSIs, and compare these practices with current EBP guidelines.	A prospective, cross-sectional descriptive survey was conducted.	<p>The sample involved all 24 OTs in 11 public hospitals located in the Izmir province, Turkey.</p> <p>Data was collected via face-to-face interviews with charge nurses in 24 OTs in the 11 hospitals.</p>	<p>Form 1: Preoperative patient preparation:</p> <p>Adherence with preoperative hair removal was reported in 23 (95.5%) cases.</p> <p>Adherence with preoperative showering was reported in 2 (8.4%) cases.</p> <p>Removal of wearing of Jewellery was reported in 37.5% of cases.</p> <p>Form 2: intraoperative infection control and issues</p> <p>Adherence to skin preparation cleaning with povidone iodine in 75% of cases and savlon (chlorhexidine) in the remaining 25% of cases.</p> <p>Cleaning OT with wet mop (58.4%).</p> <p>Cleaning with disinfectant agent (25%).</p>	<p>Good adherence was reported to the following procedures:</p> <ul style="list-style-type: none"> * Preoperative skin preparation * Wearing of surgical attire * Wearing gloves for scrubbing * Use of surgical gowns and drapes <p>Low adherence was reported to the following procedures:</p> <ul style="list-style-type: none"> * Low adherence was occurred in hair removal. * Low adherence was occurred in preoperative showering
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					<p>Wearing of surgical attire (100%).</p> <p>Not wearing shoe covers for the prevention of SSI (16.7%).</p> <p>Wearing gloves for scrubbing (100%).</p> <p>Use of surgical gowns and drapes (100%).</p>	<p>* Low adherence was occurred in removal of wearing of Jewellery</p> <p>* Low adherence was occurred in cleaning of OT environment</p> <p>Comments:</p> <p>* The study focused on those overseeing the units, which means there might be potential for information bias.</p> <p>* The survey was not assessed for content validity</p>
	Davis et al. (2008), Canada	* The purpose of the study was to determine local surgeons' methods of SSI prevention, compare their practices to recommendations, and examine whether certain demographic	A cross-sectional survey	<p>A total of 589 surgeons were recruited in this study, but only 247 returned the questionnaires, thus representing a 42% response rate.</p> <p>The surgeons were working in different specialisms,</p>	<p>Form 1: Preoperative patient preparation:</p> <p>Of a total of 230 surgeons, preoperative bathing was recommended by 52 (23%) of them. Of those recommending bathing to their patients, junior</p>	<p>Good adherence was reported to the following procedures:</p> <p>* Preoperative skin preparation technique and use of antiseptic agents.</p>

		factors influenced their practices.		<p>including general surgeons, orthopaedic surgeons, vascular and cardiac surgeons, cardiothoracic surgeons, gynaecologic surgeons and plastic surgeons.</p>	<p>surgeons (73%) were found to be more likely than senior surgeons to recommend bathing with chlorhexidine.</p> <p>Overall, 83% of the 196 surgeons who responded to the questionnaire removed hair in the OR, using clippers in 63% of cases and razors in the remaining 32% of cases.</p> <p>All surgeons surveyed used appropriate antiseptic for skin preparation, such as chlorhexidine, povidone-iodine or an alcohol based solution.</p> <p>69% of surgeons reported following appropriate skin preparation technique.</p> <p>There were some discrepancies about when antibiotic prophylaxis was administered. For example, gynaecological surgeons were significantly less likely</p>	<p>Low adherence was reported to the following procedures:</p> <ul style="list-style-type: none"> * Preoperative hair removal * Antibiotic prophylaxis administration <p>Comments:</p> <ul style="list-style-type: none"> * Most of the surgeons surveyed were not in compliance with the recommendations of evidence-based guidelines for SSI prevention. * Data were collected by survey, which may make it susceptible to recall bias.
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					(45%) than general surgeons (69%) to administer antibiotic prophylaxis at the appropriate induction time.	
	Mater (2014), Jordan	* The purpose of this study was to determine the attitudes and practices of surgeons towards the control of SSIs, in relation to the CDC's guidelines on SSIs.	<p>The first method for collecting data was a cross-sectional survey.</p> <p>The second method of data collection involved semi-structured interviews with two cardiac surgeons working in public hospitals and three hospital infection control directors, two of which worked in the private sector and one in the public sector.</p>	<p>75 Surveys were sent to surgeons and surgical residents at five hospitals, made up of three public hospitals, one military hospital and one private hospital in Jordan.</p> <p>The survey was sent to surgeons of various specialisms.</p>	<p>Form 1: Preoperative patient preparation:</p> <p>Preoperative bathing with an antiseptic was recommended in only 47.1% of cases.</p> <p>About 29.8% of surgeons removed patients' hair in the OR, with clippers used in 57.1% of cases, whilst 42.9% stated that razors were used.</p> <p>According to the 57 surgeons who responded, 87.7% stated that they use antibiotic prophylaxis routinely in surgery. 40.4% of surgeons rated their adherence to antibiotic prophylaxes as very good, 38.6% believed their adherence was excellent,</p>	<p>Good adherence was reported to the following procedures:</p> <ul style="list-style-type: none"> * None <p>Low adherence was reported to the following procedures:</p> <ul style="list-style-type: none"> * Preoperative antiseptic bathing * Methods and timing of hair removal * Administration of antibiotic prophylaxis <p>Comments:</p> <ul style="list-style-type: none"> * The data were collected using surveys and semi-structured interviews.

					<p>whilst 19.3% believed their adherence was good or average.</p> <p>Majority of surgeons (96.5%) believed that they can improve their practice on antibiotic administration.</p> <p>In analysing the data regarding surgeons' ratings about how well they follow infection control protocol, it was found that a majority of respondents indicated that they follow protocol either excellently or very good.</p> <p>Factors affecting non-adherence</p> <p>Negligence and lack of education and training.</p> <p>Organisational factors (i.e. place factor).</p> <p>Reluctance of surgeons to update their practices.</p>	<p>* Out of the 75 surveys distributed at five hospitals, only 57 surveys were received completed.</p> <p>* Factors affecting non-adherence were presented in this study.</p>
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					<p>Lack of supervision on the administration of antibiotic prophylaxis.</p> <p>Lack of guidelines for antibiotic prophylaxis.</p> <p>Mistakes about sterilisation in the central sterile services department.</p> <p>No written infection control guidelines and drawing upon old experiences and training.</p> <p>Lack of resources.</p>	
	Oliveira and Gama (2015), Brazil	* Evaluate pre- and intraoperative practices adopted by medical and nursing teams for the prevention of SSI.	A prospective observational study conducted in a surgical unit of a large public teaching hospital	18 surgical procedures were observed.	<p>Form 1: Preoperative patient preparation:</p> <p>Preoperative bathing was provided for 15 (83.3%) patients. 11 (73.3%) bathed in the hospital and 4 (26.7%) at home.</p> <p>Bathing with antiseptic was carried out on only one (6.7%) occasion.</p>	<p>Good adherence was reported to the following procedures:</p> <p>* Timing of hair removal</p> <p>* Choice and timing of antibiotic prophylaxis</p> <p>* Use of protective gear like caps/hoods that cover hair and ears, wearing masks</p>

					<p>Hair removal was performed on 27.7% of patients in the OR, using blades in 80% of the cases and clippers in the other 20% of cases.</p> <p>Hair removal was done in 60 minutes of surgery for all patients.</p> <p>Antibiotic prophylaxis was administered to all patients by the surgical team at least 60 minutes before the incision in 78.6% (11) of cases, more than 60 minutes before incision in 7.1%(1) of cases, and more than 30 minutes after the incision in 14.3%(2)of cases.</p> <p>Of the 14 patients who received antibiotics, 6 (42.9%) received another dose during surgery.</p> <p>The timing of administration was about 180 minutes</p>	<p>which were properly positioned, and using surgical gloves.</p> <p>Low adherence was reported to the following procedures:</p> <ul style="list-style-type: none"> * Bathing with antiseptic agents * Methods of hair removal * Duration of antibiotic prophylaxis * Keeping the door closed during surgical procedures * Number of personnel were higher than required for surgery. * Use of protective gear like goggles and shoe covers.
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					<p>after the first incision in 5 (83.3%) cases.</p> <p>The antibiotic of choice in 90.9% of cases was cefazolin.</p> <p>Form 2: intraoperative infection control and issues</p> <p>The doors remained open during the entire duration of surgical procedures in 16 (88.9%) cases, and remained open in one (5.6%) surgery for 90% of the duration.</p> <p>An average of 9 personnel were present during surgery, and the surgery room door remained open in 94.4% of the operations (ranging from 5-15).</p> <p>Regarding surgical attire:</p> <p>14.3% of staff observed staff wore goggles, 58.6% used shoe covers and other rubber shoes, 5 (7.2%) wore their caps properly covering</p>	<p>Comments:</p> <p>* It is suggested that training and professional skills development is introduced.</p> <p>* Monitor infection control practices to improve the quality of care.</p>
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					<p>their hair and ears, 100% of staff wore gowns, 97.1% used the mask properly covered mouth and nose, whilst 100% used surgical gloves.</p> <p>Failures occurred in hair removal due to the use of blades, which is not recommended practice, keeping the door open during surgeries, and in relation to the number of personnel in the OR, which was higher than necessary for the procedures.</p> <p>Factors affecting non-adherence to guidelines:</p> <p>Negligence and lack of knowledge</p> <p>Lack of awareness</p>	
	Christoforo and Carvalho (2008), Brazil	* The study aimed to examine the nursing care provided as part of preparing patients for elective surgeries in the	This is a descriptive, cross-sectional, qualitative study, which was conducted in the	The study population consisted of 129 patients, selected according to a convenience sample.	<p>Form 1: Preoperative patient preparation:</p> <p>About 61% of the patients were admitted on the same day of surgery, with 31%</p>	Good adherence was reported to the following procedures:

		immediate preoperative period.	<p>surgical units of two hospitals in the city of Ponta Grossa.</p> <p>Data collection was carried out via structured interviews.</p>		<p>admitted one day before incision.</p> <p>Hair removal was done in 34% of cases, 28% of whom were shaved in the hospital and 32% shaved at home, using razors in 39% of cases and blades in 59% of cases.</p> <p>It was also verified that shaving was carried out 2 hours and 10 hours before incision.</p> <p>The authors observed a lack of adherence to bathing, because 41% of surgical patients were not bathed.</p> <p>Antiseptic bathing is recommended at least one night before surgery, but its efficacy has not been scientifically proven.</p> <p>Factors affecting nonadherence to guideline;</p> <p>Feelings of the patient</p>	<p>* Preoperative hospital stay</p> <p>Low adherence was reported to the following procedures:</p> <p>* Method and timing of hair removal</p> <p>* Bathing with antiseptic agents</p>
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					Lack of orientation	
	Diana et al. (2010),	* The study was designed to evaluate surgeons' strategies and adherence to preventive measures for SSIs.	* Swiss multi-centric surveillance programme for SSIs, involved a questionnaire developed from the NICE (2008) UK clinical guidelines on prevention and treatment of SSIs.	<p>50 surgeons were selected for active surveillance, 16 of the 50 surgeons working in university hospitals, whilst the remaining 34 worked in 10 different secondary care hospitals.</p> <p>Overall, 45 of the 50 contacted surgeons (90.5%) answered the questionnaire.</p>	<p>Adherence to antiseptic showering was reported in 62 (68%) cases.</p> <p>Adherence to hair removal practices (did not perform routine hair removal) was reported for 2 (17%) of the cases.</p> <p>Adherence to timing of hair removal was reported in 85 (94%) cases (in OR).</p> <p>Adherence to methods of hair removal were reported in 89 (91%) of cases (with clippers)</p> <p>Adherence to keep movement to a minimum was reported in 75% of cases.</p> <p>Adherence to antibiotic prophylaxis indication was reported in 94% of cases.</p>	<p>Comments:</p> <p>* All surgeons participating in a prospective multicentre surveillance</p> <p>* The present study provides evidence that perioperative surgical care varies widely among surgeons.</p>

					<p>Adherence to antibiotic timing was reported in 62 (92%) of cases.</p> <p>Postoperative antibiotics were administered in 13% of contaminated cases.</p> <p>Adherence to repeated doses after 3 hours of incision was reported in 66% of cases.</p> <p>Adherence to skin disinfection using povidone-iodine or chlorhexidine was reported in 60% of cases.</p> <p>Adherence to surgical drapes was reported in 100% of cases.</p> <p>Adherence to wound dressing was applied in 57 (79%) of cases</p> <p>Adherence to sterile technique was reported in 55% of cases.</p> <p>Dressing changes were performed after simple</p>	
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					hand disinfection by 87% of the surgeons and under sterile conditions by 55% of the surgeons.	
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Appendix 2: The Databases Searched, Terms Used, the Number of Hits Generated and Limitations Applied

Research questions	<p>* What is the level of adherence of healthcare workers to international and national guidelines for preventing SSI in elective surgery in surgical wards and OTs in Oman?</p> <p>* What are the factors determining the uptake and utilisation of SSI prevention guidelines in elective surgery in Oman?</p>			
Databases	Search Terms EARCH	Limits	Number of Hits	Articles Included After Screening
AMLED	<p>Adherence* OR compliance* OR obedience*non-adherence* AND recommendations*OR protocols*OR guidelines* AND antibiotic prophylaxis* OR antimicrobial prophylaxis* OR preoperative skin preparation* OR skin antisepsis* AND hair removal* OR shaving* AND preoperative shower* OR preoperative bathing* AND length of hospital stay* AND traffic in operating theatre* AND surgical site infection* OR surgical wound infections* OR postoperative wound infection*</p>	<p>English language</p> <p>Peer review</p> <p>Publications (2001-2016)</p>	9.434 under topic	No articles were found

	AND nosocomial infection* OR healthcare associated infections* AND preventive measures *AND contributing risk factors* OR barriers*.			
AMBASE 1947-PRESENT	Adherence OR compliance OR obedience OR non-compliance OR non-adherence AND recommendations OR protocol OR guidelines AND antibiotic prophylaxis OR preoperative antimicrobial prophylaxis OR preoperative skin preparation OR hair removal OR shaving OR shower OR length of hospital stay OR surgeon skill OR traffic in operating theatre AND surgical site infection OR nosocomial infection OR wound infection OR healthcare associated infections	English language Peer review Publications (2001-2016)	272 under topic	1 relevant article found
OVID	Nurse* AND adherence AND recommendations OR guidelines AND wound sepsis OR Surgical site infection OR wound infection OR Barriers to non-adherence to guidelines	English language	199 under topic	No articles were found
ScienceDirect	Adherence* OR compliance* AND recommendations* OR guidelines* AND surgical site infection* OR postoperative wound infection* OR surgery infection* AND perioperative practices*	English language	1.129 under topic	12 relevant articles found

British Nursing Index (BNI)	Adherence* OR compliance* AND recommendations* OR guidelines* AND surgical site infection* OR postoperative wound infection* OR surgery infection* AND perioperative practices*	English language	2.479 under topic	3 relevant articles found
CINHAL	Adherence* OR compliance* OR obedience*non-adherence* AND recommendations*OR protocols*OR guidelines* AND antibiotic prophylaxis* OR antimicrobial prophylaxis* OR preoperative skin preparation* OR skin antisepsis* AND hair removal* OR shaving* AND preoperative shower* OR preoperative bathing* AND length of hospital stay* AND traffic in operating theatre* AND surgical site infection* OR surgical wound infections* OR postoperative wound infection* AND nosocomial infection* OR healthcare associated infections* AND preventive measures *AND contributing risk factors* OR barriers*.	English language Publications (2001-2016)	3.599 under topic	No articles were found
Medline/PubMed	Adherence* OR compliance* OR protocols* AND recommendations* OR guidelines* AND surgical site infection* AND infection control practices* AND surveillance*	English language	26 under topic	7 relevant articles found
Google Scholar	Adherence* OR compliance* AND recommendations* OR guidelines* AND surgical	English language	1.550 under topic	Search found same 7 relevant articles and 4

	site infections OR postoperative wound infections			additional articles by Mater (2014); Diana et al (2015); Oliveira & Gama (2015) and 1 qualitative study by Cristoforo & Carvalho (2009).
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Appendix 3: Literature Review Inclusion and Exclusion Criteria

Inclusion Criteria:	Exclusion Criteria:
<ul style="list-style-type: none">▪ All empirical studies in English language▪ Primary research on elective surgeries▪ Directly relevant to the topic▪ Studies published between 2001 to 2016▪ Studies focus on contributing factors to SSIs	<ul style="list-style-type: none">• Studies more than 15 years old• Articles not in the English language• Studies focusing only on other health acquired infections and not directly related to surgical site infections• Studies conducted on paediatric population• Studies including emergency surgeries• All studies focused on emergency surgeries or certain surgical procedures, such as ear, nose and throat, eye and vaginal surgeries.

