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HOSPITAL ACQUIRED INFECTIONS IN INTENSIVE CARE UNITS IN SAUDI ARABIA

by

Elizabeth De Beer

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg

In partial fulfilment of the requirements for the degree of

Master of Science in Nursing

Johannesburg, 2018

DECLARATION

I, Elizabeth de Beer, declare that this Research Report is my own, unaided work. It is being submitted for the Degree of Master of Science in Nursing at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University. Human Research Ethics Clearance Certificate was received – no. M160365.



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E. De Beer

4 June 2018 in Riyadh, Saudi Arabia

DEDICATION

This is dedicated to my husband and family for their love, support and patience during my stay in Saudi Arabia. Thank you for motivating me every time that I wanted to give up.

ACKNOWLEDGEMENTS

I would like to acknowledge the Department of Nursing and supervisor Ms. Viv Herbert for the support and encouragement that I've received during my studies at the University of the Witwatersrand.

ABSTRACT

It is primarily the role of the nurse to monitor, prevent and reduce hospital acquired infections (HAIs). To implement an infection prevention and control (IPC) programme it is necessary to gather baseline data on the major causes of HAIs in order to provide the evidence needed to develop a quality improvement plan and to monitor progress against the baseline data. HAIs are a leading cause of serious illnesses (morbidity) and deaths (mortality) of patients admitted to intensive care units (ICUs). Device-related infections, which are a major source of HAIs, are costly, preventable infections targeted by the Centre of Disease Control and Prevention (CDC) for eradication. Research information for infections related to devices not readily available Saudi Arabia. This study is relevant to clinical practice.

Purpose: The purpose of this study is to determine the current situation relating to hospital acquired infection rates, risk profiles and risk factors in the selected ICUs of a healthcare facility (HCF) in Saudi Arabia.

Design: Through a record review, data was collected on HAIs in the selected ICUs of the HCF. The selected ICUs consist of 102 beds in total. A total sample of all patients' (n=76), records were reviewed for possible HAIs. The South African National Health Insurance (NHI) site prevalence initiative data sheet and definitions based on the European Centre of Disease Control (ECDC) 2012 information were used.

Results: The prevalence rate of HAIs for all the patients resident in the adult ICU on the day of the survey was 44.7%. Females represented 34.21% of the survey population and males 65.8%. Device usage was high overall. A total of 88.2% of the patients had urinary catheters, while 52.6% had a peripheral line, 48.7% a central intravascular catheter and 68.4% were mechanically ventilated. The most common HAI category was pneumonia (23.68%), followed by bloodstream infection (13.15%), surgical site infections (9.2%) and urinary tract infection (3.9%).

Conclusion: A baseline rate has been established for the healthcare facility. With the baseline data available, infection control programmes for improvement and performance goals can be set. The nursing management can introduce a quality improvement programme based on the finding of the study through a link nurse

programme. A repeat Point Prevalence Survey (PPS) should be repeated in the same facility within the next year or two, in order to be able to evaluate if the quality improvement programme has been successful and to adjust the programme as necessary.

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Nomenclature

AM	Antimicrobial
AMR	Antimicrobial Resistance
AMU	Antimicrobial use
BSI	Bloodstream infection
CAUTI	Catheter-associated urinary tract infection
CDC	Centre for Disease Control and Prevention
CNS	Central nervous system
CR-BSI	Central line related bloodstream infection
CVC	Central vascular catheter
CVS	Cardiovascular system
ECDC	European Centre for Disease Prevention and Control
HAI	Hospital-acquired infection
HCF	Health Care Facility
ICU	Intensive Care units
IPC	Infection Prevention and Control
IPCN	Infection prevention and control nurse
IRB	Institution Research Board
NHI	National Health Insurance
NHSN	National Healthcare Safety Network
NNIS	National Nosocomial Infection Surveillance
PPS	Point Prevalence Survey
PVC	Peripheral vascular catheter
SSI	Surgical site infection
UC	Urinary catheter
UTI	Urinary tract infection
VAP	Ventilator-associated pneumonia

CHAPTER ONE

OVERVIEW OF THE STUDY

1.1 INTRODUCTION

This chapter presents an overview of the study and provides a background to the study. The problem statement, research questions, purpose of the study, research objectives and the significance of the study is explained. Ethical considerations, validity and reliability of the study are clarified, and an overview of the research report is provided.

1.2 BACKGROUND OF PREVALENCE RATES AND HAIs

The background to this study describes the importance of a baseline prevalence rate and surveillance for Hospital-acquired infection (HAI) in an Intensive Care Unit (ICU). Infection control surveillance data forms the basis of risk management in infection control.

1.2.1 Role of the nurse in fighting HAI

Florence Nightingale became one of the first infection control practitioners by implementing hand washing practices. From day one in preparing for clinical nursing practice, nurses are taught the importance of hand washing to prevent HAI. Nurses form the largest segment of the healthcare workforce in most facilities, therefore all nursing staff play a key role in the fight against HAI.

Evidence based practices form the backbone of nursing interventions. Nursing procedures and interventions are based on Infection Prevention and Control (IPC) principles to prevent infections, for example, the prevention of device-associated infection.

Nurses are at the bedside on a 24-hour basis. This is more than any other healthcare worker. Nurses are responsible for the monitoring of devices, surgical sites and are directly involved in infection control practices in preventing HAI.

It is necessary to set baselines in order to be able to show the improvement in the fight against HAI. After establishing the baseline, infection control practitioners can implement evidence-based nursing interventions in an effort to reduce HAI rates.

1.2.2 Importance of reducing HAI

“A HAI can be defined as an infection that is acquired by a patient receiving care in a hospital or other health-care facility, which was not present or incubated at the time of admission” (WHO, 2011:6). HAIs are a global problem. HAI’s also increase the morbidity and mortality of patients. When a patient acquires a HAI the patient usually stays longer in the hospital and the chance of building up antibiotic resistance also increases. (WHO, 2011:3). Overall costs increase for healthcare facilities due to higher usage of consumables like gloves, masks and aprons when a patient have an infection. HAIs can affect patients in any kind of setting and can appear even after being discharged. Patients in ICU are even more likely to contract HAIs due to their lowered immunity and exposure to various risk factors,

such as indwelling devices that predispose them to possible infections (Zorgani et al., 2015).

Different types of devices are used in ICU during life support, for example, an endotracheal tube, central lines, and urinary catheters. HAIs are more likely in ICU patients due to the use of these different types of devices. "Device related infections are recognized as markers for patient safety and data relating to device associated infections are sparse and, in some facilities, non-existing in Saudi Arabia" (Jaffar, Almalraj and Memish, 2013:1207). Statistics have shown that more people develop HAIs and die of them than a combination of other diseases (Heitz, 2013).

A study undertaken in a Saudi Arabian hospital showed that device-related infections were identified in 42.2% of urinary tract infections, 38.5% of bloodstream infections and 19.3% of pneumonias (Jaffar, Almalraj and Memish, 2013). A study by Balkhy et al., (2006) in a tertiary care centre in Saudi Arabia showed that 46.7% of the patients in ICU had a HAI. In the same study it was mentioned the risk for the patient also increase 12.7-fold within 8 days (Balkhy et al., 2006:328). From the data obtained from the Jaffar studies, the morbidity and mortality of patients are increased, place a high burden on the healthcare system and increase the workload of the multidisciplinary team (Jaffar, Almalraj and Memish, 2013).