Appendix 4: Overall Electronic Search Results for Literature

No	Electronic Database	Overall Electronic Search Results
1	British Nursing Index (BNI)	2,479
2	AMLED	8,334
3	Cumulative Index of Nursing and Allied Health Literature (CINAHL)	3,172
4	EMBASE	272
5	Google Scholar	1,550
6	OVID	199
7	Science Direct	1.129

Appendix 5: Centres for Disease Control and Prevention (2011) and Gulf Cooperation Council- Centre for Infection Control (2013) Guidelines Framework for the Study

Preoperative infection control procedures	Recommendations
Length of hospital stay	International and national guidelines: Keep preoperative hospital stay as short as possible while allowing for adequate preoperative preparation of the patient
Skin preparation at incision area	International and national guidelines: Wash and clean skin around the incision area using an approved skin preparation
Hair removal	International and national guidelines: If necessary, hair removal should be removed immediately before the operation (clippers are preferable methods).
Showering and bathing	International and national guidelines: Showering with antiseptic skin cleaners should be implemented on at least night before surgery.
Antibiotic prophylaxis	International and national guidelines: Administer only when indicated.
Timing of antibiotic prophylaxis	International and national guidelines: Administer in one hour of surgical incision. This time is considered optimal for tissue and serum perfusion.
Choice of antibiotic prophylaxis	International and national guidelines: Select appropriate antibiotic prophylaxis based on the type of surgery and published guidelines.
Duration of antibiotic prophylaxis	International and national guidelines: Stop antibiotic prophylaxis in 24 hours after the surgical incision.
Intraoperative Infection Control Procedures	
Doors opening during surgery in the OR.	International and national guidelines: OR doors should be kept closed except as needed for passage of equipment, personnel or the patient to reduce the microbial level in the air.
Number of OR personnel during surgery.	International and national guidelines: Number of extraneous people (those not contributing to the procedures, e.g. visitors, students, porters and other health care workers).
Wearing of Jewellery	International and national guidelines: Jewellery should be removed because bacteria are present on the skin beneath in higher numbers than on skin not covered CDC (2013) (Category II).

Wearing of Surgical Attire	<p>International and national guidelines:</p> <p>Adherence with surgical attire protocols means:</p> <p>(1) Wear a surgical mask that fully covers the mouth and nose when entering the OR(Category IB).</p> <p>(2) Wear a cap or hood to fully cover hair on the head and face when entering the OR(Category IB).</p> <p>(3) Use surgical gowns in OR(Category IB).</p> <p>(4) Wear sterile gloves if a scrubbed surgical team member (Category IB),</p> <p>(5) Put on gloves after donning a sterile gown and wearing sterile gloves before any aseptic procedures (Category IB).</p>
Surgical Procedures Drapes	<p>International and national guidelines: The sterile draping should be used to cover patient and surrounding areas with sterile cloths to maintain a sterile field during operations (CDC 2011) (Category IB).</p>
Cleaning and disinfection of environmental surfaces	<p>International and national guidelines: Do not perform special cleaning or closing of ORs after contaminated or dirty operations (Category IB).</p> <p>International and national guidelines: No recommendation on disinfecting environmental surfaces or equipment used in ORs between operations in the absence of visible soiling.</p>

Appendix 6: Data Collection Tool: Observation Checklist (Perioperative Procedures)

Complete one form for each surgical procedure using this observational checklist

Section I: General Data:						
Patient study ID Label			Age			
Gender	Male	Female				
	1	2	Operation Name as posted			
	<input type="checkbox"/>	<input type="checkbox"/>				
Date of Admission	<input type="text"/>		Time	<input type="text"/>		
Date of Surgery	<input type="text"/>		Hospital	A	B	
				1	2	
				<input type="checkbox"/>	<input type="checkbox"/>	
Time of Incision			End of surgery	<input type="text"/>		
Type of Surgery	1.	General surgery <input type="checkbox"/>				
	2.	Orthopaedic <input type="checkbox"/>				
	3.	Neurosurgery <input type="checkbox"/>				
	4.	Plastic Surgery <input type="checkbox"/>				
	5.	Others <input type="checkbox"/>				
Type of Wound	1.	Clean <input type="checkbox"/>				
	2.	Clean-Contaminated <input type="checkbox"/>				
	3.	Contaminated <input type="checkbox"/>				

Section I: Preoperative Length of Hospital Stay

Focus areas	Codes	Performance measures	Criteria to assess adherence and compliance with current practices in Oman and compared with international guidelines							
Preoperative length of hospital stay	CO-1	A	Day of admission	How long did the patient stay in the hospital before operation?						
				1	On the day of surgery	<input type="checkbox"/>	3	2 days before surgery	<input type="checkbox"/>	
				2	1 day before surgery	<input type="checkbox"/>	4	3 days before surgery	<input type="checkbox"/>	
		B	Duration of preoperative hospital stay			5	More than 3 days before surgery		<input type="checkbox"/>	
				1	Less than 24 hours	<input type="checkbox"/>	2	About 24 hours	<input type="checkbox"/>	3
		Preoperative length of hospital stay		Criteria to assess adherence and compliance with current practices in Oman and compared with international guidelines						
		Patient should be kept as short as possible before surgical procedure		Keep hospital stay as short as possible					Appropriate (1)	<input type="checkbox"/>
				Preoperative hospital stay < 1 day as a reference category because for most bacterial nosocomial infections, the infection usually becomes evident after 48 hours (WHO 2002).					Inappropriate (0)	<input type="checkbox"/>
Comments										

Section II-A: Preoperative Shower or Bathing

Focus areas	Codes	Performance measures	Criteria to assess adherence and compliance with current practices in Oman and compared with international guidelines			
Preoperative patient showering or bathing	CO-2	Patient had shower or bath at least one night before operation	Require patients to shower or bath with an antiseptic agent on at least the night before the operative day	YES (1)	<input type="checkbox"/>	
				NO (0)	<input type="checkbox"/>	
		Detergent used for bathing or showering	1. A chlorhexidine		<input type="checkbox"/>	
			2. Soap and water		<input type="checkbox"/>	
			3. Povidone iodine		<input type="checkbox"/>	
			4. Others specify		<input type="checkbox"/>	
		Showering or bathing, using either a chlorhexidine based solution or a common detergent	Based solution is preferable	Adhèrent (1)	<input type="checkbox"/>	
				Non-Adhèrent (0)	<input type="checkbox"/>	
Comments						

Section II-B: Preoperative Hair Removal

Focus areas	Codes	Performance measures	Criteria to assess adherence and compliance with current practices in Oman and compared with international guidelines									
Preoperative hair removal/ Methods of hair removal	CO-3	No removal of hair at the operative site unless necessary	Has the patient had preoperative shaving of the surgical site incision before surgery?					Yes (1)	<input type="checkbox"/>	No (0)	<input type="checkbox"/>	
		What method used for hair removal?	If necessary, then which hair removal method used?									
			1	Clipper	<input type="checkbox"/>	3	Depilation cream	<input type="checkbox"/>				
			2	Razor	<input type="checkbox"/>							
		If necessary, use of hair clipping rather than shaving with razor	If necessary hair removal should be done immediately before the operation. Preferable: Electronic clippers					1	Adherent	<input type="checkbox"/>		
								2	Non-Adherent	<input type="checkbox"/>		
		Where is the hair removal done?	1	Hospital	1. Surgical wards	<input type="checkbox"/>	2	Home	<input type="checkbox"/>	1	Adherent	<input type="checkbox"/>
2. OTs	<input type="checkbox"/>				2	Non-Adherent				<input type="checkbox"/>		
Comments												

Section Three: Preoperative Skin Preparation at Incision Area

Focus areas	Codes	Performance measures	Criteria to assess adherence and compliance with current practices in Oman and compared with international guidelines							
Preoperative Skin preparation	CO-4	Preoperative antiseptic agent for skin preparation	Is preoperative skin preparation done before surgery?				Yes (1)	<input type="checkbox"/>	No (0)	<input type="checkbox"/>
		Antiseptic agents used for skin preparation	If Yes, which antiseptic agent used for antiseptic?							
			1	Chlorhexidine gluconate	<input type="checkbox"/>	3	Other agents	<input type="checkbox"/>		
			2	Povidone iodine	<input type="checkbox"/>		If any Specify	Spirit alcohol solution		
		Use appropriate antiseptic agent for skin preparation	Select the most appropriate perioperative skin antiseptic agent				Adherent (1)		<input type="checkbox"/>	
						Non-Adherent (0)		<input type="checkbox"/>		
Comments										




Section Four: Preoperative Antibiotic Prophylaxis

Focus areas	Codes	Performance measures	Criteria to assess adherence and compliance with current practices in Oman and compared with international guidelines								
Preoperative antibiotic prophylaxis	CO-5	Antibiotic prophylaxis	Has the patient received antibiotic prophylaxis for elective surgical procedures?	No (0)		<input type="checkbox"/>		Yes (1)		<input type="checkbox"/>	
		Compliance with antibiotic choice	Appropriate antibiotic prophylaxis choice according to international or national (local) prophylaxis guidelines	Non-Adherent (0)		<input type="checkbox"/>		Adherent (1)		<input type="checkbox"/>	
		Compliance with antibiotic timing	Appropriate timing, in one hour of surgery to achieve tissue concentration.	Non-Adherent (0)		<input type="checkbox"/>		Adherent (1)		<input type="checkbox"/>	
		Compliance with duration	Followed by timely discontinuation of antibiotic in 24 hours after surgical wound closure.	Non-Adherent (0)		<input type="checkbox"/>		Adherent (1)		<input type="checkbox"/>	
			Time between 1 st dose and incision	1	2	3	4	1	1 hr. before incision		
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2	in 1 hr. of incision		
								3	more than 1 hr. before incision		
				4	Unknown						
Additional Doses			1. Yes: <input type="checkbox"/>								

						2. No: <input type="checkbox"/>		
Antibiotic agent is used		Types of antibiotic prophylaxis based on national guidelines used in Oman	1.	Ceftriaxone	<input type="checkbox"/>	12.	Clindamycin	<input type="checkbox"/>
			2.	Cefazolin	<input type="checkbox"/>	13.	Vancomycin	<input type="checkbox"/>
			3.	Cefuroxime	<input type="checkbox"/>	14.	Metronidazole	<input type="checkbox"/>
			4.	Cefotaxime	<input type="checkbox"/>	15.	Ceftazidime	<input type="checkbox"/>
			5.	Amoxicillin + Clavulanic acid	<input type="checkbox"/>	16.	Gentamicin	<input type="checkbox"/>
			6.	Meropenem and imipenem	<input type="checkbox"/>	17.	Teicoplanin	<input type="checkbox"/>
			7.	Amikacin	<input type="checkbox"/>	18.	Aminoglycoside (gentamicin)	<input type="checkbox"/>
			8.	Cloxacillin	<input type="checkbox"/>	19.	Trimethoprim	<input type="checkbox"/>
			9.	Sulfamethoxazole	<input type="checkbox"/>	20.	Quinolone like ciprofloxacin	<input type="checkbox"/>
			10.	Penicillin	<input type="checkbox"/>	21.	Others	<input type="checkbox"/>
				11.	Ampicillin	<input type="checkbox"/>		
Comments								

Section Five: Intraoperative Phase:

5.1 Doors of Operating theatre

Duration of operation (The time between skin incision and skin closure (Leong et al 2006).										
Focus areas	Codes	Performance measures	Criteria to assess adherence and compliance with current practices in Oman and compared with international guidelines							
The doors opened in the OR	OT 1	The doors opened in the OR	A	Are doors opened during surgical procedures?		Yes (1)	<input type="checkbox"/>	No (0)	<input type="checkbox"/>	
		The doors should be kept shut unless it is necessary to be opened for shifting patients or equipment	B	If Yes, how long are the doors opened during surgery?				Minutes		
			C	How many times are doors opened during operation?				Times		
			D	What are the reasons for doors opening during the surgical procedures?						
			1	Paperwork	<input type="checkbox"/>	6	sample collection	<input type="checkbox"/>		
			2	Communication	<input type="checkbox"/>	7	Others specify	<input type="checkbox"/>		
			3	Equipment supply	<input type="checkbox"/>	8	Unknown reasons	<input type="checkbox"/>		
		4	X-ray or other investigation	<input type="checkbox"/>						
5	Patients	<input type="checkbox"/>								

Comments	
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5.2 Number of Personnel in the OR during surgery

Focus areas	Codes	Performance measures	Criteria to assess adherence and compliance with current practices in Oman and compared with international guidelines			
Number of personnel in ORs	OT-2	Number of extraneous people (those not contributing to the procedures e.g. visitors, students and porters)	The number of OR personnel should be limited (there is no specific ratio). Number of extraneous people (those not contributing to the procedures e.g. visitors, students, porters and other healthcare workers).	OT Personnel		
				1	Scrub nurse	
				2	Circulator nurse	
				3	Anaesthesiologist	
				4	nurse anaesthetist	
				5	Surgeons	
				6	Surgical resident	
				7	Other	
		Process measures	Criteria to assess adherence to current practices in Oman compared with international guidelines	Appropriate (1)	Inappropriate (0)	
			<input type="checkbox"/>	<input type="checkbox"/>		
	Number of OR personnel	The number of OR personnel should be limited (there is no specific ratio). Number of extraneous people (those not contributing to the procedures e.g. visitors, students, porters and other healthcare workers).				
Comments						

Observer	Name: Salim Al Ismaili	Signature: Salim
<ul style="list-style-type: none"> Adherence to guidelines will be evaluated with 1 or 0 point respectively for performing or not performing each of the following items: antibiotic prophylaxis, preoperative shaving, preoperative skin preparation and doors opened during surgery. Adherence to guidelines will be evaluated with 1 or on 0 point respectively for adherence and non-adherence to each of the following items: antibiotic prophylaxis, preoperative shaving, preoperative skin preparation and preoperative showering or bathing. Adherence to guidelines will be evaluated with 1 or 0 point respectively for appropriate and inappropriate behaviour with respect to each of the following items: preoperative length of hospital stay and number of personnel in OTs. Presence of an indicator is given a score from 0-1 (0= non-adherent, 1= adherent). Presence of an indicator is given a score from 0-1 (0= inappropriate, 1= appropriate). <p>Abbreviations:</p> <p>CO-1: Compliance with preoperative length of hospital stay</p> <p>CO-2: Compliance with preoperative shower or bathing</p> <p>Co-3: Compliance with hair removal and method of hair removal</p> <p>CO-4: Compliance with skin preparation</p> <p>CO-5: Compliance with antibiotic choice, timing, discontinuation of prophylaxis antibiotics and types of antibiotic agents used in Oman</p> <p>OT-1: Monitoring door openings in the OR (The observer will record the time of incision and doors openings until closure of the incision site).</p> <p>The following data will be included:</p> <ul style="list-style-type: none"> - Duration of procedure - Total number of doors opening during procedures - Reasons for door openings - Stage in surgery at which the door opening occurred (During surgery) <p>OT-2-: Number of OR personnel in the room during surgical procedures.</p>		

The following data will be included:

- Personal type entering and leaving the OT.
- Total number of surgical team staff and other HCWs that present in OR during surgery.

Appendix 7: Proforma for Data Extraction from Electronic Patient Records System in the Hospital

Patient ID:

hospital A		Hospital B	
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Type of surgery:

Date of review:

Reviewer:

Medical charts review:	Adherence to perioperative recommendations for the prevention of SSIs			
	Preoperative application in routine surgical practices	Yes	No	Comments
1.	Length of hospital stay on the same day of surgery			
2.	Skin preparation (pre-incision preparation) Using: a. Chlorhexidine gluconate b. Povidone iodine c. Spirit swabs d. Others			
3.	Hair removal Using: a. Electric clippers b. Avoid razors c. Others			
4.	Showering and bathing Using: a. Chlorhexidine based solution b. Soap and water c. Others			
5.	Approved antibiotic prophylaxis - Penicillin, amoxicillin, ampicillin - Cloxacillin - Aminoglycoside (gentamicin)			

	<ul style="list-style-type: none"> - Sulfamethoxazole/trimethoprim - Fusidic acid - Cephalosporin/cephalexin, cefuroxime/ceftriaxone, cefotaxime and ceftazidime). - Quinolone like ciprofloxacin - Amoxicillin and clavulanate - Antipseudomonal Piperacillin - Meropenem and imipenem - Clindamycin - Vancomycin - Metronidazole - Teicoplanin - Others 			
5.A	Appropriate or inappropriate choice of antibiotic prophylaxis based on national guidelines			
5.B	Appropriate or inappropriate timing of antibiotic (30 minutes before surgery) prophylaxis based on national guidelines			
5.C	Appropriate or inappropriate duration of antibiotic therapy (Stop antibiotic prophylaxis in 24 hours after the surgical incision) prophylaxis based on national guidelines			
Comments:				

Appendix 8: Data Collection Guide: Observational Fieldwork Schedule

The observational fieldwork schedule is based on guidelines developed by LeCompte and Preissle (1993) which have adapted for use in the present study.

Set of guidelines for direct observations:

Where does the clinical practice take place?

Who is involved in the wards?

How many people are there? What are their characteristics?

How do participants come to be members of groups/event?

What are the various statuses and roles of those involved?

What events are taking place?

How long does the event take place?

What resources are being used in the interaction?

How are the issues being described, explained, organised and justified?

How do the participants behave towards each other?

What rules govern the social organisation of both surgical wards and ORs?

Who is talking, who is listening?

How are change and stability managed?

Why is this event occurring and occurring in the way that it is?

Who is making what decisions, for whom and why?

What is being said in relation to the decision-making?

What appear to be the most significant issues being carried out?

What are the people trying to achieve?

What meanings are participants attributing to what is happening?

What examples of non-verbal communication can be seen?

What are the outcomes?

Appendix 9: Data Collection Schedule: Interview Guide for Healthcare Professionals

Form 2: An Interview Guide for Healthcare Professionals

Section A

Name of hospital:.....

Interview length: 20-30 minutes

Code for interviewee:.....

Name of interviewer:.....

Date:

Time:

Do you agree to this interview being tape-recorded?

.....
.....
.....

Please sign the informed consent form.

.....
.....
.....

Could you tell me about your role in the surgical ward?

.....
.....
.....

Thank you for being willing to take part in an interview for this study. I can assure you that you will remain anonymous and no records of the interview will be kept with your name on them. I would like to ask you for permission to audio record this interview. If you do not have any further questions, I would like to briefly introduce you again to the main subject of this interview.

Section B

Questions number	Topic	Content
1.A	An awareness and familiarity with the guidelines	<p>1. A. Do you know any SSI prevention guidelines that exist regarding preoperative and intraoperative infection control practices in elective surgery?</p> <p>1. Yes</p> <p>2. No</p> <p>3. Not sure</p>
		<p>.....</p>
		<p>* If your answer is no or not sure, please move to question number (6)</p>
		<p>* If your answer is yes, then please move to question number (1.B)</p>
1.B		<p>1. B. please can you describe the perioperative standards and recommended practices for the prevention of SSIs in elective surgery?</p>
		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

		2. Partially agree () 3. Disagree () 4. Not sure ()
	
3.A	Compliance with guidelines	Q3. A. Do you use the SSI prevention guidelines in your routine daily clinical practices? 1. always () 2. sometimes () 3. Never ()
	
3.B		Q3. B. If yes, which recommendations do you follow in your routine surgical practices for prevention of SSIs in elective surgery?
	

5.	Practical Skills: effectiveness of evidence-based guidelines	Q5. How effective are guidelines in preventing SSI?
		<div></div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div>
6.	Clinical experiences	Q6. Are there any practice guides to follow in your department?
		<div></div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div>

		<p>Probes: Are antibiotic prophylaxis used routinely?</p> <p>(1) Yes ()</p> <p>(2) No ()</p>
		<p>Q9. B. How often would you estimate Healthcare workers actually administer antibiotic prophylaxis at the appropriate time?</p>
		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
		<p>Q9. C. When should you administer prophylaxis antibiotics to surgical patients?</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

		<p>Probes: If yes, on average, how long should antibiotic prophylaxis be maintained after the incision in the OR is closed?</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>Probes: How well do you believe you follow protocols for antibiotic prophylaxis?</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>Probes: Do you believe your levels of adherence to protocols regarding antibiotic prophylaxis can be improved?</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
--	--	--

		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
		<p>Q9. D. In which surgical procedures are antibiotic prophylaxis given?</p>
		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
		<p>Q9. E. Which surgical procedures routinely do not require antibiotic prophylaxis?</p>
		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

10.	Opinion about factors affecting non-adherence to guidelines	Q10. In your opinion, which factors affect non-adherence to national recommendations for the prevention of the SSI in elective surgery?
		<div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div>
11.	Experiences about the major barriers to implementation	Q11. In your experience, what are the major barriers preventing your hospital from implementing the guidelines for reducing SSIs?
		<div></div> <div></div> <div></div> <div></div>

		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
12.	Practical skills: preoperative skin preparation	<p>Q12. As you know, preoperative skin preparation is essential, so what are the most effective strategies for preparing the patient's skin prior to surgery to reduce the risk of SSI?</p>
		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>Probes: Do you require patients to bathe with an antiseptic before surgery?</p> <p>(1) Yes ().</p> <p>(2) No ().</p>

13	Practical skills: best method of hair removal	Q13. If hair removal is needed, which is the best method of preoperative hair removal?
		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
14	Practical skills: the best time for hair removal	Q14. If hair removal is necessary, when is the best time for preoperative hair removal?
		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>Probes: Should removal of patient's hair be done in the OR?</p> <p>(1) Yes ().</p> <p>(2) No ().</p>
15	Practical skills: traffic flow in OT	Q15. To what extent do you think that doors opening during surgery may increase the incidence of SSI?
		<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

16. A	Practical skills: intraoperative infection control practices and SSIs.	Q16. A. Is there a relationship between intraoperative infection control practices and SSIs? 1. Yes () 2. No () 3. Not sure ()
	
16. B		Q16. B. If yes, could you tell me in detail what is the nature of the relationship?
	

Respondent's Signature: **Date:**.....

Interviewer's signature: **Date:**.....

**“Thank you for your participation. Once again, if you are interested I can provide you
with a copy of the research findings once they are released”**

Appendix 10: Factors Affecting Non-adherence to the Guidelines

Figure 1: possible barriers to adhering to guidelines recommendations in clinical practice.

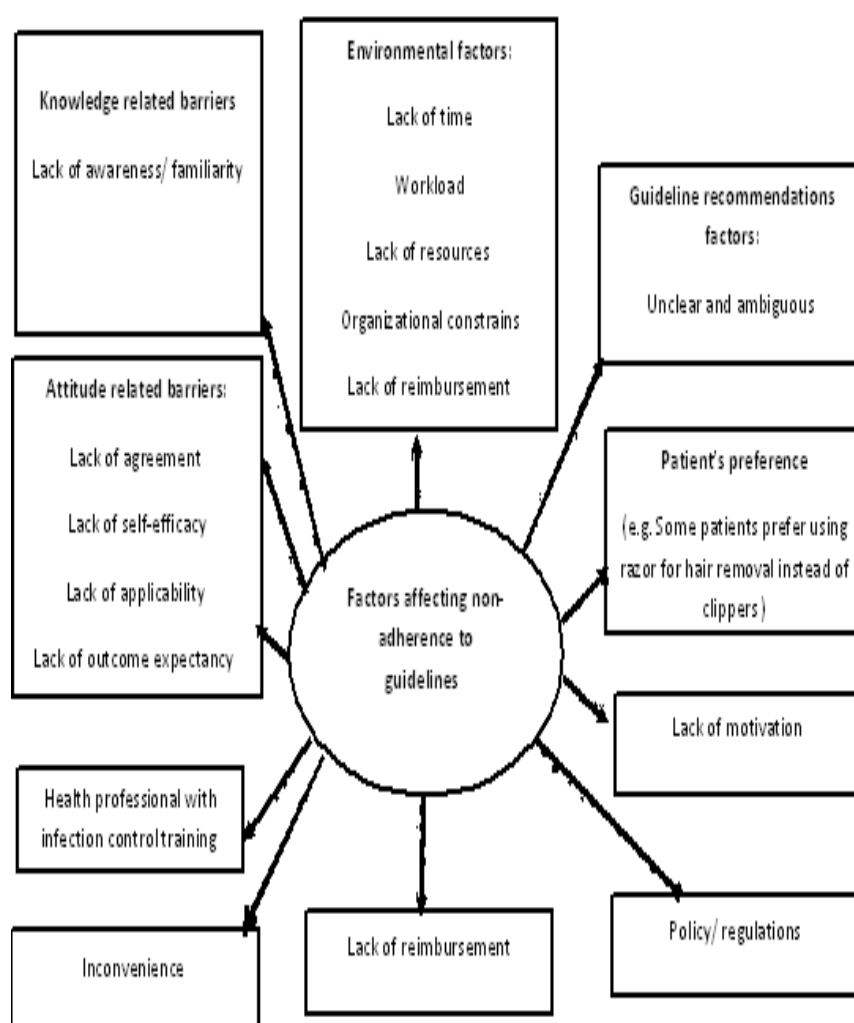


Figure 1: conceptual model: factors influence non-adherence to infection control guidelines according to the framework of (Caban et al 1999; Zoutman et al 1999 & Tan et al 2006).

Appendix 11: The School's Research Review and Ethics Screening Committee (RRESC)



Appendix 12: School of Research Ethics Committee (HCARE) REC at Cardiff University



Appendix 13: Research and Ethical Review and Approval Committee (RERAC) for the Ministry of Health (MOH), Oman

Sultanate of Oman
Ministry of Health
Directorate General of Planning
and Studies



سلطنة عُمان
وزارة الصحة
المركزية العامة للتخطيط
والدراسات

Ref. : MH/DGP/R&S/PROPOSAL_ APPROVED/12/2015

Date. : 23.02.2015

الرقم :
التاريخ :
الموافق :

Salim Khamis Al Ismaili
Principal Investigator

Study Title: "Adherence to international and national recommendations for the prevention of surgical site infection in elective surgery in Oman: Mixed Methods Study "

After compliments

We are pleased to inform you that your research proposal "Adherence to international and national recommendations for the prevention of surgical site infection in elective surgery in Oman: Mixed Methods Study" has been approved by Research and Ethical Review and Approve Committee, Ministry of Health.

Regards,

أحمد محمد القاسمي

Dr. Ahmed Mohamed Al Qasmi
Director General of Planning and Studies
Chairman, Research and Ethical Review and Approve Committee
Ministry of Health, Sultanate of Oman.



Cc
Day file

Appendix 14: Formal Request for Permission to Conduct Research in Hospitals

To:

Dr Ali Bin Mahad AL Mashani. Director General

Mr. Khaled Basha, Superintendent of Nursing & Midwifery

Dr. Salim Bin Moosa Al Abri, Executive Director

Mr. Ahmed Bin Said Al Hadrami, Head of Nursing Department

From:

Salim Khamis Al Ismaili, PhD student at Cardiff University

Date: 17/12/2014

Subject: Request for permission to conduct research and get access to hospitals to collect data for the study

My name is Salim Khamis Zahran Al Ismaili; I am a PhD student at Cardiff University in the United Kingdom. The research I wish to carry out as part of my PhD thesis is entitled: "Evaluating Adherence to International and National Recommendations for the Prevention of Surgical Site Infections in Elective Surgery in Oman". I have a scholarship from the ministry of health in Oman and the course lasts for the duration of four years starting on October 1 2013 and ending on September 30 2017. The research project aims to determine adherence to international and national recommendations for the prevention of surgical site infections in elective surgery in Oman. The project will be conducted under the supervision of Cardiff University and my two supervisors, Professor Dinah Gould and Professor. Dianne Watkins.

I am hereby seeking approval to conduct the research in your respectful hospitals, starting March 2014 and September 2015. I will provide you with a copy of my research protocol, which includes copies of consent forms, enclosed information sheets, and a copy of approval letter from Cardiff University. After completion of the study, I commit to providing both hospitals with a copy of the full research report. If you require any further information, please contact me at any time during the working day at (00968) 99444061 or +447541980590 by email, AllsmailiSK@Cardiff.ac.uk or skz4321@gmail.com

Thank you for your help and continued support in this matter,

Yours sincerely,

Salim Al Ismaili

Cardiff University

Appendix 15: Participant Information Sheet for Healthcare Professionals

Invitation Letter

(For all healthcare professionals)

Research area: Adherence to International and National Recommendations for the Prevention of Surgical Site Infection in Elective Surgery in Oman

You have been invited to take part in a study that aims to describe current preoperative and intraoperative procedures for preventing surgical site infection (hereafter abbreviated as SSI) in surgical wards and operating theatres, and evaluate staff adherence to SSI prevention guidelines. Additionally, the study will investigate factors affecting non-adherence to guidelines in elective surgery in two Governorate hospitals in Oman. An information sheet is enclosed with this letter. You are invited to participate in this research study because you are one of the multidisciplinary team caring for patients undergoing elective surgery. Please take your time to go through the written information to decide whether to take part in the study or not.

I am Salim Khamis Zahran Al Ismaili, a senior tutor in the Oman Specialised nursing institute (hereafter abbreviated as OSNI) in Muscat, Oman. I am currently enrolled on the PhD course of Nursing Philosophy at Cardiff University in Wales (hereafter abbreviated as UK), and am in the process of conducting data for my study. Before you decide whether to take part, you need to understand why the research is being done and what it would involve for you. Please take sufficient time to read all the information provided. If you would like to discuss any aspect of this research in greater detail or if you have any queries, then please feel free to call the researcher (Salim Al Ismaili) on 0096899444061 or contact me via email at (AlismailiSK@cf.ac.uk) or (skz4321@gmail.com).

This project is a part of my PhD study, which is supervised by Professor Dinah Gould and Dr Dianne Watkins of the School of Healthcare Sciences, Cardiff University, Wales, UK.

Yours Sincerely,

Salim Al Ismaili

What is the purpose of the study?

The study's principle aims are to describe existing preoperative and intraoperative procedures aimed at preventing SSI, and to evaluate the application of preoperative and intraoperative procedures recommended for the prevention of SSI in surgical wards as well as operating theatres. Additionally, it will investigate the factors affecting non-adherence and assess the perceived barriers to the use of SSI guideline recommendations in two tertiary hospitals in Oman.

Why have you been invited?

You have been invited because you are one of the multidisciplinary team (surgeon or a charge nurse or staff nurse) who provide perioperative care for patients undergoing elective surgery as well as those who have perioperative surgical experiences. If you agree to be a part of this study, the researcher will be watching elective surgeries during routine clinical practices in relation to preoperative patient preparation and the monitoring of traffic flow in the operating theatre without taking part. The researcher would like to monitor 250 to 315 elective surgical procedures to assess adherence to recommendations, in addition to conducting 30 structured interviews to investigate the factors affecting non-adherence to SSSI guideline and identify the barriers to successful implementation.

Do I have to take part?

Your participation in this study is voluntary. Your decision as to whether or not to participate will not affect your current or future relationship with us. If you initially decide to participate, you are still free to withdraw at any time later without any reason, even if you have already given your consent. If you are agreeing to take part, the researcher will then ask you to sign a consent form.

What will happen to me if I take part?

If you agree to participate in this study, during direct observations, the researcher will monitor a total of 250 to 315 elective surgeries in two tertiary hospitals in Oman. The researcher will be watching elective surgery during routine clinical practices with an eye on preoperative patient preparation and monitoring the traffic flow in the operating theatre without taking part. Along with being observed, you may be invited to participate in a structured interview. 30 structured interviews will be conducted in two tertiary hospitals in Oman. The interviews will be clearly

explained to you before beginning the interviewing process. The interview questions have been developed and reviewed by three experts in the field.

What will I have to do?

In the study, 250 to 315 surgical procedures will be monitored during preoperative and intraoperative procedures in the surgical ward as well as Operating rooms. As one of the healthcare professionals, you will be invited to participate in the study. 30 structured interviews will be conducted with a multidisciplinary team including surgeons (n=10), operating theatre staff (n=10) and surgical ward nurses (n=10) in two tertiary hospitals. You will be interviewed and asked specific questions about implementation of SSI prevention guidelines. You will be asked structured questions along with a few open-ended questions developed for this purpose. You will be called to schedule a convenient time for the interviews that is suitable for you and which prevents interruption to patient care. The participants will be recruited from surgical wards as well as operating theatres. The interviews will last between 30 to 40 minutes and are voluntary. If you decide not to take part in this interview, it will not affect you in any way. Completing this interview is entirely your choice and your answers are anonymous, which means that no one can link your name with your answers and the answers will not be shared with anybody else in the hospital. The privacy of all participants will be protected, including information, setting and dissemination. You have the right to ask questions at any time, since you are agreeing to take part in the study.