1.2.3 Surveillance in HAI

The first important step to reduce HAIs is surveillance and through the results risks can be identified and prioritized. The WHO (2011:9) indicate "that conducting

prospective surveillance activities help to raise awareness of the problem and finally decrease infection rates".

HAI surveillance is a key component of effective IPC programmes. When applying the HAI definitions, the collections of data can be very complex. Detailed information of the patients, risks, and procedures are needed. While collecting the data the IPC teams need to focus on accuracy to minimize any errors. Surveillance is not a simple process. It need expertise to conduct research and the use of standardised criteria is important. The interpretation of the results is also crucial. Infection control surveillance is either based on incidence surveillance or prevalence surveillance. (Geoghegan et al., 2012:11). For an effective prevention and control programme, HAI surveillance needs to have a standardised collection of data, correct dissemination of information and subsequent evidence-based action on the findings (Humphreys and Smyth, 2006).

"The European Centre for Disease Prevention and Control (ECDC) network for surveillance of HAIs in ICUs collects data from national HAI surveillance networks on ICU-acquired pneumonia, bloodstream infections, urinary tract infections and surgical site infections" (Richards, Thursky and Buising, 2003:3) The above mentioned ECDC study was repeated in 2012 in Northern Ireland, showing that prevalence surveillance is an important part of the way Public Health Agencies fight HAIs. The 2012 definitions of the CDC were applied in this study.

1.2.4 Replication of the study

The surveillance system that was used for this study was piloted in six healthcare facilities (HCFs) in Gauteng Province, South Africa, in 2006, and was repeated in the National Health Insurance (NHI) site surveillance study during 2014/2015. “The system was found to be accurate, easy-to-use and relatively inexpensive” (Duse, 2006: no page). The overall prevalence of HAIs in the six facilities surveyed was 9.27% (Durlach et al., 2012:220). In the 2014/2015 study, the overall HAI prevalence in South Africa’s NHI acute care hospitals was 18.1%. According to Duse the South African results was in line with the rates observed in the Argentina study of 2008. (Duse, De Beer and Moolman, 2015: no page). In the 2015 study done in South Africa a total of 4249 patients were surveyed and 480 of the patients had at least one HAI, resulting in a prevalence of 11.3% of patients (Duse, De Beer and Moolman, 2015: no page). This study in Saudi Arabia is based on the study done in South Africa.

1.3 PROBLEM STATEMENT

HAIs in ICU patients increase the patient mortality. HAI can also lead to long-term recovery periods. HAIs are a threat to the hospital population and despite efforts to reduce them, they are still present in healthcare settings. It is primarily the role of the nurse to monitor, prevent and reduce HAIs.

In order to implement an IPC programme, it is necessary to gather baseline data on the major causes of HAIs to provide the evidence needed to develop a quality improvement plan and to monitor progress against the baseline data. Limited

prevalence data exists in the selected healthcare facility and this study's aim is to provide more information.

1.4 RESEARCH QUESTION

What is the current situation relating to the prevalence rate, risk profile and risk factors in the ICUs of the selected healthcare facility in Saudi Arabia?

1.5 PURPOSE OF THE STUDY

Limited prevalence data is available for the selected healthcare facility. Therefore, the purpose of this study was to determine the situation relating to prevalence rates, risk profiles and risk factors in the ICUs of the selected healthcare facility in Saudi Arabia.

1.6 RESEARCH OBJECTIVES

The objectives of this research are to**:**

- Determine the prevalence rate for the four major infections.
- Describe HAI by types of patients and specialties.
- Describe the risk factors such as indwelling devices, surgery and immune suppression risks.
- Describe the sites, micro-organisms and antimicrobial resistance (AMR) profiles for the identified HAIs.

1.7 SIGNIFICANCE OF THE STUDY

Nursing care need to be caring for the patient in a holistic manner. Quality care is needed for all patients and ensuring that their human rights are protected. Patient safety and prevention of infection is a core part of caring for patients.

This study set the baseline to enable the nursing management to strengthen IPC nursing activities in the selected ICUs. Data generated from this study will enable the facility and nursing management to make informed, evidence-based and cost-conscious decisions related to HAI prevention and control. The effectiveness of a quality improvement plan can be measured once the baseline HAI rates are established and available.

The significance of this study is thus to provide prevalence data for HAI in the specific facility in Saudi Arabia. This data will set a baseline in order to start improve patient safety. The data collected from this study will provide baseline information that will be used to identify the risk factors to which ICU patients are exposed to enable management to devise a programme or make decisions on the current risk and to improve patient safety.

This study is significant for the following groups:

- Nursing staff
- Critically ill patients
- Critically ill patients' families
- ICU clinicians (doctors and nurses)
- Infection control department of the Institution.

1.8 DEFINITIONS USED IN THE STUDY

The definitions used are the same definitions used in the 2015 South African study (Duse, De Beer, Moolman, 2015) and are based on the definitions of the CDC 2012. The same definitions were also used in the Northern Ireland study in 2012. The definitions are set out in the Point Prevalence survey of healthcare-associated infections and antimicrobial use Protocol 4.2 Codebooks (ECDC, 2012).

The definitions are:

Active infections

"Defined as the infection that the patient has on the day of the survey, or as the infection for which the patient is undergoing antimicrobial treatment on the day of the survey. Antimicrobials used for prophylaxis should not be considered an active infection" (CDC, 2012:12).

Hospital acquired infection (HAI)

HAI is based on the following CDC 2012 definition:

- "Patient met one of the HAI case definitions on the day of survey.

  Or

- Patient was receiving antimicrobials for a HAI on the day of survey and the HAI had previously met one of the case definitions between day 1 of antimicrobial treatment and the day of the survey.

In addition, onset of HAI must have occurred within one of the following time frames:

- Day 3 of current admission onwards (day of admission is Day 1)
- Present on admission (or presenting on Day 1 or 2) in patients discharged from hospital (acute or non-acute) in previous 2 days
- Surgical site infection presents on admission (or presenting on Day 1 or 2)
- Device-associated infection [Pneumonia - Ventilator Associated Pneumonia (VAP), Urinary Tract Infections (UTI), Bloodstream Associated Infection specific to device-related, for example, Central Line Related Bloodstream Infection (CR-BSI)] following insertion of device (including Day 1 or 2 of admission)" (CDC 2012:12).

Secondary bloodstream infections

"The patient has a culture-confirmed bloodstream infection and a related HAI at another site. An exception is when a vascular access device is present and no other infection site is evident. In such case a bloodstream infection is considered a primary bloodstream infection" (CDC 2012:16-9).

1.9 METHODOLOGY

A brief overview of the research methodology is provided. A detailed description is provided n Chapter 3.

1.9.1 Research Design

This is a quantitative study using a cross –sectional survey in the form of a record review and collecting the data on a validated data sheet. It is also a comparative, descriptive design used to identify current HAI rates of infections, risk factors, antimicrobial use and resistant patterns in the selected ICUs. Data was collected on a data sheet, using hospital records as the source of data.

1.9.2 Target population

The target population was all patients resident in the selected adult ICUs of the healthcare facility in Saudi Arabia on the day of the visit.

1.9.3 Sample and sampling method

A total sample was used. Prevalence data was collected from each patient in the adult ICU in the facility. Each ICU was visited on a selected day and all eligible patient records were reviewed on the day of the survey for possible HAIs.

1.9.4 Data collection

The data collection took the form of a record review and data from the records was entered on a data sheet.