What are the risks of taking part in this study?

No risks to individuals are expected. However, any potential physical and psychological harm that may occur during the duration of the study will be recorded and subsequently reported to the heads of surgical wards and operating theatres to take immediate action to maintain patient's safety. Any risk, unsafe practice and discomfort that are observed or described will be outlined and reported to the heads of surgical wards and operating theatres.

What are the possible benefits of taking part?

There are no direct benefits for you as an individual participant, however the findings of this study will help to improve your knowledge and awareness of the international and national recommendations for the prevention of SSIs, and provide you with an opportunity to improve your infection control practices in line with recommendations for the prevention of SSI. The findings will also help in the process of reviewing preoperative and intraoperative procedures, and improving of standards and procedures on infection prevention. Most importantly, this

study may improve your compliance with recommendations and provide guidelines to maintain patient safety.

What if there is a problem?

Any complaints about the way you have been approached or treated during the study will be addressed. If you have a concern or any problem with any aspect of the study, you can contact Professor Dinah Gould and Professor Dianne Watkins at the School of Healthcare Sciences, Cardiff University, Wales, UK. Email: GouldD@cardiff.ac.uk or watkinssd@cf.ac.uk. Tel: +44 (0)2920917804 or (0)29 20687776.

What will happen if I don't want to continue and wish to withdraw from the study?

Your participation is voluntary and you are thus free to withdraw at any time without providing a reason, even if you have already given your consent. Your decision as to whether to participate in this study will not affect your current or future relationship with the organisation. If you initially decide to participate, you are still free to withdraw at a later time without any penalty. If you would like the researcher to destroy any previous records and documentations, please contact me at any time and I will destroy them immediately.

Will participation in this study be kept confidential?

Yes. The study will follow strict ethical and legal guidelines, which means that all information about your participation will be handled and kept confidential. All data will be kept under lock and key and will only be accessible to the researcher conducting the study. Electronic files will be saved and password protected. The record of this study will be kept private and all information collected will be entered into an electronic database. The information will be safely stored and the data collected will not be shared with anybody else in the study. The researcher is the only person who has access to the identifiable data along with authorised persons, including supervisors, who are checking that the study is being carried out correctly. All information in this study is confidential and no participant's identity will be linked to the information provided, and their names will never be used when reporting the results. The anonymity of the participations will be guaranteed by a coding system. Electronic data and paper documentations will be securely stored in the School of health care Sciences at Cardiff University until completing the holding period and then will be destroyed. Data collected during the study will be stored for 15 years after the completion of the study. The researcher will ensure that personal data is kept secure at all times and the researcher will avoid disclosing identifiable information. All information which is collected during the course of the research will be kept

strictly confidential, and any information about you which leaves the hospital/surgery will have your name and address removed so that you cannot be recognised. There are no limitations which potential participants need to know about, because the information sheet includes appropriate high-quality information. Potential participants need information on which they can base their decision to take part or not. Therefore, the researcher will provide information before seeking consent.

What will happen with the results of the research study?

The results of this study may be submitted for publication in journals for nursing professionals in Oman and may be presented at conferences. If you would like, a summary of the results can be sent to you after completion of the study.

Who is organised and funding the research?

The study is being organised by the School of Healthcare Sciences, Cardiff University. This study will be conducted by the researcher (Salim Al Ismaili) and supervised by Professor Dinah Gould and Professor Dianne Watkins of the School of Healthcare Sciences, Cardiff University, Wales, UK. This study is funded by the Ministry of Health in Oman.

Who has reviewed the study?

The study has been reviewed by the Research Review and Ethics Screening Committee (RESSC), and by the School Research Ethics Committee (SREC) at Cardiff University, Wales, UK. It will also be reviewed and approved by the Research and Ethical Review & Approval Committee [RERAC] at the ministry of health (MOH) in Oman.

Contact for further information:

Please feel free to contact me at any time to discuss any part of this study.

Researcher: Salim Khamis Al Ismaili

Oman contact information:

Sultanate of Oman

P.O.BOX 1401

Postal code: 611

Mobile: 006899444061

Email: skz4321@gmail.com or AlIsmailiSK@cardiff.ac.uk

UK contact information:

Cardiff University, Cardiff, Cardiff, CF 10 3XQ, EASTGATE house, CF 24 0AB, UK

Mobile number: +44754198590

Email: ALIsmailiSK@cardiff.ac.uk or skz4321@gmail.com

Appendix 16: Information Sheet for Patients [English version]

Invitation Letter

(For all patients)

Research area: Adherence to international and national recommendations for the prevention of surgical site infection in elective surgery in Oman.

You have been invited to take part in a study that aims to describe current preoperative and intraoperative procedures for preventing surgical site infection (hereafter abbreviated as SSI) in surgical wards and operating theatres, and to evaluate adherence to SSI prevention guidelines. Additionally, the study will investigate factors affecting non-adherence to the guidelines during elective surgeries in two tertiary hospitals in Oman. An information sheet is enclosed with this letter. You are invited to participate in this research study because you are one of the patients who is undergoing elective surgery and receiving perioperative care. Please take your time to go through the written information to decide whether or not to take part in this study.

I am Salim Khamis Zahran Al Ismaili, a senior tutor in the Oman Specialised nursing institute ((hereafter abbreviated as OSNI) in Muscat, Oman. I am currently enrolled in the PhD course of Nursing Philosophy at Cardiff University in Wales, UK and am currently in the process of conducting my study and collecting data. Before you decide whether to take part, you need to understand why the research is being done and what it would involve for you. Please take sufficient time to read all the provided information, and if you have any further questions or if something is unclear, then please call the researcher (Salim Al Ismaili) on 0096899444061 or via email to (AlismailiSK@cf.ac.uk) or (skz4321@gmail.com).

This project is a part of my PhD studies, which is supervised by Professor Dinah Gould and Professor Dianne Watkins of the School of Healthcare Sciences, Cardiff University, Wales, UK.

Yours Sincerely,

Salim Al Ismaili

What is the purpose of the study?

The study's principle aims are to describe existing preoperative and intraoperative procedures aimed at preventing SSI, and to evaluate the application of preoperative and intraoperative procedures recommended for the prevention of SSI in surgical wards and operating theatres. Additionally, it will investigate the factors affecting non-adherence to the implementation of SSI guideline in two tertiary hospitals in Oman.

Why have I been invited?

You are one of the patients who are undergoing elective surgery and receiving perioperative care. Ideally, all patients undergoing elective surgery and receiving perioperative care in two tertiary hospitals will be involved in the study. If you decide to give permission for the researcher to access your medical records, we will ask you to sign a consent form indicating your willingness to participate in the study. Your health care will not be affected by your decision as to whether or not to participate in the study.

Do I have to take part in the study?

Your participation in this study is entirely voluntary. Your decision as to whether or not to participate will not prejudice you or affect your current or future medical care. If you initially decide to participate, you are still free to withdraw at a later time without any explanation, even if you have already given your consent. If you are agreeing to take part, the researcher will then ask you to sign a consent form.

What will happen to me if I take part?

As part of this study, you may be asked to verify some procedures like preoperative showering and shaving. If you agree to participate in this study, through direct observations the researcher will monitor routine clinical practices during elective surgeries to assess the adherence of healthcare professionals with six main practices, including length of preoperative hospital stay, preoperative skin preparation, preoperative showering, hair removal, antibiotic prophylaxis, and traffic flow in operating theatres. The researcher will also ask your permission to gain access to your medical charts to record the administration of antibiotic prophylaxis. The data and transcription will be verified by the researcher and the coding system will be used via NVivo software. The results will not be matched with the identity of the research participants. In addition, electronic data and paper documentation will be securely stored in the School of health care Sciences (SOHCS) at Cardiff University until completion of the holding period after which it will be destroyed.

What will I have to do?

As part of the study, you will not be asked to do anything, but you may be asked to verify some procedures like preoperative showering and shaving. I will monitor 250 to 315 elective surgeries in two tertiary hospitals in Oman during preoperative and intraoperative procedures. Moreover, if you agree to participate in this study, the researcher will request your consent to access your medical and nursing charts to collect some information concerning antibiotic prophylaxis administration.

What are the risks of taking part in this study?

No risks to individuals are expected. However, any potential physical and psychological harm occurring during the study will be recorded and then reported to the heads of surgical wards and operating theatres to take immediate action to maintain patient's safety. Any risk, unsafe practice and discomfort that are observed or described will be outlined and reported to the heads of surgical wards and operating theatres.

What are the possible benefits of taking part?

You will not directly benefit from taking part in the study, however there is a general benefit in the sense of improving future care for patients undergoing elective surgical procedures and reducing the contraction of SSIs.

What if there is a problem?

Any complaints about the way you have been dealt with during the study will be addressed. If you have a concern or any problem about any aspect of the study, you can contact Professor Dinah Gould and Dr Dianne Watkins of the School of Healthcare Sciences, Cardiff University, Wales, UK. Email: GouldD@cardiff.ac.uk or watkinssd@cf.ac.uk. Tel: +44 (0)2920917804 or [\(0\)29 20687776](tel:02920687776).

What will happen if I don't want to continue and wish to withdraw from the study?

Your participation is entirely voluntary and you are free to withdraw at any time without explanation, even if you have already given your consent. Your decision as to whether or not to participate will not affect your current or future medical care. If you initially decide to participate, you are still free to withdraw at any later time without any penalty. If you would like any previous records and documentation to be destroyed, please contact the researcher at any time and I will destroy them immediately.

Will participation in this study be kept confidential?

Yes. The study will follow strict ethical and legal guidelines, which means that all information about you will be handled in confidence. Records from this study will be kept private and all information collected will be entered into an electronic database. The information will be safely stored and the collected data will not be shared with anyone else in the study. The researcher will be the only person who has access to identifiable data along with authorised personnel such as my supervisors who will monitor that the study is being carried out correctly. The findings of the study will be published and disseminated without including any identifiable information about you. The research data will be kept in a locked file and only the researcher will have access to the records. Your confidentiality as a participant in this study will remain protected. All information in this study is confidential and no participant's identity will be linked to the information provided and their names will never be used when reporting the results. The anonymity of the participants will be guaranteed by a coding system. Electronic data and paper documentation will be securely stored in the School of health care Sciences (SOHCS) at Cardiff University until completion of the holding period after which they will be destroyed. Data collected during the study will be stored for 15 years after the completion of the research project.

There are no circumstances in which confidentiality will be broken because data will be protected using a coding system and the data will be secured and protected by a key which nobody else will have access to. The researcher will ensure that all personal data is kept secure at all times, and the researcher will also avoid disclosing identifiable information. All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves the hospital/surgery will have your name and address removed so that you cannot be recognised. There are no limitations which potential participants need to know about the study, because the information sheet includes appropriately high-quality information. Potential participants need information upon which they can base their choice. Therefore, the researcher will provide information before seeking consent.

What will happen with the results of the research study?

The results of this study may be submitted for publication in journals for nursing professionals in Oman and may be presented at conferences. If you would like, a summary of the results can be sent to you upon completion of the study.

Who is organising and funding the research?

The study is being organised by the School of Healthcare Sciences, Cardiff University. This study will be conducted by the researcher (Salim Al Ismaili) under the supervision of Professor Dinah Gould and Professor Dianne Watkins of the School of Healthcare Sciences, Cardiff University, Wales, UK. This study is funded by the Ministry of Health in Oman.

Who has reviewed the study?

The study has been reviewed by the Research Review and Ethics Screening Committee (RESSC), and by the School Research Ethics Committee (SREC) at Cardiff University, Wales, UK. It will also be reviewed and approved by the Research and Ethical Review & Approval Committee [RERAC] at the ministry of health (MOH) in Oman.

Contact for further information:

Please feel free to contact me at any time to discuss any aspect of this study.

Researcher: Salim Khamis Al Ismaili

Oman contact information:

Sultanate of Oman

P.O.BOX 1401

Postal Code: 611

Mobile: 006899444061

Email: skz4321@gmail.com or AlIsmailiSK@cardiff.ac.uk

UK contact information:

Cardiff University, Cardiff, Cardiff, CF 10 3XQ, EASTGATE house, CF 24 0AB, UK

Mobile number: +44754198590 Email: AlIsmailiSK@cardiff.ac.uk or skz4321@gmail.com

Appendix 17: Information Sheet for Patients [Arabic version]

{ رسالة دعوة للمرضى }

{ التقيد بالتوصيات والبروتوكول الدولية والوطنية للوقاية من الإصابة بالموقع الجراحي في الجراحة الاختيارية في سلطنة عمان }

اسم الباحث: سالم بن خميس بن زهران الإسماعيلي

لقد تم دعوتك للمشاركة في دراسة التي تهدف إلى وصف الإجراءات ما قبل واثناء العمليات الجراحية، لمنع ومكافحة العدوى ما قبل الجراحة في قسم الجراحة وغرف العمليات الجراحية ولتقييم مدى الالتزام مقدي الخدمات الصحية بالبروتوكول الوطني والدولي لمنع ومكافحة العدوى ما بعد العمليات الاختيارية. بالإضافة إلى ذلك، التحقيق من العوامل التي تؤثر على عدم التقيد والالتزام بالبروتوكولات ودراسة وتحديد العوائق المحتملة أمام الالتزام بالبروتوكول في العمليات الجراحية الاختيارية في اثنين من المستشفيات إحالة إقليميين في عمان. ومرفق طيه ورقة المعلومات مع هذه الرسالة. أنت مدعو للمشاركة في هذه الدراسة البحثية لأنك احد المرضى الذين يخضعون للجراحة الاختيارية وتلقي الرعاية قبل واثناء الجراحة. من فضلك اطلب منك قراءة المعلومات البحث وفهم محتواه قبل اتخاذ اي قرار.

أنا سالم خميس زهران الإسماعيلي وأنا محاضر في " معهد عمان للتمريض التخصصي" في مسقط، سلطنة عمان، وحاليا مسجل كطالب دكتوراه في فلسفة التمريض في جامعة كاردف في ويلز (المملكة المتحدة) وأنا الآن في عملية إجراء دراستي وجمع البيانات. قبل أن تقرر ما إذا كان تود المشاركة ام لا، تحتاج إلى فهم الهدف من عمل هذا البحث، وما هو الجزء الخاص بك في البحث. يرجى أخذ الوقت الكافي لقراءة جميع المعلومات ولا تتردد إذا كنت ترغب في مناقشة أي جانب من جوانب هذا البحث في أي وقت. إذا كان لديك أي أسئلة أو استفسارات، يرجى الاتصال الباحث (سالم الإسماعيلي) على رقم 0096899444061 أو عبر البريد الإلكتروني (AlismailiSK@cf.ac.uk) أو (skz4321@gmail.com) إذا لم يكن هناك أي شيء غير واضح .

هذا المشروع هو جزء من دراستي الدكتوراه، التي يشرف عليها البروفيسور جولد دينه والدكتور ديان واتكينز من مدرسة علوم الرعاية الصحية، جامعة كاردف، ويلز بالمملكة المتحدة.

لك خالص الامنتنان

سالم الإسماعيلي

ما هو الهدف الدراسة؟

هذه الدراسة تهدف إلى وصف الإجراءات ما قبل واثناء العمليات الجراحية الاختيارية لمنع ومكافحة العدوى ما قبل الجراحة في قسم الجراحة وغرف العمليات الجراحية وتهدف الي تقييم مدى الالتزام مقدمي الخدمات الصحية بالبروتوكول قبل واثناء العمليات الجراحية الاختيارية للوقاية من العدوى ما بعد العمليات الاختيارية. بالإضافة إلى ذلك، التحقيق من العوامل التي تؤثر على عدم التقيد والالتزام بالبروتوكولات ودراسة وتحديد العوائق المحتملة أمام الالتزام بالبروتوكول في العمليات الجراحية الاختيارية في اثنين من المستشفيات إحالة إقليميين في عمان. بالإضافة إلى ذلك، سيتم التحقق من العوامل المؤثرة على عدم الالتزام وتقييم المعوقات المتوقعة من الالتزام بالتوصيات من استخدام والعمل بالبروتوكول لمنع ومكافحة العدوى في اثنين من المستشفيات الإحالة في عمان .لماذا أنا دعيت؟

كل المرضى الذين يخضعون للجراحة الاختيارية في اثنين من المستشفيات الإحالة الإقليميين سوف يدعون للمشاركة في هذا البحث. في هذا البحث انت مطالب للسماح للباحث الوصول إلى البيانات الطبية والتمريضية الخاصة بك. إذا قررت إعطاء الإذن للباحث للوصول إلى السجلات الطبية الخاصة بك، سوف نطلب منك التوقيع على استمارة موافقة التي تشير إلى استعدادكم للمشاركة في الدراسة. لن تتأثر الرعاية الصحية الخاص بك قبل اتخاذ قرار بالمشاركة في الدراسة من عدمه .