The term record review refers to the review of information that is recorded in hospital records. Documentation reviewed included: all nursing notes, physician records, temperature charts, X-rays and laboratory reports. Active infections were identified guided by the definitions used.

With the record review, data was collected on active infections. These active infections needed to be acquired due to hospitalization in an acute care hospital. Data was captured for each HAI. Information included was based on the definitions. HAIs were considered active based on the CDC definitions (CDC, 2012). See Annexure D to Annexure I. The patient needed to meet one of the HAI case definitions or receive antimicrobials for a HAI to be recorded. Infections that originated in other healthcare facilities were included. Excluded from the study was infections originated in long-term healthcare facilities, like fragile care units and rehabilitation centres.

Risk factors for possible infections were also included. Each record was reviewed for the presence of invasive devices at the time of the infection, as per the definitions.

Data was collected on an individually serialized data sheet that was designed for the South African study and adapted for this study. The data sheet consisted of 3 sections, namely survey details, risk factors and infection details. The data sheet is explained in detail in Chapter 3.

1.9.5 Data analysis

Data analysis included internal data verification and validation principles. A quality check of 10% of the data was done. Statistics were calculated according to CDC guidelines for hospital acquired infections. A statistician verified the analysis of the data.

Simple descriptive statistics are provided. The number of HAIs is described compared with the size of the population at risk. An overall prevalence rate for HAIs was established for all the selected ICUs and per specific ICU. Prevalence rates for pneumonia, bloodstream, urinary tract and surgical site infections were established. A systematic description of the risk factors, patient categories, antimicrobial usage, micro-organisms and resistant patterns for micro-organisms are described.

1.10 VALIDITY AND RELIABLITY

The method and data sheet has been validated in the Northern Ireland, Argentina and South Africa studies, using the CDC definitions to establish HAI prevalence rates in all of these countries. The data sheet was validated in 2006, “using categorical variables compared with the Pearson’s Chi-squared test and with the Fisher exact test for low frequency variables. Continuous variables were compared with the Mann-Whitney test” (Fitzpatrick et al., 2008:268).

“The statistical analyses were performed using SPSS 14.0 with significance defined as $P < 0.05$. Odds ratios and their 95% confidence intervals were

calculated by the Coxe-Hinkleye-Miettinene-Nurminen method" (Fitzpatrick et al., 2008:268).

To ensure the data sheet content reliability of data in this survey, the data collection process was repeated with the same data sheet on 10% of all the records reviewed. This is done to yield consistent reliability of results from the same records

1.11 CONCEPT OF DATA COLLECTION

The data was collected during the month of July 2016 in the adult ICUs of the selected HCF. Prior to the month of July all administrative tasks were conducted and Ethics Clearance was obtained from the Ethics committees in South Africa and Saudi Arabia.

1.12 ETHICAL CONSIDERATIONS

Ethical clearance was obtained from the regulatory authorities as stipulated by the Human Research Ethics Committee of the University of the Witwatersrand see Annexure L). Permission was received from the Institution Research Board (IRB) at the healthcare facility (see Annexure M), together with a permission letter to commence with data collection. A coding system was used for the raw data collected to ensure the anonymity of the patients. Access to the raw data was restricted to the researcher and supervisor only. Details of the ethical considerations are discussed in Chapter 3.

1.13 OVERVIEW OF THE STUDY

The research report is structured as follows:

- Chapter One: Overview of the study
- Chapter Two: Literature review
- Chapter Three: Research Methodology
- Chapter Four: Data analysis and discussion of results
- Chapter Five: Summary, conclusions, limitations and recommendations

1.14 SUMMARY

Infection control surveillance data forms the basis of risk management in infection control. To be able to define a good infection control plan for an institution, appropriate data is needed. This study set the baseline to start an improvement in patient safety by gathering risk assessment information through prevalence data. Literature reviewed, showed the importance of surveillance and evidence-based plans for infection control practices. Nurses form the backbone to improve patient outcomes and are the main implementers of such interventions.

In this chapter, an overview of the research has been given, including the background to the study, the statement of the problem, the purpose, the aim and objectives and the importance of the study.

In the next chapter a review of the literature relating to the topic under study is presented.

CHAPTER TWO

LITERATURE REVIEW

2.1. INTRODUCTION

The body of knowledge generated through nursing research provides the scientific foundation essential for all areas of nursing and encompasses the vision and social mandate for the profession (Burns and Grove, 2016:26). According to Burns and Grove, (2016:26) “nursing research is defined as a scientific process that validates and refines existing knowledge and generates new knowledge that directly and indirectly influences the delivery of evidence-based nursing”.

Databases used for literature searches included but were not limited to: PubMed, Elsevier, Journal of Hospital Infection, Journal of Infectious Diseases and CDC.

Key words used in the searches: prevalence study, infection control, role of nursing in infection control, risk factor for infection control, infection control in ICU, major infections.

Although HAI programmes exist in healthcare facilities, HAIs are still present. This chapter reviews the importance of infection control surveillance, baseline information on risk factors and the influences on HAIs, evident in the literature.

2.2. RESEARCH

According to Brink, van der Walt and van Rensburg (2012:1) healthcare need research to ensure good evidence-based practise, ensure a high standard of

education and to ensure good nursing management. The ultimate aim of health science research is to provide strong evidence to ensure quality care (Burns and Grove, 2016:79). The researcher needs to be actively involved in the search for data and in this case for HAIs, as surveillance is recognised as an important method of reducing HAI. During this study, the researcher was actively involved in the search for data to improve the quality of care, based on the data.

In this study, quantitative research with non-interventional strategies were used. The literature reviewed indicates that quantitative research may be interventional or non-interventional. In this non-interventional design, characteristics were measured and counted for the variables as they exist naturally (Burns and Grove, 2016:361). Epidemiologists use non-interventional strategies extensively to track disease outbreaks and patterns (Burns and Grove, 2016:369). In quantitative research, the findings are provided through statistical analysis of the quantitative research's output and numerical data (Burns and Grove, 2016:362) as described in Chapter 4.

Descriptive designs give a picture of a phenomenon as it occurs naturally and are used in studies where information is required in a particular field (Brink, van der Walt and van Rensburg, 2012:112). In this study, the field is infection control with a specific picture of the phenomenon of HAIs in ICUs. These designs describe the variables, in this case the variables around HAI, in order to answer the research question. In this PPS, variable risks are identified as they occur naturally, without establishing a cause-effect relationship (Brink, van der Walt and van Rensburg, 2012:112).

HAIs are acquired by patients while receiving care in a healthcare facility and represents the most frequent adverse events in healthcare facilities. The WHO (2011:2) makes it clear that reliable data is not readily available and therefore the global burden of disease is unknown.

2.3. BURDEN OF HEALTHCARE ASSOCIATED INFECTIONS

If a patient develops a HAI it places a significant burden on the healthcare system (WHO, 2011). The selected healthcare facility is a governmental facility; therefore, minimum cost is covered by the patient, and thus the financial burden is on the government if an infection occurs. According to the WHO (2011:14) patients admitted to ICU's are a high-risk population. HAIs will affect the patient's length of stay in hospital, which could result in increased medical costs for the patient and his/her family, and it could cause long term disabilities or death of the patient (WHO, 2011). As the selected facility specialises in trauma patients, the length of stay is higher and that increases the cost related to the treatment of the patients.

HAIs are acquired by patients while receiving care in a healthcare facility and represents the most frequent adverse events in healthcare facilities. No type of healthcare facility can claim to be without any risk of infections (WHO, 2011:6).

HAI leads to significant financial losses (WHO, 2011:20). In the 2011 WHO report, it was noted that HAI infections cause 16 million extra days of hospital stay and cost approximately €7 billion per annum (WHO, 2011). In a paper published in 2013, it was concluded that the "total annual costs for the five major infections (central line infections, urinary tract infections, ventilator associated infections, C

difficile infections and surgical site infections (SSIs) was $9.8 billion" (Zimlichman et al., 2013:2039). According to Zimlichman et al. (2013) SSI contributed the most to the overall costs making up 33.7% of the total. The study of Zimlichman, with a specific focus on the infections covered in this this study make it relevant. Hospital expenditure can be reduced if the prevention of HAIs is seen a priority. (Balkhy et al*.,* 2006:326).

HAIs has an impact on different aspects for e.g. the length of hospital stay, increased use of products and also for the families. (WHO, 2011:4). According to the WHO (2011:3) "HAIs are a recognised public health problem worldwide and contribute significantly to morbidity and mortality in the hospital population".

"The prevalence of HAI is defined as the number of infected patients divided by the total number of patients in the unit" (Zang et al., 2016:163). This rate calculation is used in this study and is the same used in other prevalence studies. Infection rates in hospitals are high. In a study done in ICUs by Meric et al. (2012:297) the most common diagnoses were bloodstream infections (26.8/100 patients), ventilator-associated pneumonia (24.3/100 patients) and urinary tract infections (8.6/100 patients). The ECDC reported that approximately 4,131,000 patients are affected by HAI episodes yearly, with a hospital-wide mean prevalence of 7.1% (WHO, 2011). According to the WHO urinary tract infections was the highest at 36% (WHO, 2011).

Variation of prevalence rates are known and are influenced by patient mix, use of different definitions as well as the period when it was collected. (Humphreys and Smith, 2006:3). The period can be for instance during a flu season then more pneumonias might be present. Humphreys and Smith (2006:3) also suggested

that all HAI prevalence surveys should be performed according to internationality agreed definitions. Therefore, the standardised definitions of the CDC 2012 are used in this study.

2.4. SURVEILLANCE OF HAI

The importance of standardised definitions for HAI surveillance need to be stressed to ensure reliability of HAI surveillance. Standardised definitions will ensure that the condition is a true infection and not a colonization (WHO, 2011:9). It is important to use reliable definitions like those issued by the CDC, the USA National Nosocomial Infection Surveillance (NNIS) system and the National Healthcare Safety Network (NHSN) (WHO, 2011:9). The standardised definitions used in this study are based on the CDC definitions. The use of standardised definitions helps in the comparison of local, national and international levels. To be able to apply these definitions, clinical evidence is needed from the patient records as well as supporting evidence like microbiological test and information from a physician (WHO, 2011:9).

To reveal the prevalence of HAIs and community acquired infections PPS can be used (Balkhy et al., 2006:326). PPS are generally easy to conduct and provide data regarding patients at a particular point in time (Humphreys and Smith, 2006:2). PPS of healthcare-associated infections offer advantages over incidence surveys, (Humphreys and Smith, 2006:2). “PPS can also monitor the effectiveness of infection control programmes (Humphreys and Smith, 2006:2). The importance of standardised methodology and internationally recognised definitions of infection

are emphasised by more several authors (Humphreys & Smith, 2006:2). "PPS results are influenced by the time of collection, patients volume, type of service and can even differ in the same hospital due to these influences. (Balkhy et al*.,* 2006:330).

HAIs also plays a role in the increased resistance of micro-organism to antimicrobials (WHO, 2011). Duse (2006) reported that a number of environmental factors can contribute to the increase of HAI, including the emergence of certain pathogens' resistance to antibiotics and contamination of inanimate objects like equipment. The CDC estimates that every year in the United States of America antibiotic resistant infection influence more than 2 million people and up to 23 000 people die as a result of such infections (CDC, 2013). The CDC published a report in 2013 titled 'Antibiotics Resistance Threats in the United States' to increase the awareness of the seriousness of the health threat of antibiotic resistance and to encourage immediate action to address this threat (CDC, 2013).

2.5. MEDICAL RECORD REVIEW

Medical record makes up for as much as ¼ of scientific studies (Worster and Haines, 2004). Pre-recorded patient data is the primary source of information with a record review (Worster and Haines, 2004:187). The greatest advantage of a medical record review is that the data are already collected. Medical record reviews give information for prospective surveillance on pre-selected indicators (WHO, 2011:10). Therefore, prospective surveillance is considered the gold

standard (WHO, 2011:10). Prospective surveillance is reliable and saves time especially for ICU patients.

Worster and Haines (2004:187) state that medical records are capable of giving reproducible and valid data. A record review was selected for this study; information is already documented and can be collected through the review. The sources used in this study included: Doctors' notes either electronic or paper based, prescriptions, drug charts, nursing notes and care plans, temperature charts, radiology report, surgical notes, laboratory reports and any other relevant charts to ensure data accuracy. These types of record reviews are used by the NHS. It was also used during the Northern Ireland, South African and Argentina studies on which this study is based.

2.6. RISK FACTORS RELATED TO HAI

The risk factors for HAI in the HCF depend on the type of service the facility is providing (WHO, 2011:7). In this study the risk factors are related to adult ICUs in a tertiary HCF in Saudi Arabia. According to the WHO (2011:7) age, emergency admissions, admission to an ICU, hospital stay longer than 7 days, use of devices, surgery and immune related disease increase the risk of infection. Most of the admission in the HCF in this study is through the emergency or trauma unit. Therefore, the risk factors in this study is important possible contributing factors to HAI.

The diagnosis of HAI is not easy due the multiple factors that play a role and can therefore not be based on a single laboratory test (WHO, 2011:4). In this study the application of the definitions is required to identify the active infections. The record review assists in the identification of clinical indications and contributing factors.

Invasive devices influence the high frequency of infection for e.g. Central lines, urinary catheters and ventilators (WHO, 2011:3). According to a report on device associated infections: 'in 173 ICUs in Latin America, Asia, Africa and Europe, the mortality rate in adult patients was 1.5%, 23.6% and 29.3% respectively for UTIs, CR-BSI and VAP" (WHO, 2011:3). Bloodstream infections, pneumonia and urinary tract infections are generally associated with the use of invasive devices (Richards, Thursky and Buising, 2003:3). Invasive devices are more common in patients admitted to the ICU, as expected in this case.

Exposure to a cephalosporin antibiotic and having a tracheostomy cannula, or nasogastric tube, were found to be significant factors based on incidence density analysis of extrinsic risk factors (Meric et al., 2012). This study was based in adult ICUs and patients would most likely have been exposed to some kind of antibiotic.

Meric et al. (2012:298) state: "Univariate analysis revealed that having a non-fatal underlying disease, the presence of a central vascular line, exposure to cephalosporin antibiotics, mechanical ventilation and admission to the lCU were significant factors that contributed to the risk of HAI".

Several guidelines and prevention tools are currently available to reduce HAIs. Most of these evidence-based guidelines come from the CDC and include bundle compliance, environmental cleaning and standard precautions amongst others.

Before implementing these reduction plans, surveillance is needed to confirm what type of risk factors are influencing the HAIs and what the current rates are.