هل من الضرورة للمشاركة في الدراسة؟

يمكنك المشاركة في هذه الدراسة طوعا. لك القرار للمشاركة في الدراسة او عدمه وعدم مشاركتك لن يؤثر على الرعاية الصحية الخاصة بك في المستقبل. إذا وافقت وأردت المشاركة منذ البداية، فأنت لك الاختيار للانسحاب في أي وقت لاحقاً بدون ذكر أي سبب حتى لو كنت تم بالفعل الحصول على موافقتك. إذا كنت توافق على أن تشارك سوف يقوم الباحث بطلب منك التوقيع على استمارة موافقة.

ماذا سيحدث لي إذا كنت جزء من الدراسة؟

في هذا الدراسة لن تشارك بصورة مباشرة ولكن قد يتم سؤالك بالتحقق من بعض الإجراءات والممارسات مثل الاستحمام والحلاقة ما قبل الجراحة وذلك لتأكد من العمل بها. إذا كنت توافق على المشاركة في هذه الدراسة، من خلال الدراسة الرصدية المباشرة، سوف يراقب الباحث الجراحة الاختيارية خلال الممارسات السريرية الروتينية المتعلقة بإعداد المريض قبل الجراحة، ورصد الحركة وعدد الاشخاص المتواجدين في غرف العمليات الجراحية دون أي عمل مباشر من الباحث. وسيقيم الباحث رصد المتخصصين في الرعاية الصحية ذات الصلة اتجاه الممارسات الرئيسية الستة التي تشمل، التنويم ما قبل الجراحة، تعقيم وتطهير مكان العملية قبل الجراحة، والاستحمام قبل الجراحة وإزالة الشعر، ووصف واعطاء المضادات الحيوية وملاحظة فتح باب العمليات ورصد عدد الكادر الطبي والتمريضي في غرف العمليات الجراحية. جميع البيانات سيتم التحقق منها ونسخها حرفيا عن طريق الباحث وسوف يستخدم نظام الترميز باستخدام برنامج . يسمى أن فيفا (NVivo) . وكذلك النتائج سوف لن تعرف بهوية المشاركين في البحث. وبالإضافة إلى ذلك للبيانات الإلكترونية والوثائق سوف تخزن في مكان امن في ملف كلية العلوم الصحية بجامعة كاردف حتى إكمال فترة العقد المتفق عليه في البحث العلمي ومن ثم سيتم تدميرها كليا.

ما سيتم فعله؟

في هذه الدراسة، سوف لا يطلب منك القيام بأي شيء ولكن قد يطلب منك التحقق من بعض الإجراءات مثل الاستحمام والحلاقة قبل الجراحة. في هذا البحث سوف يقوم الباحث برصد 250 إلى 315 عملية جراحية اختيارية في اثنين من المستشفيات الاحالة في سلطنة عمان خلال الإجراءات قبل الجراحة واثناء العمليات. وعلاوة على ذلك، إذا كنت توافق على المشاركة في هذه الدراسة، فإن الباحث سوف يأخذ موافقتك الوصول البيانات الخاصة لجمع بعض المعلومات عن المضادات الحيوية المتعلقة بالعمليات الجراحية فقط.

ما هي المخاطر من المشاركة في هذه الدراسة؟

هناك لا يوجد أي مخاطر مرتبطة بالمشاركة في هذه الدراسة متوقعه .

ما هي فائدة المرجوة من المشاركة؟

أنت لن تستفيد مباشرة من المشاركة في الدراسة ولكن هناك فائدة عامة لتحسين الرعاية في المستقبل للمرضى الذين يخضعون للعمليات الجراحية الاختيارية وتخفيف العرصة بالإصابة بالعدوى ما بعد العمليات الاختيارية.

ما إذا كان هناك مشكلة؟

إذا كان لديك أي مشكلة حول الجانب المتعلق بالدراسة أو مصدر قلق، يمكنك الاتصال بالاستاذة ديناً غولد والدكتور ديان واتكينز من مدرسة علوم الرعاية الصحية، جامعة كاردف، ويلز، والمملكة المتحدة. الايميل الخاص بهم هو

GouldD@cardiff.ac.uk أو watkinssd@cf.ac.uk او بالاتصال على الهاتف رقم: 029 /+44(0)2920917804 .20687776

ماذا سيحدث إذا كانت لا تريد الاستمرار والانسحاب من الدراسة؟

مشاركته تطوعية وأنت حر أن تسحب في أي وقت دون إبداء سبب حتى لو كنت قد تم بالفعل الحصول على موافقتك ويمكنك المشاركة في هذه الدراسة طوعاً ولك قرار المشاركة من عدمه وهذا لن يؤثر على الرعاية الصحية الحالية المستقبلية الخاصة بك. إذا أردت المشاركة منذ البداية فأنت لا تزال حراً للانسحاب في أي وقت خلال الدراسة او لاحقاً بدون أي عقوبة. إذا كنت ترغب في تدمير أي معلومات او سجلات السابقة والوثائق، يرجى الاتصال بنا في أي وقت وسيتم تدميرها فوراً .

المشاركة في هذه الدراسة ستبقى سرية؟

نعم. سوف نتبع الممارسة الأخلاقية والقانونية وسوف تكون جميع المعلومات التي تخصك سوف تعامل بسرية تامة، سيتم الاحتفاظ بالسجل لهذه الدراسة الخاصة سرياً، وسيتم إدخال جميع المعلومات التي يتم جمعها في قاعدة بيانات إلكترونية. سيتم تخزين المعلومات بأمان وجمع البيانات لن يتم تبادلها او مشاركتها مع أي شخص آخر في هذه الدراسة. وستنشر هذه النتائج التي توصلت إليها هذه الدراسة ونشرها بدون تضمين أي معلومات عنك التي سوف تجعل من الممكن التعرف عليك. يتم حفظ البيانات للبحث في ملف مؤمن وسوف يكون فقط الباحث الوصول إلى السجلات. الباحث فقط الشخص الذي يستطيع الوصول للبيانات الشخصية وكذلك قد يشمل الأشخاص المأذون لهم كالمشرفين على الدارسة للتحقق من أن الدراسة تجري بشكل صحيح. السرية الخاصة بك كمشارك في هذه الدراسة سوف تظل محمية. جميع المعلومات في هذه الدراسة السرية وسيتم ربط هوية أي

مشارك بالمعلومات المقدمة وسوف يستخدم اي اسم عند نشر النتائج. سوف يضمن عدم الكشف عن هويتك في الدراسة وسوف يستخدم نظام ترميز خاص في التحليل.

ماذا سيحدث لنتائج الدراسة البحثية؟

نتائج هذه الدراسة قد تقدم للنشر في المجالات في مجال التمريض في سلطنة عمان وقد تقدم في مؤتمرات. إذا كنت تريد يمكن إرسال ملخص للنتائج إليكم بعد انتهاء الدراسة.

من المسؤول والممول لهذا البحث؟

هذه الدراسة تمت مراجعتها والموافقة عليهما من قبل جامعة كاردف بالتعاون مع المشرفين البروفسور ديناً غولد والدكتور ديان واتكينز من مدرسة علوم الرعاية الصحية، جامعة كاردف، ويلز، والمملكة المتحدة. كما إن الدراسة ممولة من قبل وزارة الصحة في سلطنة عمان.

من المراجع لهذه الدراسة ؟

الدراسة تم مراجعتها من قبل لجنة البحث العلمي و اللجنة البحث الاخلاقية في جامعة كاردف ، وليرز بالمملكة المتحدة وكذلك عن طريق لجنة البحث العلمي والاخلاقي في وزارة الصحة بسلطنة عمان

الاتصال للحصول على مزيد من المعلومات:

الرجاء لا تتردد في الاتصال بي في أي وقت لمناقشة أي جزء من هذه الدراسة .

الباحث: سالم خميس الإسماعيلي

معلومات الاتصال في سلطنة عمان:

سلطنة عمان نزوى

ص. ب. 1401

الرمز البريدي: 611

موبايل: 006899444061

البريد الالكتروني: skz4321@gmail.com or AlisamiliSK@cf.ac.uk

معلومات الاتصال في المملكة المتحدة:

جهة الاتصال:

جامعة كاردف CF 10 3XQ

منزل ايسجيت، " 0AB 24 CF

موبايل المملكة المتحدة رقم: +44754198590

البريد الإلكتروني: AllsmaliSK@cardiff.ac.uk

تأكيد موافقة هل أنت على استعداد المشاركة في هذه الدراسة؟

نعم: ____ لا: ____

إذا كان الجواب نعم، يرجى تسجيل الاسم والتوقيع

توقيع المشارك _____ الوقت: _____ التاريخ: _____

الباحث: _____ الوقت: _____ التاريخ: _____

Appendix 18: Consent Form for All Participants

Title of Study: Evaluating Adherence to International and National Recommendations for the Prevention of Surgical Site Infection in Elective Surgery in Oman

Name of researcher: Salim Khamis Zahran Al Ismaili

	Please initial Box
I confirm that I have read the information sheet for the above study, and have understood the aims and purpose of the study. I confirm that I have had the opportunity to consider all the information, ask questions and have had these answered satisfactorily.	
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.	
(If appropriate) I understand that relevant sections of my medical and nursing notes and data collected during the study may be looked at by the researcher [Salim Al Ismaili] from Cardiff university, where it is relevant to my participation in this research. I give permission for this individual to have access to my records.	
I understand that all information about me will be secured and treated in confidence, and my name will not be mentioned in any written work stemming from this study. The interview records will be transcribed and stored electronically on a secure password protected computer located in the school of Healthcare Science Studies, Cardiff University.	
I understand that I will receive no compensation in exchange for my consent to participate in this study.	
(If appropriate) I am willing to participate in the interviews, and I agree to the interview being audio-recorded and used for research purposes. I understand that one of the purpose of recording may be to include direct quotes for research purposes, including in the final report and other publications.	
I understand that I can ask for the information I provide to be destroyed at any time in accordance with the Data Protection Act.	
I agree to take part in the above study voluntarily	
Name of respondent..... Date: Signature: Name of person seeking consent:..... Date: Signature of person seeking consent:..... <i>After completion: copy for participant and copy for investigator</i>	

Appendix 19: Participant Consent Form for Patients [Arabic version]

المرفق الثامن: ورقة معلومات للمرضى (النسخة العربية)

عنوان البحث: الالتزام بالبرتوكول والتوصيات الدولية والوطنية لمنع ومكافحة العدوى في مستشفيات إحالة إقليميين بعد العمليات الجراحية الاختيارية في عمان.

إسم الباحث: سالم بن خميس بن زهران الاسماعيللي

حدد الخانة المناسبة	
أؤكد أنني قد قرأت ورقة المعلومات للدراسة المذكورة أعلاه، وأنا فهمت الهدف من الدراسة والغرض من الدراسة المذكورة أعلاه وكانت لي فرصة للنظر في المعلومات وطرح الأسئلة والحصول علي اجابة مرضية.	
أنا أفهم أن مشاركتي طوعية وأنتني حر في الانسحاب في أي وقت دون إبداء أي سبب، ودون ان تتأثر رعايتي طبية او حقوقي القانونية.	
(إذا كان ذلك مناسباً) أنا أفهم أن البيانات الطبية والتمريضية التي تخصني سوف تجمع عن طري الباحث {سالم الاسماعيللي} وقدم يتم جمعها لغرض الدراسة فقط وهنا انا اعطي الاذن للباحث المذكور للحصول على البيانات الصحية الخاصة بي من ملفي الالكتروني بالمستشفى برغبة مني	
أنا أفهم أن كل المعلومات عني سيتم تأمين عليها وسوف تعامل بسرية تامة ولن يتم ذكر اسمي او التلميح له با صيغة وفي تقرير مكتوب خلال هذه الدراسة.	
أنا أفهم أنني لن أحصل على أي تعويض عن موافقتي للمشاركة في هذه الدراسة.	
أنا أفهم أن أستطيع أن أسأل عن المعلومات التي أقدمتها وكذلك حذفها وتدميرها في وقت اريده وفقاً لقانون حماية البيانات	
(إذا كان ذلك مناسباً) أنا مستعد بأن اعطي أي معلومة يردها الباحث لأغراض البحث واعطيه الاذن والموافقة لنشر وكتابة التقرير النهائي لدراسته.	
أنا أوافق على المشاركة في الدراسة المذكورة طوعاً	
<p>إسم المشارك في البحث:..... التاريخ:.....</p> <p>التوقيع:.....</p> <p>إسم الشخص الذي اخذ التوقيع:.....</p> <p>التاريخ:.....</p> <p>التوقيع:.....</p> <p>عند الانتهاء من اخذ الموافقة نسخه تعطى للمشارك واخرى للباحث</p>	

Appendix 20: Levels of Compliance to Each Different Item on the Guidelines for Both Hospitals Individually and Collectively

Adherence	Assessment of Adherence:						Overall adherence for both hospitals individually and together		
Levels Classified as:	Good levels of Adherence >80% (No improvement strategies required).								
	Intermediate levels of Adherence (60-80%) (Action required to improve quality to optimal level).								
	Poor levels of Adherence <60 (Immediate action required to improve quality).								
	The guidelines for the prevention of SSIs are categorised in relation to existing scientific evidence (CDC 2011).								
Compliance	Hospital A: results of observation (n=165)	Hospital A: support from fieldnotes	Hospital A: results from interviews (n=15)	Hospital B: results of observation (n=150)	Hospital B: support from fieldnotes	Hospital B: results from interviews (n=15)	Hospital A: Overall adherence	Hospital B: Overall adherence	Observation results for both hospitals

Item 1: Length of Preoperative hospital stay	<p>The mean adherence rate was 83.7%.</p> <p>The mean for length of preoperative hospital stay was 1.47, whilst the median rate was 1 day with a range of 0-19 days.</p>	<p>Most of the patients were admitted at least one day prior to surgery, but some patients with medical problems, such as heart disease, HTN, and diabetes were admitted at least 2 days before surgery.</p>	<p>13 people opined that patients should be admitted 1 day before surgery.</p> <p>6 people noted that surgical patients with medical problems should be admitted at least 2 to 3 days before surgery for further examination and preparation. For</p>	<p>The mean adherence rate was 85.3%.</p> <p>The mean length of stay in the surgical center was 1.55 days, and the median rate was 1 day with a range of 0-18 days.</p>	<p>Most of the patients were admitted at least one day before surgery, but some patients were admitted 2 to 3 days before surgery for further examination and preparation.</p>	<p>14 people mentioned that patients should be admitted 1 day before surgery.</p> <p>4 people mentioned that some patients need more than 2 days for further examination and preoperative treatment.</p>	<p>Level of adherence was considerably good for this recommendation (>80%),</p>	<p>Level of adherence was considerably good for this recommendation (>80%).</p>	<p>The mean adherence rate was 84.4%.</p> <p>The mean for length of preoperative hospital stay was 1.55 days, whilst the median rate was 1 day with a range of 0-18 days.</p>
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			example, Diabetic patients should be admitted at least 2 days before major surgery to control blood sugar levels.						
Item 2: Length of preoperative hospital stay by category of surgery	The mean adherence rate was 83.6%.	It was noted that the length of preoperative care provided to surgical patients during the preoperative period was related to the type of	2 people stated that length of preoperative hospital stay depended on the type of surgery. For example, for some orthopaedi	The mean adherence rate was 85.3%.	It was noted that the length of preoperative care provided to surgical patients depended on the type of surgery. Most patients were admitted one day before surgery to have adequate time	1 person stated that the length of hospital stay was dependent on the type of surgery.	Level of adherence was considerably good for this recommendation (>80%)	Level of adherence was considerably good for this recommendation (>80%)	The mean adherence rate was 84.4%. 37(11.7%) patients were admitted on the day of surgery.