2.7. RISKS RELATED TO ICU

Patients in an lCU have a higher risk of acquiring HAIs than patients in non-critical care areas. Richards, Thursky and Buising, (2003:3) found that ICU infection rates are five to ten times higher than in general ward patients. According to a multicentre study the proportion of infected patients in ICU can be as high as 51% (WHO, 2011:14). A study showed that “the risk of developing a HAl was 9.1 times higher among patients who were admitted to ICU in comparison to those admitted to non-ICU wards” (Balkhy et al*.,* 2006:328).

HAIs are the cause of substantial morbidity, mortality and financial burden and are frequently seen among patients admitted to ICUs, mostly due to the high incidence of predisposing factors such as high utilization of antibiotics, prolonged use of invasive equipment and the existence of severe underlying diseases in these patients (Meric et al., 2012). Many other studies showed that there are high rates of HAIs in ICUs. Meric et al. (2012:297) indicate that that higher ICU infection rates were the reason for longer ICU stay and not the other way around.

In a study done by Balkhy et al. (2006) in a Saudi Arabian hospital, the prevalence rate was 8%, but this included all areas of the hospital and was not only focussed on the ICUs. From the study, 46.7% of the HAIs were found to be in the ICUs (Balkhy et al*.,* 2006:326). The Balkhy et al., (2006) study was a hospital wide

prevalence study that included ICUs, and was also based in Saudi Arabia, and thus provides significant comparatives to this study.

Patients in ICUs have a higher risk of acquiring hospital-associated infections. Broad spectrum antibiotic use occurs in ICU. ICUs Antibiotic-resistant pathogens are also more frequent than in non-critical areas. ICUs have become increasingly more important, to reduce HAI as many infections occur. Healthcare facilities total ICU beds are also increasing proportion, having a direct effect on the HAI rates. The morbidity and mortality in an ICU is higher with approximately 30% of patients having and infection. (WHO, 2011:3).

2.8. ROLE OF INFECTION CONTROL NURSES.

Hughes, (2008:6) make it clear that healthcare workers are the first line of defence to apply infection control practices on a daily basis. Complexity of care within ICUs requires that healthcare professionals work as a multidisciplinary team to improve patient safety. Dawson (2003:251) suggest that infection control practises are the responsibility of all healthcare workers. One way to achieve this is to start an infection control link nurses program in the units (Zhang, 2003). In a nurse driven process of reduction of UTIs, the CAUTI rate reduced from 4.9/1000 catheter days in 2009 to 0.2/1000 catheter days in 2013 (Quin, 2015); this shows the importance of nursing involvement in infection control.

Recent outbreaks globally have put the focus again on the importance of infection control, not only in hospitals but also in the community. Worldwide, the focus is

currently on the prevention of infections and never before has there being more emphasis on infection control. The infection control practitioner, the infection control link nurse and multidisciplinary team at the bedside play a big role.

The role of the infection control practitioner is to identify, prevent and control the outbreak of infections in healthcare facilities. Hughes (2008:5) suggest that an infection control practitioner is doing surveillance of infections, calculate infection rates and report the data. These data are then used to do risk assessment, education and training. To be able to do these activities, the knowledge and skills required are exceptionally advanced and complex. The internationally recommended ratio for infection control practitioners per acute hospital bed is currently 1:100. This will ensure that infection control practitioners are able to assist in the improvement of infection control practices (Hughes, 2008). To ensure that the infection control practitioners is up to standard certification can be achieved by enrolling to the Certification Board.

For nursing to implement an effective infection control programme that is well planned, managed and evaluated it is important to collect, analyse and interpret infection control data. This study provides the baseline data to be able to do quality improvement and focus on patient safety in the HCF under review.

Quality improvement is part of infection control. With the focus more on infection control, quality healthcare is important for patient outcomes. It is primarily the role of the nurse to monitor, prevent and reduce HAIs with a focus to improve quality. Nurses have a unique opportunity to reduce HAIs as they are present in the healthcare setting 24 hours a day and can play a key role in the modelling and promotion of evidence-based infection control practices. As frontline caregivers,

nursing interventions are central to reducing HAIs. HAI data enable the facilities and nursing management to make informed, evidence-based and cost-conscious decisions related to the HAI prevention and control.

2.9. SUMMARY

HAIs are a problem all over the world. Patients has an increase in morbidity and mortality due to infections acquired in hospitals, especially in ICUs. Healthcare facilities struggle financially due to the increase in cost to treat patients with infection. ICUs have been identified as one of the focus areas of infections in an HCF. The increase in device usage also plays a significant role in the risk of infections.

The role nurses play in this process must not be underestimated: they are the key role players in the prevention of infection in an HCF. The implementation of evidence-based infection control practices, based on scientific data collection and quality improvement programmes, can reduce the burden of HAIs in HCFs.

The following chapter describes the details of the methodology used in this study.

CHAPTER THREE

RESEARCH DESIGN AND METHOD

3.1. INTRODUCTION

The focus of this chapter is the research design and method used to explore and analyse the propositions of Chapter 1. The research design is discussed and gives consideration to the study setting, population, sample, sampling and data collections process. Details of the data collection sheet used in the data collection, the method of data analysis and the ethical considerations acknowledged and adhered to for the exploration of the authenticity of the study are stated. The chapter concludes with the details on the validity and reliability of the study

A comparative, descriptive design, was used in this study. The setting for this study was adult ICUs (Main ICU, Trauma ICU, Burn ICU and Maternity ICU) of a large tertiary hospital in, Saudi Arabia. All patients admitted to the ICUs on the day of the data collection were included in the study. The selected ICUs consist of 102 beds in total and are divided into Main ICU, Trauma ICU, Burns ICU and Maternity ICU. A total sample of all patients admitted into the ICUs records were interrogated for possible HAIs.

The study is a repetitive study and thus the South African NHI site prevalence initiative data sheet, based on the European Centre of Disease Control (CDC) 2012 definitions, was used to collect the data. Data collected was processed and analysed according to the CDC methods.

3.2. OBJECTIVES

The specific objectives for this study were to:

- Determine the prevalence rate for the four major infections
- Describe HAI by types of patients and specialties
- Describe the risk factors such as indwelling devices, surgery and immune suppression risks
- Describe the sites, micro-organisms and AMR profiles for the HAIs identified.

3.3. RESEARCH DESIGN

The method whereby the research questions are answered is called the research design. According to Burns and Grove (2016:113) a general plan for the implementation of a study and to be able to answer the research question is called a research design. Prevalence and incidence are usually part of descriptive design (Burns and Grove, 2016:113).

In this study, a comparative, descriptive design, was used to identify current HAI rates and risk factors, antimicrobial use and resistant patterns in the selected ICUs.

Quantitative concepts were applied. Data was collected on an individually serialized data sheet, using hospital records as the source of data.

3.3.1 Quantitative research

Quantitative research counts or measures in order to answer a research question (Burns and Grove, 2016:86). To be able to answer the research question the researcher need to follow a set of logical steps. (Brink, van der Walt and van Rensburg, 2012:177). This research method best fit this purpose and is compatible with the available resources.

3.3.2 Descriptive research design

A descriptive research design is a scientific method that involves the description of a population or occurrence (Burns and Grove, 2016:373). Descriptive research is conducted in a natural setting to answer a research question related to incidence, prevalence or frequency of occurrence of a phenomenon of interest (Burns and Grove, 2016:373). This type of design may be used for problem identification within current practice, justification of current practice and to compare what other professions in similar situations are doing to what is being done in current practice or to develop theories (Burns and Grove, 2016:89).

Descriptive design suits this research project as the PPS provides a picture of the HAI as it occurs in the healthcare facility during the data collection and no cause-effect is established. The data collection in this study took the form of a record review and was based on the principles of a point prevalence study. The study used an adapted version of the data collection sheet used in a similar South African study (Duse, De Beer and Moolman, 2015).

This protocol is based on the method that was used in the Northern Ireland, Argentina and the South African study of 2015. This study used a descriptive design as this design can help to identify problems within any current practice (Burns and Grove, 2005:232). Through the descriptive research design, the study was able to obtain the occurrence and distribution of HAIs in the selected ICUs.

3.3.3 Comparative research design

A comparative study, according to Burns and Grove, allows to get more information within a particular field of study (Burns and Grove, 2005:234). "A comparative study is designed to describe variables and the differences between two or more groups" (Brink, van der Walt and van Rensburg, 2012:114). Descriptive statistics, enable the researcher to analyses differences (Brink, van der Walt and van Rensburg, 2012:114).

The purpose of using a comparative design for this study was to provide prevalence rates for pneumonia, bloodstream, urinary tract and surgical site infections. A systematic description of the risk factors, patient categories, antimicrobial usage, micro-organisms and resistant patterns for micro-organisms is provided.

No manipulation was required within this comparative design; however, differences and similarities are described.

3.3.4 Contextual research design

This study is contextual in design as it was conducted in a specific context (Brink, van der Walt and van Rensburg, 2012:114). An intensive care unit is a specific area, where patients need critical attention due to life threatening situations. The ICUs that were included in this study were the Main ICU (medical and general surgery), Trauma ICU, Burn ICU and Maternity ICU. The structure of the ICUs included in this study is different. The Main ICU is in a newly built ICU that is spacious while the other ICUs are in older buildings. All the ICUs are open structured, but the Trauma ICU has five (5) specific glass cubicles used for isolation purposes. The total number of beds in these ICUs was 102.

The public-sector hospital consisted of 4 different ICU units as mentioned above. The decision to select the HCF in Saudi Arabia was taken for convenience. This hospital caters specific for patients that are not on a medical aid. Patients with any medical or surgical condition that cannot be treated in the community clinics and satellite public sector are treated in this hospital. Most patients in this HCF are admitted through the Emergency Department or the Outpatient Department.

3.4 STUDY SETTING

The location where the research is conducted is called the research setting (Burns and Grove, 2016:612). The setting for this study was the adult intensive care units in a tertiary government hospital in Saudi Arabia. The facility has different services,

which are mostly focus on trauma. Admissions are mainly through the emergency department.

3.5 RESEARCH METHOD

“Research methodology consist of steps, procedures and strategies for gathering and analysing data” (Burns and Grove, 2016). The population, sample, sampling method, data collection and data analysis are very important and need to be taken into careful considerations of research methods.

3.5.1 Research design

A comparative, descriptive design was used in this study to identify current HAI rates and risk factors, antimicrobial use and resistant patterns in the selected ICUs. Quantitative concepts were applied. Data was collected on a structured data sheet, using hospital records as the source of data.

The PPS was piloted in six HCFs in Gauteng Province, South Africa in 2006, and was repeated in the National Health Insurance (NHI) site surveillance study during 2014/2015. “The system was found to be accurate, easy-to-use and relatively inexpensive” (Duse, De Beer and Moolman, 2015: no page).

3.5.2 Records reviewed

Hospital records were reviewed to collect the data for the PPS to identify HAIs in the selected ICUs of the HCF in Saudi Arabia. The total number of record reviewed was 76 (n=76).

Data was collected from all available sources including: including clinical records, nursing notes, temperature charts, X-rays and laboratory reports. Only active infections were recorded as set out in the definition.

3.5.3 Population

A total sample was used. Records of all patients resident in the selected ICUs on the day of data collection were reviewed for possible HAIs. Patient data are collected for each patient. Active HAIs was recorded during the time of collection. Active infections were identified according to the definitions used. The patient had to meet the applied definitions to be recorded as a HAI.

The HCF has a bed capacity of 1380, which includes the 102 selected ICU beds. The ICU beds are divided into sections covering - Adult ICU, Trauma ICU, Burns ICU and Maternity ICU.

3.5.4 Inclusion and exclusion criteria

Patients admitted from other health care facilities was included in the study. Excluded from the study was patients coming from facilities with long term care like nursing homes. Patients of any age admitted to the adult ICUs on the morning of the visit were eligible for inclusion. If patients were transferred out of ICU by the time of data collection they were excluded from the study.

The sample of the study consisted of all patients resident in the 4 ICUs. The sample represented all categories of patients in the ICUs.

Table 3.1: ICU units and bed capacity

Name of ICU	Total patients	Bed capacity
Trauma ICU	25	41
Adult ICU	42	48
Burn ICU	5	8
Maternity ICU	4	5
Total patients	**76**	**102**

3.5.7 Data collection sheet

Data was collected on an individually serialized data sheet. The data sheet consists of three (3) sections: the general demographic and personal data section,

the risk factors sections and the HAI- specific data, the micro-organism/s cultured and related antimicrobial resistance patterns. The majority of questions required an “x” in a checkbox or a number. See Annexure A

Active hospital acquired infections was recorded according to definition. Risk factors for possible infections were also included for the study. Each record was reviewed for the presence of invasive devices at the time of the infection. Data of insertion of a relevant device was important for the onset of the infection e.g. central vascular catheter that can lead to a bloodstream infection.

Each section is described in more detail below.

Section 1: Demographics and personal data

Section one consisted of questions in which the demographic and patient details were collected. These factors were used to analyse the differences subgroups.

This section recorded the following:

- Date of the survey
- Ward name
- Type of service
- Patient’s unique identifier
- Gender
- Age
- Date of admission
- Main diagnosis.

Section 2: Risk factors

Section two consisted of questions in which the different risk factors for infection were identified. The risk factors indicate the contributory factors for each patient to acquire a HAI.

Data collected in this section was the following:

- Invasive devices e.g. urinary and central intravascular catheters
- High risk procedures
- High risk medication
- Comorbidities of the patient.

Section 3: Possible HAIs

Section three had questions to identify if the patient fitted the definitions used for a HAI or/and if the patient was on treatment with an antimicrobial for a HAI. Infections were identified by applying the definitions as set out by the CDC.

3.5.8 Data entry

Data was entered into a Microsoft Excel programme specifically designed for this research. Data was captured according to the code system as set out in previous studies. See Annexure B, Annexure C, Annexure J and Annexure K Statistical calculations were done according to the CDC and ECDC guidelines for HAI.

3.5.9 Consent obtained

Before data collection could begin, permission was obtained from the Healthcare facility and the ICU's manager. Each ICU visit was scheduled for a specific date. The study did not affect any clinical decision making or treatment of the patient. Codes where used to ensure that no patient information could be link to any data. Therefore, neither verbal nor written informed consent was obtained from patients.

3.6 VALIDITY AND RELIABILITY

The study method and data sheet have been validated in the Northern Ireland, Argentina and South Africa studies, using the CDC definitions to establish HAI prevalence rates in these countries. According to Fitzpatrick et al. (2008:268) "the data sheet was validated in 2006 using categorical variables. Categorical variables were compared with Pearson's Chi-squared test and with Fisher's exact test for low frequency variables. Continuous variables were compared with the Manne Whitney test"

To further ensure validity and reliability Fitzpatrick et al. (2008:268) performed the "the statistical analyses using SPSS 14.0 with significance defined as $P < 0.05$". "Odds ratios and their 95% confidence intervals were calculated by the Coxe-Hinkleye-Miettinene-Nurminen method" (Fitzpatrick et al., 2008:268).