		<p>surgery. The majority of patients were admitted one day before surgery to have adequate time for preparation, hygiene and bathing procedures, examination and obtained consent. In addition, the preoperative care involved preparing the patients physically and emotionally</p>	<p>c cases, patients should be admitted at least 2 days before surgery.</p>		<p>for preparation, examination and to obtain consent. In addition, the preoperative care involved physically and emotionally preparing patients for surgery. For most patients, preparation began one day prior to surgery.</p>				<p>229 (72.7%) patients were admitted 1 day before surgery.</p> <p>49 (15.6%) patients were admitted 2 days or more before surgery.</p>
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		for surgery. For most patients, the preparation stage began one day before surgery.							
Item 3: Preoperative showering or bathing	The mean adherence rate was 90.9%. Showering was done in 150 (90.9%) of cases.	It was noted that most of the patients received oral instructions to take a bath before surgery. Most of the patients in both hospitals took a preoperative shower	12 people agreed that patients were required to shower or bathe before surgery.	The mean adherence rate was 89.3%. Showering was performed in 134 (89.3%) cases.	It was noted that most of the patients received oral instructions to take a bath before surgery. Most of the patients in both hospitals took a preoperative shower before surgery, but a chlorhexidine	15 people agreed that patients required to shower or bath before surgery.	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 90.2%. Preoperative showering or bathing was provided for 284(90.2%) of cases.

		before surgery, but a chlorhexidine solution was used in only a few cases in hospital A.			solution was not used in all cases.				
Item 4: Shower or bath with antiseptic agents at least during the night before the surgery	The mean adherence rate was 50.9%. Showering or bathing with an antiseptic agent was done in	Most of the patients were instructed to shower on either the night before or the day of surgery with antibacterial soap, but still some patients preferred to use normal soap and	12 people stated that patients were required to shower or bathe with an antiseptic agent at least the night before surgery.	The mean adherence rate was 0%. Showering or bathing with an antiseptic solution was done in 0 (0.0%) cases.	Most of the patients were instructed to practice good skin hygiene prior to surgery, but some patients nevertheless preferred to use normal soap and water when bathing.	15 people stated that patients were required to shower or bathe with an antiseptic agent on at least the night prior to surgery.	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 26.7%. Preoperative showering or bathing with an antiseptic agent was adhered to

	84 (50.9%) cases.	water when bathing.							in 84 (26.7%) cases.
Item 5: Preoperative antiseptic bathing by category of surgery	The mean adherence rate was 50.9%.	All patients were informed to take a bath with an antiseptic solution before surgery.	12 people stated that patients were required to shower or bathe with an antiseptic agent at least the night before surgery.	The mean adherence rate was 0%.	12 people stated that patients were required to shower or bathe with an antiseptic agent at least the night before surgery.	All patients were informed to take a bath with an antiseptic solution before surgery.	Overall compliance was considerably poor for this recommendation ($<60\%$).	Overall compliance was considerably poor for this recommendation ($<60\%$).	The mean adherence rate was 26.7%.
Item 6: Hair removal performance	Preoperative hair removal was conducted in 110	Regardless of the type of surgery, hair removal was still performed	14 people agreed that hair removal should be conducted	Preoperative hair removal was conducted in 98 (65.3%) cases.	Regardless of the type of surgery, hair removal was still performed using either a	15 people agreed that hair removal should be conducted	Overall compliance was considerably intermediate	Overall compliance was considerably intermediate for this	Preoperative hair removal was applied in 208

	(66.7%) cases.	using either a razor blade or clippers. The patients were informed not to shave the area of incision and if it was deemed necessary, then it should be removed by nurses in the surgical ward or by operating theatre staff inside the OR.	before surgery. 1 person mentioned that hair removal should be avoided.		razor blade or clippers. The patients were informed not to shave the area of incision and if it was deemed necessary, then it should be removed by nurses in the surgical ward or by operating theatre staff inside the OR.	before surgery.	ate for this recommendation (60-80%)	recommendation (60-80%).	(66.7%) cases.
Item 7: Using the appropriate hair removal	The mean adherence rate	It was observed that most	9 people stated that they used	The mean adherence rate was 19.6%.	The methods of hair removal varied: many	8 people stated that they used	Overall compliance was	Overall compliance was	The mean adherence

methods (clipper or depilatory cream).	was 16.4%. Clippers were used in 27 (16.4%) cases.	hair removal was done using a razor, rather than clippers or depilatory cream.	clippers for hair removal, and avoided shaving with razors. 4 people stated that they used razors for hair removal. 2 people said that they use depilatory cream for hair removal.	Clippers were used in 26 (17.3%) of cases, whilst depilatory cream was used in 2 (1.3%) cases.	HCWs used razor for hair removal, but orthopaedic surgeons used clippers more often.	clippers for hair removal, and avoided shaving with razors. 7 people stated that they used razors for hair removal. 2 people said clippers were not available in the OT.	considerably poor for this recommendation (<60%).	considerably poor for this recommendation (<60%).	rate was 17.5%. Clippers were used in 53 (16.8%) cases. Depilatory cream was used in 2 (0.6%) cases.
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			1 person said that there were no clippers or depilatory cream available in the unit.						
Item 8: Timing of hair removal	The mean adherence rate was 40.6%. 67 (40.6%) patients were shaved in OTs.	It was observed that most hair removal was done on the operating table prior to surgery; therefore, the dispersal of loose hair was observed in	7 people said that hair removal should be done in OTs. 8 people said that hair removal should be	The mean adherence rate was 36.7%. 55 (36.7%) patients were shaved in the OT 40 (26.7%) were shaved in surgical wards.	It was observed that most hair removal was carried out the operating table prior to surgery; therefore, the dispersal of loose hair was observed in the sterile field.	9 people mentioned that hair removal should be done in OTs. 3 people posited that hair removal should be done in	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 38.7%. 122 (38.7%) patients were shaved in OTs.

	33 (20.0%) patients were shaved in surgical wards. 10 (6.1%) shaved at home.	the sterile field.	done in surgical wards.	3 (2.0%) people shaved at home.		surgical wards. 2 people preferred to perform hair removal in private areas.			73(23.2%) was done in surgical wards. 13(4.1%) of shaving done at home.
Item 9: Preoperative hair removal by category of surgery	The mean adherence rate was 16.4%.	It was noted that most hair removal procedures were carried out on an operating table in OTs or surgical wards by nurses,	2 people reported that hair removal in orthopaedic cases was performed by surgeons in the OR.	The mean adherence rate was 18.7%.	Regardless of the type of surgery, hair removal was done by nurses or surgeons in ORs.	1 person noted that hair removal in orthopaedic cases was performed by surgeons in the OR.	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 17.5%.

		except in the case of orthopaedic surgeries in which case it was carried out by surgeons.							
Item 10: Administration of antibiotic prophylaxis	Antibiotic prophylaxis was administered to 156 (94.5%) patients.	It was observed that antibiotic prophylaxis was routinely prescribed in most elective surgeries. The main problem was	12 people agreed that antibiotic prophylaxis should be given to surgical patients. 6 people noted that there were no clear guidelines	Antibiotic prophylaxis was given to 141 (94.0%) patients.	It was observed that antibiotic prophylaxis was routinely prescribed in most elective surgeries. The main problem was that there were no written guidelines for	13 people agreed that antibiotic prophylaxis should be given to surgical patients. 4 people reported that there were no clear	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	Antibiotic prophylaxis was administered in 297 (94.3%) operations.

		that there were no written guidelines for antibiotic surgical prophylaxis in either hospital.	for antibiotic prophylaxis . 11 people stated that adherence with antibiotic prophylaxis could be improved by implementing clearer guidelines for staff to follow.		antibiotic prophylaxis in either hospital.	guidelines for antibiotic prophylaxis. 15 people stated that adherence with antibiotic prophylaxis guidelines could be improved by implementing clear guidelines for staff to follow.			
Item 11: Choice of antibiotic prophylaxis	Choice was	It was observed that	3 people stated that antibiotic	Choice was concordant	It was observed that cefazolin, cefuroxime and	3 people stated that antibiotic	Overall compliance was	Overall compliance was	Choice was concordant

(cefazoline or cefuroxime)	<p>concordant with guidelines in 90.9% of cases.</p> <p>The antibiotics that were chosen included cefazolin (50.8%), cefuroxime (16.4%) and ceftriaxone (18%).</p>	cefazolin, cefuroxime, and ceftriaxone were the most commonly administered antibiotics.	<p>prophylaxis should be administered as indicated by guidelines.</p>	<p>with guidelines, in 92.0% of cases.</p> <p>The antibiotics that were chosen included cefazolin (61.2%), cefuroxime (10.0%), and ceftriaxone (11.2%).</p>	amoxiclav were the most commonly administered antibiotics.	prophylaxis was administered in line with recommendations.	considerably good for this recommendation (>80%)	considerably good for this recommendation (>80%)	<p>with guidelines in 91.4% of cases.</p> <p>The antibiotics that were chosen included cefazolin (53.7%), cefuroxime (15.6%), and ceftriaxone (12.7%).</p>
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Item 12: Timing of antibiotic prophylaxis (is it done immediately before surgery, at the induction of anaesthesia	The mean adherence rate was 89.1%.	Data from observations show that most of the prophylaxes were administered in 60 minutes of the induction of anesthesia.	13 people said that antibiotic prophylaxis was administered in 60 minutes of incision. 8 people reported that a lack of communication is a major determinant of non- adherence to antibiotic guidelines.	The mean adherence rate was 88.0%.	Data from observations show that most of the prophylaxes were administered in 60 minutes of incision. However, some prophylaxis doses were administered intraoperatively.	12 people noted that antibiotic prophylaxis was administered in 60 minutes of incision. 7 people mentioned that a lack of communication was a major determinant of non- adherence to antibiotic guidelines.	Overall compliance was considerably good for this recommendation (>80%)	Overall compliance was considerably good for this recommendation (>80%)	The mean adherence rate was 88.6%.
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Item 13: Duration of antibiotic prophylaxis (discontinued in 24 hours before surgery).	The mean adherence rate was 76.4%.	Most of the surgeons used prophylaxis and most of them complied with duration guidelines. Most of the prophylaxis was discontinued in 24 hours of surgery. For procedures between two to four hours in length, additional doses of antibiotic	8 people agreed that antibiotic prophylaxis should be discontinued in 24 hours of surgery.	The mean adherence rate was 42%.	Most surgeons used prophylaxis, but were not in compliance with duration guidelines. The surgeons prescribed more than a single dosage of antibiotics that maintained therapeutic levels for periods longer than the recommended 24 hours. For procedures between two to four hours in length, additional doses	9 people agreed that antibiotic prophylaxis should be discontinued in 24 hours of surgery.	Overall compliance was considerably intermediate for this recommendation (60-80%)	Overall compliance was considerably poor for this recommendation ($<60\%$).	The mean adherence rate was 60.0%.
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		<p>were given intra-operatively and postoperatively.</p> <p>The surgeons preferred to prolong the antibiotic regimen for more than 24 hours postoperatively.</p>			<p>of antibiotic were given intra-operatively and postoperatively.</p> <p>The surgeons preferred to prolong the antibiotic regimen for more than 24 hours postoperatively.</p>				
Item 14: Antibiotic prophylaxis by length of surgery (additional intraoperative doses in	The mean adherence rate was 78.8%.	It was observed that antibiotic prophylaxis was most frequently	1 person stated that antibiotics should be continued if the surgery	The mean adherence rate was 46.7%.	It was observed that antibiotic prophylaxis was most frequently prescribed for patients who underwent long	3 people stated that antibiotics should be continued if the surgery lasts longer	Overall compliance was considerably good for this recommen	Overall compliance was considerably poor for this	The mean adherence rate was 62.7%.

prolonged procedures are strongly recommended).		prescribed for patients who underwent long surgical procedures, especially orthopaedic cases.	lasts longer than 3 to 4 hours.		surgical procedures, especially orthopaedic cases.	than 3 to 4 hours.	ndation (>80%).	recommenda tion (<60%).	
Item 15: Administration of antibiotic prophylaxis by wound classifications	Appropriate antibiotic prophylaxis was most frequently observed in patients with a wound classified as a clean case	'no data'	3 people stated that antibiotics should only be given for clean, clean-contaminated, and contaminated cases to guard against SSIs.	Appropriate antibiotic prophylaxis was most frequently observed in patients with a wound classified as a clean case (38.6%), followed by clean-contaminated cases (63.9%), whilst antibiotics were provided for 48.9% of	'no data'	4 people stated that antibiotics should only be given for clean, clean-contaminated, and contaminated cases to guard against SSIs	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate for clean cases was 67.5%.

	(36.4%), followed by clean-contaminated cases (18.2%), whilst antibiotics were provided in 24.2% of contaminated cases.			contaminated cases.					
Item 16: Adherence with antibiotic prophylaxis by category of surgery	The mean adherence rate was 78.8%.	The recommended prophylaxis for elective procedures is cefazolin or Cefuroxime.	12 people mentioned that antibiotics were used routinely for all elective cases.	The mean adherence rate was 46.7%.	The recommended prophylaxis for elective procedures is Cefazolin or Cefuroxime.	9 people reported that antibiotics were used routinely for all elective cases.	Overall compliance was considerably intermediate for this recommendation	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 63.5%.

		Prolonged antibiotic use was the commonest reason for non-adherence, followed by using an alternative antibiotic in some cases that is not recommended in the protocol.	2 people said that antibiotics were used routinely in orthopaedic cases. 8 people mentioned that antibiotics were administered for minor operations.		Prolonged antibiotic use was the commonest reason for non-adherence, followed by using an alternative antibiotic in some cases that is not recommended in the protocol.	11 people mentioned that antibiotics were administered for minor operations.	ndation (60-80%)		
Item 17: Apply preoperative antiseptic skin preparation	The mean adherence rate was 100%.	Skin disinfection was conducted immediately	15 people said that skin antisepsis was	The mean adherence rate was 100%.	Skin disinfection was conducted immediately prior to patient being on the	15 people said that skin antisepsis was performed	Overall compliance was considerably good	Overall compliance was considerably good for this	The mean adherence rate was 100%.

	Preoperative skin preparation was applied in all cases.	prior to patient being on the operating table, using antiseptic agents such as chlorhexidine, povidone iodine and alcohol, or a combination of two antiseptic solutions.	performed for all elective cases before incision.	Preoperative skin preparation was applied in all cases.	operating table, using antiseptic agents such as chlorhexidine, povidone iodine and alcohol, or a combination of two antiseptic solutions.	for all elective cases before incision.	for this recommendation (>80%).	recommendation (>80%).	Preoperative skin preparation was applied in all cases.
Item 18: Use of an appropriate antiseptic agent for skin preparation	The mean adherence rate was 99.4%.	It was observed that some surgeons prefer to use chlorhexidine agent, and others use povidone	11 people recommended cleaning the incision site with an antiseptic solution.	The mean adherence rate was 100%.	Most of the surgeons used a combination of three different antiseptic agents, including chlorhexidine, an alcohol	11 people recommended cleaning the incision site with an antiseptic solution.	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 99.7%.

		iodine. Some also use a combination of antiseptic agents, such as chlorhexidine, an alcohol based agent and povidone iodine.			based agent and povidone iodine. However, povidone iodine was the most commonly used antiseptic for surgical preparation.				
Item 19: Preoperative patient skin preparation by category of surgery	The mean adherence rate was 100%.	Skin preparation was done for all cases before incision using chlorhexidine, povidone iodine or an alcohol antiseptic agent.	15 people noted that antiseptic skin preparation of the incision site is performed before surgery.	The mean adherence rate was 100%.	Skin preparation was done for all cases before incision using chlorhexidine, povidone iodine or an alcohol antiseptic agent.	15 people mentioned that antiseptic skin preparation for incision site is performed before surgery.	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 100%.

Item 20: Antiseptic application technique: in concentric circles from the centre to the periphery area	The mean adherence rate was 15.2%.	It was observed during intraoperative care that most surgeons failed to follow the aseptic technique while cleaning the incision site for surgery.	1 person said that cleaning should be done from the cleanest area to the dirtiest area	The mean adherence rate was 46%.	Skin preparation was carried out using an aseptic sponge holder, however skin preparation cleaning technique was not in accordance with guidelines for most surgical procedures.	'no data'	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 29.8%.
Item 21: Skin cleaning technique by category of surgery	The mean adherence rate was 15.2%.	Most surgeons did not follow the correct practice while cleaning the incision site for surgery.	'no data'	The mean adherence rate was 46%.	Most of the surgeons did not follow the correct practice while cleaning the incision site for surgery.	'no data'	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 29.8%.

Item 22 : Traffic flow in OR (Keep OR doors closed except as needed for passage of equipment and patients.	<p>The mean adherence rate was 56.4%.</p> <p>The doors opened 4495 times during 165 surgical procedures. The mean number of times of doors openings</p>	It was observed that doors remained open during the entire surgical procedure in almost all cases, for various reasons, such as equipment supplies, communication, paperwork, whilst in many cases for no	10 people said that OR doors should be kept closed during surgeries to prevent SSIs.	<p>The mean adherence rate was 70%.</p> <p>The doors opened 2528 times during 150 surgical procedures, with a mean number of times of doors openings of was 8, whilst the median was 21, and ranged from 1-40 times.</p>	It was observed that OR doors remained open during the entire surgical procedure in almost all cases for various reasons, such as equipment supplies, communication, paperwork and in many cases for no obvious reason.	10 people said that OR doors should be kept closed during surgeries to prevent SSIs.	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	<p>The mean adherence rate was 62.9%.</p> <p>OR doors were opened on more than 7023 occasions, with a median rate of 22, ranging from 1-66).</p>

	was 7, whilst the median was 25, and ranged from 1-67 times.	obvious reason. It was observed that for longer surgeries (e.g. orthopaedic surgery or neurosurgery), which can last for more than 2 hours, the mean number of door openings was very high.							
Item 23: Traffic flow in OR (number of personnel	The team size ranged	It is observed that in general, the	4 people said that the number	The mean number of people in the OR was as	It was observed that most surgeries were	1 person said that they would not	Overall compliance was	Overall compliance was	The mean adherence

during operations	<p>from 5 to 15 people, with a mean numbers of 7 persons.</p> <p>The mean adherence rate was 56.3% (more than 7 people counted as non-adherent)</p>	<p>surgical team staff is composed of surgeons, anaesthesiologists, and nurses. Other healthcare practitioners may also enter the OR when required. The healthcare practitioners called to the OR may include radiologists, cardiologists, medical students and other</p>	<p>of personnel inside OR should be kept to a minimum.</p> <p>2 people suggested to assign 7 people for each single surgery.</p> <p>1 person stated that the ideal number should be between 6-10.</p>	<p>expected for a typical operation (7 persons), ranging from 5-10 people for each single procedure.</p> <p>The mean adherence rate was 69.3% (more than 7 people counted as non-adherent).</p>	performed with more than 10 HCWs present in the OR.	limit the number of personnel in OTs.	considerably poor for this recommendation (<60%).	considerably poor for this recommendation (<60%).	rate was 62.5%.
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		experts or observers.							
Item 24: The Complexity of the Surgery and Surgical Team Size	The mean number of HCPs assigned to a single complex operation was 7, (ranging from 5 to 15 people assigned to a single procedure.	It was noted that more people were present in long length procedures, especially orthopaedic and general operations. The team size included all team members assigned to the procedure. Personnel involved, included surgeons, nurses, anaesthesiol	'no data'	The mean number of HCPs assigned to a single complex operation was 7, (ranging from 5 to 15 people assigned to a single procedure.	It was noted that more people were present in long length procedures, especially orthopaedic and general operations. The team size included all team members assigned to the procedure. Personnel involved, included surgeons, nurses, anaesthesiologists, X-ray technicians,	'no data'	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 70%.

		ogists, X-ray technicians, medical students and observers.			medical students and observers.				
Item 25: The Operation Length and Surgical Team Size	93 (56.4%) surgical interventions were performed with fewer than 8 HCWs present in the OR.	It was observed that more people were present in OR during long operations.	'no data'	105 (70%) surgical interventions were performed with fewer than 8 HCWs present in the OR.	It was observed that the number of personnel were similar for short and long operations.	'no data'	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably intermediate for this recommendation (60-80%).	198 (62.8%) surgical interventions were performed with fewer than 8 HCWs present in the OR.
Item 26: Traffic flow by category of surgery	The mean adherence rate was 56.4%.	Data from observations reported that more traffic flow and number of personnel were	'no data'	The mean adherence rate was 70.0%.	It was noted that the operating door openings and number of personnel were highest during general	'no data'	Overall compliance was considerably poor for this recommendation	Overall compliance was considerably intermediate for this recommendation	The mean adherence rate was 62.9%.

		monitored in general surgeries.			surgeries, compared with other types of surgical procedures.		ndation (<60%).	tion (60-80%).	
Item 27: Removing personal accessories (i.e., jewellery, rings, prostheses, etc.).	The mean adherence rate was 2.4%.	On several occasions, it was observed that surgical team staff wore accessories, such as necklaces, earrings, wedding rings and wrist watches during surgery.	1 person stated that wearing rings and other jewellery on hands should be avoided.	The mean adherence rate was 7.3%.	On several occasions, it was observed that surgical team staff wore accessories, such as necklaces, earrings, wedding rings and wrist watches during surgery.	'no data'	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 4.8%.

Item 28: Using mobile phones and computer keyboards during surgery without hand washing.	<p>The mean adherence rate for usage of mobile phones in OR was 55.8%.</p> <p>The mean adherence rate for usage of computer keyboards in OR was 7.9%.</p>	<p>On several occasions, it was observed that mobile phones were used inside OR for communication, playing games and taking photos of the surgical site. Some anaesthesiologists also used portable devices such as iPad and laptops inside OR.</p>	<p>1 person stated that phones should be kept outside the OT.</p>	<p>The mean adherence rate for using mobile phones in OR was 48%.</p> <p>The mean adherence rate for using computer keyboards in OR was 18.7%.</p>	<p>On several occasions, it was observed that mobile phones were used inside OR for communication and taking photos of the surgical site. Some anaesthesiologists also used portable devices such as iPad and laptops inside OR.</p> <p>In addition, it was observed that some HCWs used the hospital computer</p>	'no data'	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	<p>The mean adherence rate for using mobile phone in OR was 52.1%.</p> <p>The mean adherence rate for using computer keyboards in OR was 13%.</p>
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		In addition, it was observed that some HCWs used the hospital computer during surgery without hand washing.			during surgery without hand washing.				
Item 29: Wearing of surgical masks that fully covers the nose and mouth	The mean adherence rate was 76.6%.	On several occasions, it was observed that some surgical team staff entered the OR, either without their mask or with the mask	'no data'	The mean adherence rate was 70.7%.	On several occasions, it was observed that some surgical team staff entered the OR, either without their mask or with the mask hanging around their neck.	1 person said there was no masks available in the unit.	Overall compliance was considerably intermediate for this recommendation (60-80%).	Overall compliance was considerably intermediate for this recommendation (60-80%).	The mean adherence rate was 73.9%.

		hanging around their neck. surgical masks did not fully cover mouth and nose.			surgical masks did not fully cover mouth and nose.				
Item 30: Changing of surgical masks between elective surgeries.	The mean adherence rate was 27.4%.	On several occasions, it was observed that most staff did not change their mask between operations.	'no data'	The mean adherence rate was 22.7%.	On several occasions, it was observed that most of the surgical team staff did not change their mask between operations.	'no data'	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 35.0%
Item 31: Wearing a cap/hood to fully cover hair	The mean adherence rate	It was monitored that most people wore	'no data'	The mean adherence rate was 73.9%.	It was monitored that most people wore surgical	1 person stressed the necessary of wearing OT	Overall compliance was considerably	Overall compliance was considerably	The mean adherence rate was 70.2%.

on head and face	was 67.2%.	surgical caps/hoods that fully covered their hair surfaces in the OR during surgical procedures. However, some HCWs wore caps that did not fully cover their head hair or face.			caps/hoods that fully covered their hair surfaces in the OR during surgical procedures. However, some HCWs wore caps that did not fully cover their head hair or face	gowns in the OR.	bly intermediate for this recommendation (60-80%)	intermediate for this recommendation (60-80%).	
Item 32: Wearing the surgical gown	Level of adherence was 100%.	It was observed that all HCWs changed their personal clothes and wore a	2 people recommended wearing OT gowns in OR.	Level of adherence rate was 100%.	It was observed that all HCWs changed their personal clothes and wore a hospital gown before entering OTs.	5 people recommended wearing OT gowns in OR.	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 100%.

		hospital gown before entering OTs.							
Item 33: Surgical sterile gloving was adapted for all skin preparation	The mean adherence rate was 99.7%.	Almost all HCWs wore sterile gloves before skin preparation.	4 people recommended putting on sterile gloves before sterile procedures.	The mean adherence rate was 99.4%.	Almost all HCWs wore sterile gloves before skin preparation.	5 people recommended putting on sterile gloves before sterile procedures. 1 person said that that sometimes there were no sterile gloves available in the unit.	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	Level of adherence was 100%.
Item 34: Wearing adequate eye protection	The mean adherence rate was 96.4%	Eye shields and goggles were worn in specific circumstance	'no data'	The mean adherence rate was 97.3%	Eye shields and goggles were worn in specific circumstances. For example,	1 person recommended wearing eye protectors	Overall compliance was considerably good	Overall compliance was considerably good for this	The mean adherence rate was 96.8%.

		s. For example, when an aerosol might be created during orthopaedic surgeries.			when an aerosol might be created during orthopaedic surgeries (i.e., when using drills).	(i.e., goggles) during surgery.	for this recommendation (>80%).	recommendation (>80%).	
Item 35: Wearing surgical scrubs before surgery	The mean adherence rate was 100%.	It is noted that all surgeons who were directly involved in the surgery wore surgical scrubs.	'no data'	The mean adherence rate was 100%.	It is noted that all surgeons who were directly involved in the surgery wore surgical scrubs.	'no data'	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 100%.
Item 36: Cleaning of OT between elective cases	The mean adherence rate was 100%.	Cleaning with normal detergent (e.g. ordinary soap) between surgeries	'no data'	The mean adherence rate was 100%.	Cleaning with normal detergent (e.g. ordinary soap) between surgeries was	1 person said there was poor cleaning of OTs.	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean of adherence rate was 100%.

		was done in all cases. Disinfectant solution was not used in almost all surgical procedures			done in all cases. Disinfectant solution was not used in almost all surgical procedures		ndation (>80%).	recommenda tion (>80%).	
Item 37: Applying sterile draping	The mean adherence rate was 93.3%.	It was observed that sterile drapes were applied in all elective cases.	5 people stated that they applied sterile draping while preparing patient for surgery in the OR.	The mean adherence rate was 100%.	It was observed that sterile drapes were applied in all elective cases.	4 people stated that they applied sterile draping while preparing patient for surgery in the OR.	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 96.5%.
Item 38: Protect the incision with a sterile dressing	The mean adherence rate	It was observed that sterile	3 people stated that they	The mean adherence rate was 100%.	It was observed that sterile dressing was	4 people stated that they applied	Overall compliance was	Overall compliance was	The mean adherence

	was 100%.	dressing was applied after all surgeries using a dry sterile gauze dressing.	applied sterile dressing after wound closure.		applied after all surgeries using a dry sterile gauze dressing.	sterile dressing after wound closure.	considerably good for this recommendation (>80%).	considerably good for this recommendation (>80%).	rate was 100%.
Item 39: Maintaining the sterile field in the OR	The mean adherence rate was 93.9%.	On some occasions, some OR staff kept moving from the highly-restricted area to low restricted areas. On occasions, it was reported that some surgical personnel entered restricted area of the	'no data'	The mean adherence rate was 92.0%.	1 person said that they maintained the sterility of the field.	On occasions, it was reported that some operating theatre staff, especially the medical students, kept moving from the highly restricted area to low restricted areas.	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 93.0%.

		surgical suite without fully covering their head hair and facial hair.							
Item 40: Use of double sterile gloves in invasive procedures	<p>The mean adherence rate for single gloving was 100%.</p> <p>The mean adherence rate for double gloving was 97.7%.</p>	<p>It was observed that several incidents of glove perforation occurred during surgical procedures, whereby gloves were changed immediately.</p> <p>In addition, the frequent exchange of</p>	'no data'	The mean adherence rate for double gloving was 100%.	Glove perforations were observed during some surgical procedures.	1 person recommended putting on double gloves before any invasive procedures.	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 93.0%.

		surgical gloves during prolonged procedures was very common among orthopaedic surgeons.							
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Appendix 21: List of Evidence-Based Recommendations for Perioperative Guidelines and Overall Compliance Level to Each Item

Levels of evidence (Managam et al 1999).

Category IA. Strongly recommended for implementation and supported by well-designed experimental, clinical, or epidemiological studies.

Category IB. Strongly recommended for implementation and supported by some experimental, clinical, or epidemiological studies and a strong theoretical rationale.

Category II. Suggested for implementation and supported by suggestive clinical or epidemiological studies or a theoretical rationale.

No recommendation; unresolved issue. Practices for which there is insufficient evidence or no consensus regarding efficacy exists

Recommendations	Ranking based on existing scientific data, theoretical rationale and expert consensus	Strength of recommendation	Level of compliance Hospital A	Level of compliance Hospital B	Level of compliance Hospital A and Hospital B
Preoperative length of hospital stay	Keep preoperative hospital stay as short as possible while allowing for adequate preoperative preparation of the patient (Category II).	Weak	Level of adherence was considerably good for this recommendation (>80%).	Level of adherence was considerably good for this recommendation (>80%).	The mean adherence rate was 84.4%. The mean of preoperative hospital stay was 1.55 days and

					the median rate was 1 day, with a range of 0-18 days.
Preoperative showering	Patient should be instructed to take bath prior to surgery (Category IB).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	<p>The mean adherence rate was 90.2%.</p> <p>Preoperative showering or bathing was provided for 284 (90.2%) of cases.</p>
Shower or bathe with antiseptic agents on at least the night prior to surgery	Patient required to shower or bathe with an antiseptic solution on at least the night prior to the operative day (Category IB).	Strong	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 26.7%.

					Preoperative showering or bathing with an antiseptic solution was applied in 84 (26.7%) of cases.
Preoperative hair removal	a. Do not remove hair preoperatively, unless the hair at or around the incision site will interfere with the operation (Category IA).	Strong	Overall compliance was considerably intermediate for this recommendation (60-80%).	Overall compliance was considerably intermediate for this recommendation (60-80%).	Preoperative hair removal was applied in 208 (66.7%) of cases.

Using appropriate hair removal methods (clipper or depilatory cream) as recommended	b. If hair removal is necessary, remove immediately prior to the operation, preferably with clippers (Category IA).	Strong	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	<p>The mean adherence rate was 17.5%.</p> <p>Clipping used in 53(16.8%) of cases.</p> <p>Depilatory cream was used in 2 (0.6%) of cases.</p>
Timing of hair removal	If hair removal is necessary, remove immediately before the operation, preferably with clippers (Category IA).	Strong	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	<p>The mean adherence rate was 38.7%.</p> <p>122 (38.7%) of the shaves were done in OTs.</p> <p>73 (23.2%) were done in surgical wards.</p>

					13 (4.1%) of the shaves were done at home.
Skin preparation at incision area	a. Wash and clean skin around the incision area using an approved skin preparation (Category IB).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 100%. Preoperative skin preparation was applied in all cases.
Use an appropriate antiseptic agent for skin preparation	b. Use an appropriate antiseptic agent for skin preparation (Category IB).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 99.7%.
Skin preparation cleaning technique	Apply preoperative antiseptic skin preparation in concentric circles moving toward the periphery. The prepared area must be large enough to extend the incision or create new	Weak	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 29.8%.

	incisions or drain sites, if necessary (Category II).				
Antibiotic prophylaxis administration	Administer a prophylactic antimicrobial agent only when indicated, and select it based on its efficacy against the most common pathogens causing SSI for a specific operation and published recommendations (Category IA).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The antibiotic prophylaxis was administered in 297 (94.3%) operations.
Timing of antibiotic prophylaxis	Administer in one hour of surgical incision. This time is considered optimal for tissue and serum perfusion (Category IA). Prophylactic antibiotics should be administered in 30 minutes of surgical incision (GCC-CIC 2013).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 88.6%.