To ensure the content reliability of data in this survey, the data collection process was repeated with the same data sheet on 10% of all the records reviewed. This was done to yield consistent reliability of results from the same records.

3.7 ETHICAL CONSIDERATIONS

Nursing is a profession that is seen as an expert field. With professionalism goes honesty and integrity that are both essential when nursing research is conducted. Sound knowledge for practice is needed but most essential is the protection of human rights. Therefore, a nurse need to ensure patient safety and adhering to human rights at all times during the research process. Ethical clearance is therefore essential to prevent misconduct and any research need to be cleared before the research is commenced. The following steps were taken to address any ethical considerations in the proposed study:

- This nursing research was conducted not only with the expertise needed but also with honesty and integrity. According to Burns and Grove (2005:219), “honesty and integrity is needed so that sound knowledge will be generated for the nursing practice as a whole”.
- The research proposal and data sheet were submitted to the Postgraduate committee (Faculty of Health Sciences) of the University of the Witwatersrand for permission to undertake the research.
- The research proposal and data sheet were submitted to the Committee for Medical Research on Human Subjects of the University of the Witwatersrand to ensure compliance with ethical standards. The committee issued a clearance certificate. Certificate number: M160365. See Annexure L
- Permission to conduct the research was obtained from the Hospital Management (IRB Registration Number H-01-R-053, proposal reference number H1R1-08May 16-01). See Annexure M.

- Confidentiality to the participants was guaranteed as the researcher and the supervisor were the only persons with access to this study's raw data.

3.8 SUMMARY

In this chapter, the detail of the research methodology of the study was elaborated upon. The design, the study setting, eligibility criteria, population and sample were described, data collection and analysis were discussed, and methods to ensure validity and reliability described and related to this study and ethical considerations were explained.

The research design was selected to meet the purpose and objectives of the study appropriately. The data collection sheet used was described and was based on the South African study. Data collected was prepared an analysed. The next chapter presents the data analysis, the findings and results of the study.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

In this chapter, the approach used to analyse the results is described, and the results are presented, using a descriptive statistical interpretation of the results. The data was collected during the month of July 2016.

The number of HAIs is described compared with the size of the population at risk. An overall prevalence rate for HAIs is established for all the selected ICUs and per specific ICU. Prevalence rates for pneumonia, bloodstream, urinary tract and surgical site infections are established per ICU. A description of the risk factors, patient categories, antimicrobial usage and micro-organisms are described. The research findings are also discussed.

4.2 APPROACH TO DATA ANALYSIS

“Data analysis entails categorizing, ordering, manipulating and summarising data and describing them in meaningful terms” (Brink, van der Walt and van Rensburg, 2012:177). “The most powerful tool available to the researcher analysing quantitative data is statistics” (Brink, van der Walt and van Rensburg, 2012:178). Descriptive statistics were used to interpret data for patient demographic, risk factors, hospital acquired infections, antimicrobial treatment and microbiology results.

The raw data obtained was entered into a Microsoft Excel spreadsheet and analysed within the software's statistical package. Statistical calculations were done according to the CDC and ECDC guidelines for HAI. All data sheets were checked to ensure completeness and consistency of information.

4.3 RESULTS

The study employed an adapted version of the data collection sheet used in the South African study (Duse, De Beer and Moolman, 2015). A total of four adult ICUs from the selected healthcare facility were included in the study. A total of 76 eligible patients' medical record were reviewed to complete the data sheet. Thus, the completed data collection sheets presented for data analysis were 76 (n=76). All patients admitted to the ICU was included in the study. The largest proportion of eligible patients came from the Adult ICU with a total of 42. The bed occupancy during the survey was 74.5%.

Table 4.1: Total patients surveyed per ICU

Name of ICU	Total patients (n)	Bed capacity	Occupancy rate (%)
Trauma ICU	25 (n=25)	41	60.9%
Adult ICU	42 (n=42)	48	87.5%
Burn ICU	5 (n=5)	8	62.5%
Maternity ICU	4 (n=4)	5	80%
Total patients	**76 (n = 76)**	**102**	**74.5%**

4.3.1 Patient demographics

Females represented 34.21% (n=27) of the survey population and males 65.8% (n=50). A total of 7 females (26.92%) and 27 males (54%) had HAIs, making the males substantially higher risk group for HAI than the females. See Annexure A: Structured record review data sheet section B.

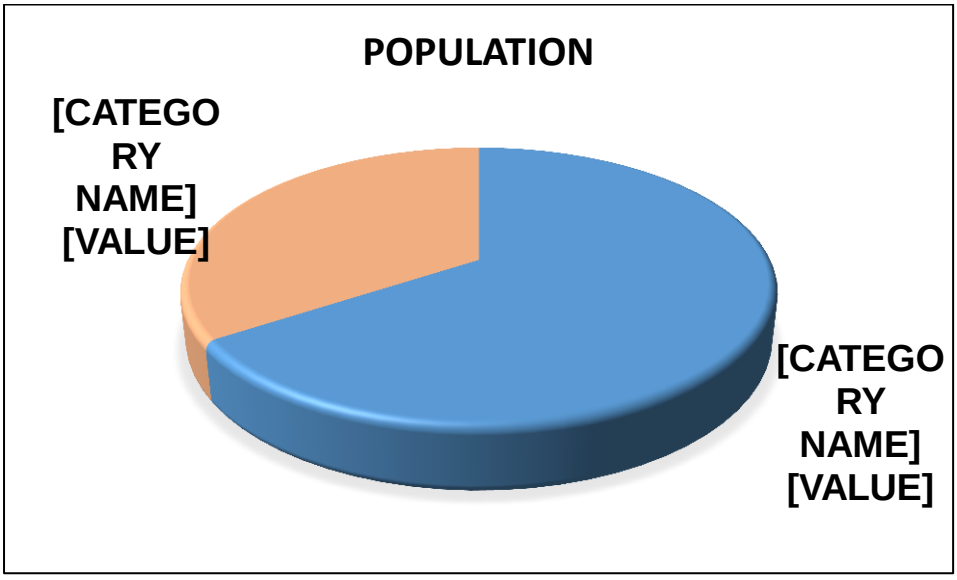


Figure 4.1: Male vs Female Population

The median age was 45 years. In this study, one patient was admitted unconsciously therefore the age is unknown and was left out of the calculations, including the total sample and the calculation of the mean but was an adult male.

The proportion of the population aged less than 24 months was 1.32%. This is unexpected as only adult ICUs were included in this study, but a child that was admitted as a trauma case with severe injuries was in the unit and awaiting transfer to a neonatal ICU when stabilized and was therefore included in the study. A total of 5 children between the age of 2 -15 were also admitted to the ICUs

(6.5%). The reason for the children being present is that the healthcare facility is one of the main trauma facilities in the Kingdom of Saudi Arabia and patients are transferred to the healthcare facility for specialized care. Refer to Figure 4.2 for data.