Choice of antibiotic prophylaxis	<p>Select appropriate antibiotic prophylaxis based on the type of surgery and published guidelines (Category IA).</p> <p>Cefazolin is an appropriate first-line agent for most surgical procedures (GCC-CIC 2013).</p>	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	<p>Choice was concordant with guidelines, for 91.4% of the cases.</p> <p>The antibiotic choice was cefazolin for 53.7% of the cases, whilst cefuroxime was used for 15.6% of the cases and ceftriaxone used for 12.7%.</p>
Duration of antibiotic prophylaxis	<p>Discontinue agent in 24 hours after surgery (Category IA).</p> <p>Antibiotics must be discontinued as per provided recommendations. Patients who have documented infections at the time of surgery or in 48 hours postoperatively should receive empiric therapy (GCC-CIC 2013).</p>	Strong	Overall compliance was considerably intermediate for this recommendation (60-80%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 60.0%.

Antibiotic prophylaxis by length of surgery	<p>Re-dose prophylactic antimicrobial agents for long procedures (Category IA).</p> <p>Administration should be repeated intraoperatively if the surgical procedure is prolonged (i.e., lasting more than 4 hours) or in the case of major blood loss (GCC-CIC 2013).</p>	Strong	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 49.2%.
Postoperative prophylaxis by wound classification	In clean and clean-contaminated procedures, do not administer additional prophylactic antimicrobial agent doses after the surgical incision is closed in the operating room (Category IA).	Strong	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate for clean cases was 63.5%.
Traffic flow in OR (Keep OR doors closed except as required for	Keep OR doors closed except as required for moving of equipment,	Strong	Overall compliance was considerably poor for this	Overall compliance was considerably poor for this	The mean adherence rate was 62.9%.

movement of equipment and patients	personnel and the patient (Category IB).		recommendation (<60%).	recommendation (<60%).	OR doors were opened more than 7023 times with a mean rate of 22%, ranging from 1-66.
Traffic flow in OR (number of individuals during operations)	Limit the number of personnel entering the OR to necessary personnel (Category II).	Weak	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 62.5%.
Removing of personal accessories	Do not wear hand or arm Jewellery (Category II).	Weak	Overall compliance was considerably poor for this	Overall compliance was considerably poor for this	The mean adherence rate was 4.8%.

(i.e., jewellery, rings, prostheses, etc.)			recommendation (<60%).	recommendation (<60%).	
Using mobile phone and computer keyboards during surgery without hand hygiene.	Use of mobile phones and other devices not approved by the guidelines. However, there is insufficient scientific evidence about the use of these items.	weak	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	<p>The mean adherence rate for using smartphones in OR was 52.1%.</p> <p>The mean adherence rate for using computer keyboards in OR was 13%.</p>
Wearing of surgical masks that fully covers the nose and mouth	Wear a surgical mask that fully covers the mouth and nose when entering the OR if an operation is about to begin, is already under way, or if sterile instruments are exposed. Wear the mask throughout the operation (Category IB).	Strong	Overall compliance was considerably intermediate for this recommendation (60-80%).	Overall compliance was considerably intermediate for this recommendation (60-80%).	The mean adherence rate was 73.9%.

Changing of surgical masks between elective surgeries.	Change mask between patients or sooner if mask becomes wet, moist or torn (GCC-CIC 2013).	Strong	Overall compliance was considerably poor for this recommendation (<60%).	Overall compliance was considerably poor for this recommendation (<60%).	The mean adherence rate was 35.0%
Wear a cap/hood to fully cover hair on head and face	Wear a cap or hood to fully cover hair on head and face when entering the OR (Category IB).	Strong	Overall compliance was considerably intermediate for this recommendation (60-80%).	Overall compliance was considerably intermediate for this recommendation (60-80%).	The mean adherence rate was 70.2%.
Wearing the surgical gown	Use surgical gowns and drapes that are effective barriers when wet (Category IB).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 100%.

Surgical sterile gloving was worn for all skin preparation	Sterile gloves should be worn before any aseptic procedures (Category IB).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The level of adherence rate was 100%.
Wearing of adequate eye protection	Wear a surgical mask (with protective eye/face wear) if splashing or aerosolisation of blood or body fluids is expected (GCC-CIC 2013).	Weak	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 96.8%.
Wearing surgical attire before surgery	Concerning attire, the recommendation for the surgical team wearing gowns, sterile surgical gloves, masks and caps covering their hair during surgery is well-established (Spruce 2004).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 100%.
Cleaning of OT between elective cases	a. Do not perform special cleaning or closing of ORs after contamination or dirty operations (Category IB).	Strong	Overall compliance was considerably good for this	Overall compliance was considerably good for this	The mean adherence rate was 100%.

	b. No recommendation on disinfecting environmental surfaces or equipment used in ORs between operations in the absence of visible soiling. Unresolved issue.		recommendation (>80%).	recommendation (>80%).	
Apply sterile draping	Use surgical gowns and drapes that are effective barriers when wet (Category IB).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 96.5%.
Protect an incision with a sterile dressing	Protect with a sterile dressing for 24 to 48 hours postoperatively an incision that has been primarily closed (Category IB).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 100%.

Maintaining the sterile field in the OR	The sterile field should be maintained (Category IB).	Strong	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 93.0%.
Use of double sterile gloves in invasive procedures	<p>Double gloving is recommended to maintain the physical integrity of gloves; this consists of the use of two gloves with the outer glove serving as a protective barrier of the inner glove (CDC 2011; Alexander 2011).</p> <p>Double gloving provides increased protection to prevent accidental blood exposure in the OT (Tanner & Parkinson 2002:4).</p>	Weak	Overall compliance was considerably good for this recommendation (>80%).	Overall compliance was considerably good for this recommendation (>80%).	The mean adherence rate was 93.0%.

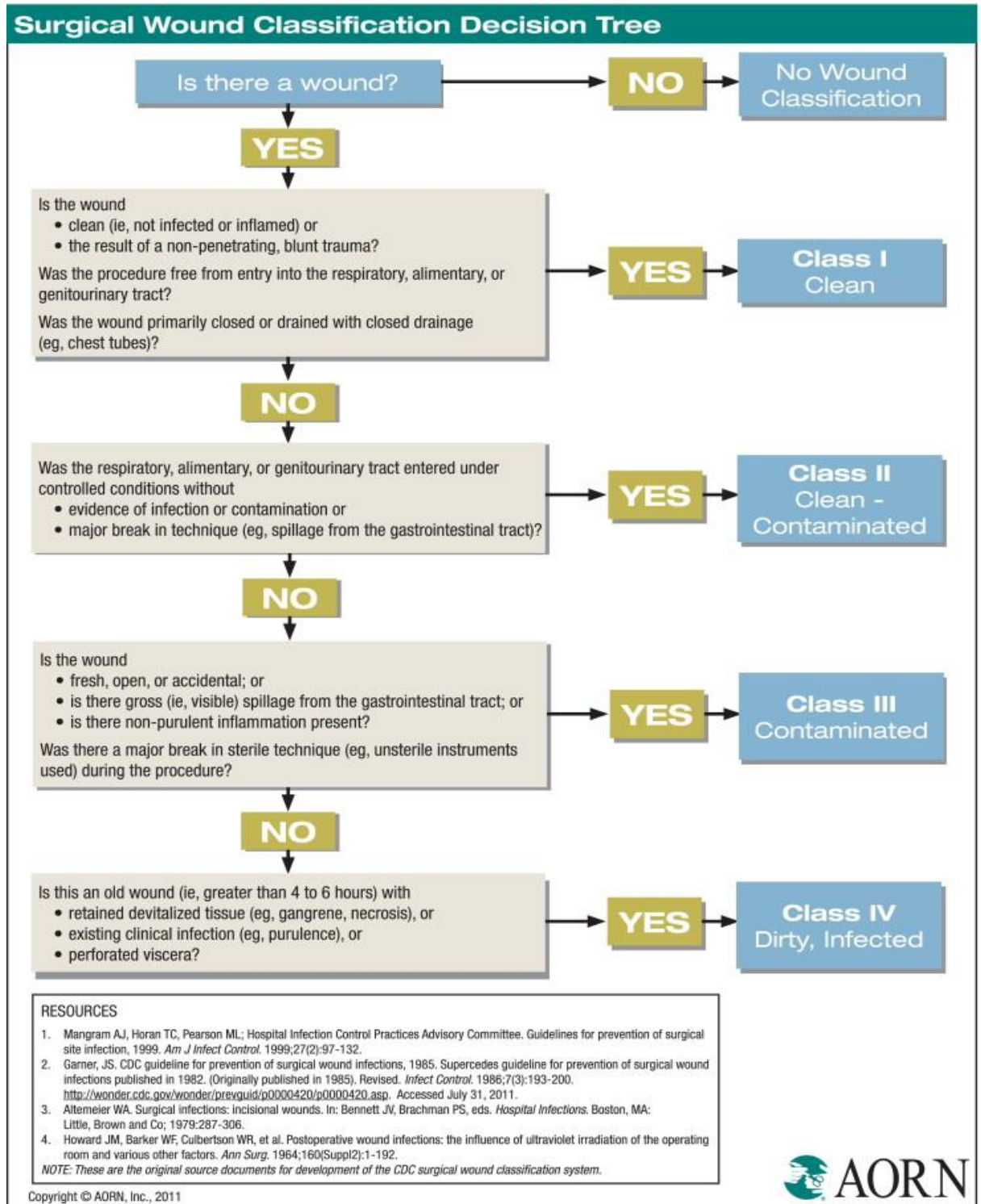
Appendix 22: Categories of Recommendations for Prevention of Surgical Site Infections

N	Preoperative surgical procedures	Category	Level of evidence
Recommendations			
1	Preoperative shower or bath	Patients are required to bathe with an antiseptic agent at least the night before surgery (category IB)	IB
	Preoperative hair removal	Do not remove hair preoperatively unless hair is interfering with the incision site (category IA). If hair removal is necessary, remove immediately prior to the operation, preferably with electric clippers (Category IA).	IA IA
2	Skin preparation	Use an appropriate antiseptic for skin preparation (Category IB). Apply preoperative skin preparation in concentric circles moving toward the periphery (Category II)	IB II
3	Preoperative hospital stay	Keep preoperative hospital stay as short as possible while allowing for adequate preparation of the patient (Category II)	II
4	Preoperative antibiotic prophylaxis	Administer a prophylaxis agent only when indicated (Category IA). Give antibiotic prophylaxis 60 minutes before surgery to maintain therapeutic levels of the agent in serum and tissue throughout the operation (Category IA). Antibiotic prophylaxis should be discontinued in 24 hour period after incision (Category IA). Do not prescribe vancomycin for antimicrobial prophylaxis (Category IB)	IA IA IA IB
5	Intraoperative procedures		
6	Doors opening during surgical procedures	Keep OR doors closed except when required for movement of equipment, personnel, and patient (Category IB)	IB
7	Number of personnel in OR	Limit the number of personnel entering the OR to necessary personnel (Category II)	II
8	Cleaning and disinfection of	No recommendation on disinfecting environmental surfaces or equipment used in ORs between operations in the absence of visible soiling (Unresolved issue).	Unresolved issue

	environmental surfaces		
9	Surgical attire and drapes	<p>Wear a surgical mask that fully covers the mouth and nose when entering the OR if an operation is about to begin or already under way, or if sterile instruments are exposed. Wear the mask throughout the operation (Category IB).</p> <p>Wear a cap or hood to fully cover hair on the head and face when entering the OR (Category IB).</p> <p>Do not wear shoe covers for the prevention of SSI. Category IB</p> <p>Wear sterile gloves if a scrubbed surgical team member. Put on gloves after donning a sterile gown (Category IB)</p> <p>Use surgical gowns and drapes that are effective barriers when wet (Category IB)</p>	<p>IB</p> <p>IB</p> <p>IB</p> <p>IB</p> <p>IB</p>
10	Sterile Dressing	Protect with a sterile dressing for 24 to 48 hours postoperatively an incision that has been primarily closed (Category IB).	IB
11	Wearing jewellery	Do not wear hand and arm jewellery	II
<p>A: category</p> <p>* Category I recommendations, including IA and IB. Both category IA and IB recommendations are applicable for and should be adopted by all healthcare facilities.</p> <p>* Category II recommendations are supported by less scientific data than category I recommendations.</p> <p>* No recommendations: some practices not recommended due to insufficient evidence or clinical consensus.</p> <p>B: Ranking:</p> <p>* Category IA: strongly recommended in practices and supported by experimental, clinical, or epidemiological studies.</p> <p>* Category IB: Strongly recommended in practices and supported by some experimental, clinical, or epidemiological studies and a strong theoretical rationale.</p> <p>* Category II. Suggested for practices and supported by clinical decision or epidemiological studies or theoretical rationale.</p> <p>No recommendation. Practices for which there are insufficient evidence or no consensus regarding some clinical practices</p>			

* (Adapted from CDC 2011)

Appendix 23: Surgical Wound Classifications



Appendix 24: Surgical Procedures and Recommended Drugs

N	Operations	Recommended Antibiotic Prophylaxis (Alternative)
1	Vascular surgeries	Cefazolin (Vancomycin and clindamycin) preoperatively
2	Ileal conduit	Cefazolin (Metronidazole and ciprofloxacin) preoperatively
3	General surgery	Cefazolin (Clindamycin and Gentamicin)
4	Neurosurgery	Cefazolin (Vancomycin) preoperatively
5	Orthopaedic surgeries, except open fractures, that are considered contaminated so treatment is indicated rather than prophylaxis	Cefazolin (Vancomycin) preoperatively and postoperatively
6	Gastrointestinal	Cefazolin (Gentamicin) preoperatively
7	Appendectomy non-perforated	Cefazolin (Clindamycin and Gentamicin) preoperatively
8	Urology: genitourinary	Ciprofloxacin (Clindamycin and Gentamicin) preoperatively
9	Biliary tract: open procedures and in high-risk patients undergoing laparoscopy surgeries.	Cefazolin (Clindamycin and Gentamicin) preoperatively
10	Plastic Surgery	Cefazolin (Clindamycin) preoperatively
11	Inguinal hernia (Complicated, recurrent mesh placement)	Cefazolin (Clindamycin and Gentamicin) preoperatively
12	Colorectal surgery	Cefazolin (Clindamycin and Gentamicin)

* MOH (2015) National Guidelines

Appendix 25: Examples of Fieldnotes Depicting the Challenges of Conducting this Study

Fieldnotes were taken describing the challenges experienced during the study, including scheduling interviews, interruptions during observations, difficulties finding observational position within ORs, the traffic flow in ORs, delays and cancellations of surgical procedures, language barriers and estimation of timing for surgical procedures.

a. Language Barriers

Language barriers posed a challenge for the observer, because some HCWs spoke more than one language. Ordinarily, HCWs conversed in English in the OT, but there were some HCWs who spoke in their own language during procedures, as noted in the following fieldnotes:

"Although English was the primary language in healthcare institutions, some HCWs still spoke in different languages from the observer. It was observed that some surgical team personnel spoke poor Arabic and did not fluently converse in English, which made the observer experience problems in interacting with some HCWs who were not good in English or the Arabic language (Fieldnotes: Surgical Team: Hospital A and Hospital B).

b. Estimation of timing for Surgical Procedures

"On several occasions, the surgeons did not follow the operating theatre schedule due to an underestimation of timing for surgical procedures. A challenge was raised when the time of operation was underestimated, as the delay in surgical procedures affected my daily observations and made it difficult to comply with my daily plan for data collection. As a result, the observer took a long time to complete the observations" (Fieldnotes: Surgical Team: Hospital A and Hospital B).

c. Cancellation and Postponement of a Surgical Procedure

"It was observed that some of the elective surgeries were cancelled on the day of surgery due to changes in the surgical plan or scheduling problems, or for miscellaneous reasons (e.g. patient's health status or emergency cases). This was inconvenient for the observer, because it made it difficult to plan for data collection" (Fieldnotes: Surgeons: Hospital A and Hospital B).

d. Interview Schedule

"Sometimes, I found it difficult to schedule the interviews during my observation, because the surgeons and nurses in both hospitals were busy and had short times between surgeries. Thus, I had to reschedule the interviews and meet with them in the outpatient clinic" (Fieldnotes: Surgeons: Hospital A and Hospital B).

e. Duration of Surgical Procedures

"It was observed that some surgical procedures, such as orthopaedic cases, were taking a long time, which meant that the observer was required to stand for a long time. Despite the actual time allocated to each procedure, it was observed that some surgeons took more time compared to others. I realised that to be an observer for the elective surgeries was difficult, because I had to stand for a long time during surgical procedures" (Fieldnotes: Surgeons: Hospital A and Hospital B).