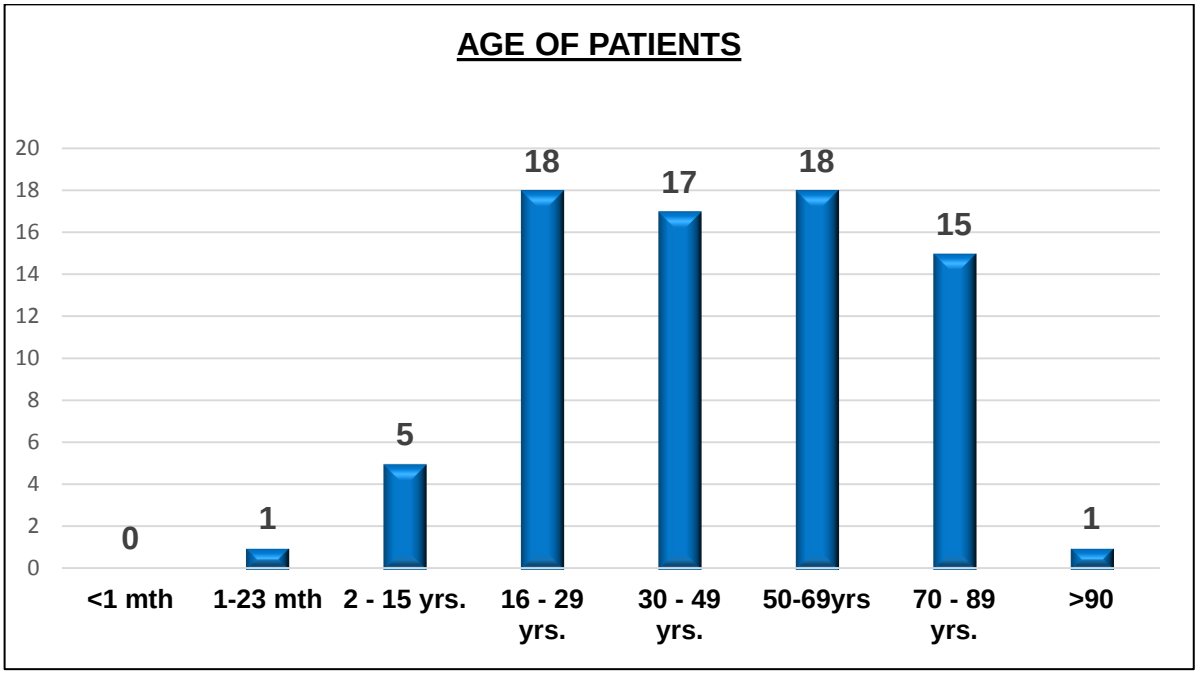


Figure 4.2: Age of patients

4.3.2 Risk factors associated with HAI

Risk factor data was collected. Information on in situ devices was recorded as per definition. The following devices was recorded: peripheral vascular catheters (PVC), central vascular catheters (CVC) and urinary catheters (UC). Underlying diseases like diabetes and cancer as well as other risk factors e.g. use of cortisone was recorded from the medical records.

The main diagnosis of the patients is reflected in Figure 4.3. The patient's diagnosis data was captured according to the codes used for main diagnosis. See Annexure A, section B and Annexure B: codes for Main Diagnosis of patient.

The biggest proportion of patient's main diagnosis was related to the nervous system with a total of 38.2%. This correspond with the head injuries in the Trauma ICU and the fact that the healthcare facility is the biggest trauma unit in the Kingdom of Saudi Arabia. The main diagnosis related to the respiratory system of patients constituted 23.7% and the injury and poisoning was third highest at 19.7%. Trauma patients' length of stay are on average higher and, therefore, their risk of infection also increases as their length of stay increases.

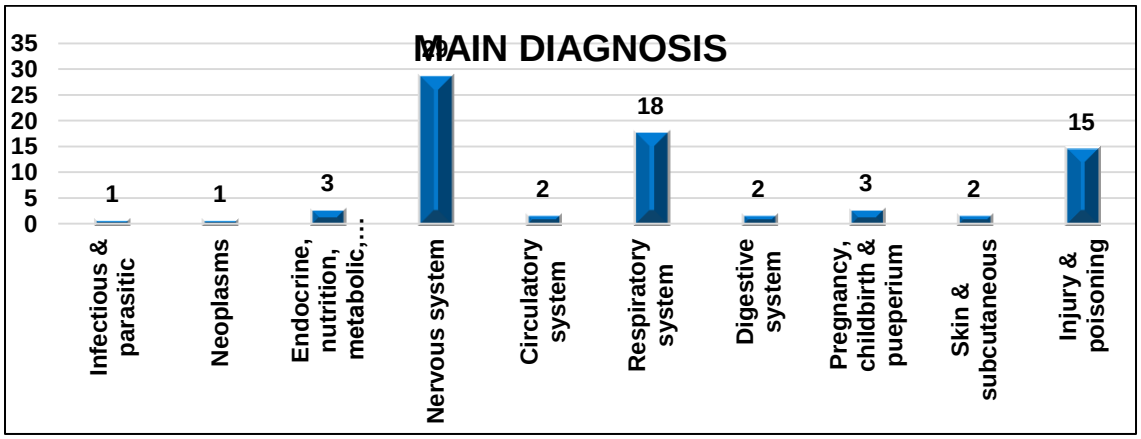


Figure 4.3: Main diagnosis of patients admitted

a) Device usage

Device usage was high overall. A total of 88.2% of the patients had urinary catheters, while 52.6% had a peripheral line, 48.7% a central intravascular catheter and 68.4% were mechanically ventilated**.** A total of 61.8% of patients had at least 3 devices in situ, increasing their risk of HAI.

As per the CDC (2012:6-5) definitions, “Lung expansion devices, such as intermittent positive-pressure breathing, nasal positive end-expiratory pressure and continuous nasal positive airway pressure devices were not considered as ventilation unless delivered via tracheostomy or endotracheal intubation”.

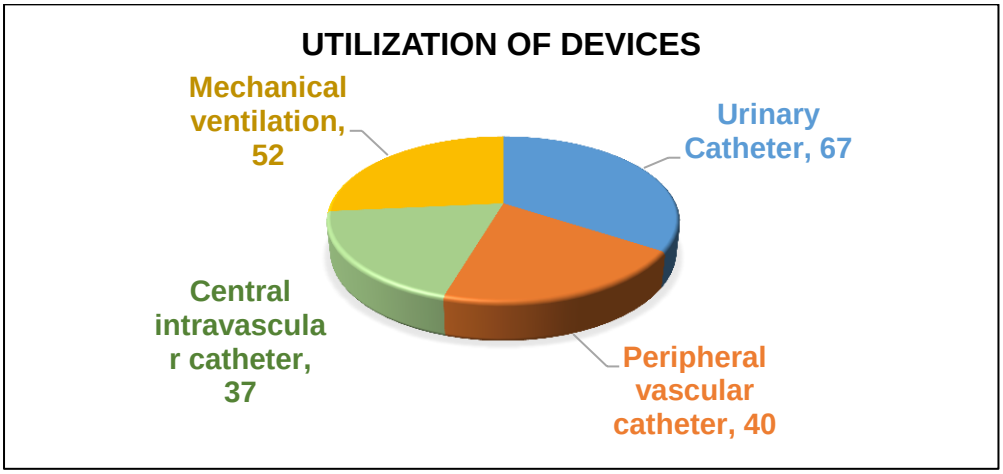


Figure 4.4: Utilisation of devices

b) Other risk factors

The following risk factors, other than devices, were recorded.

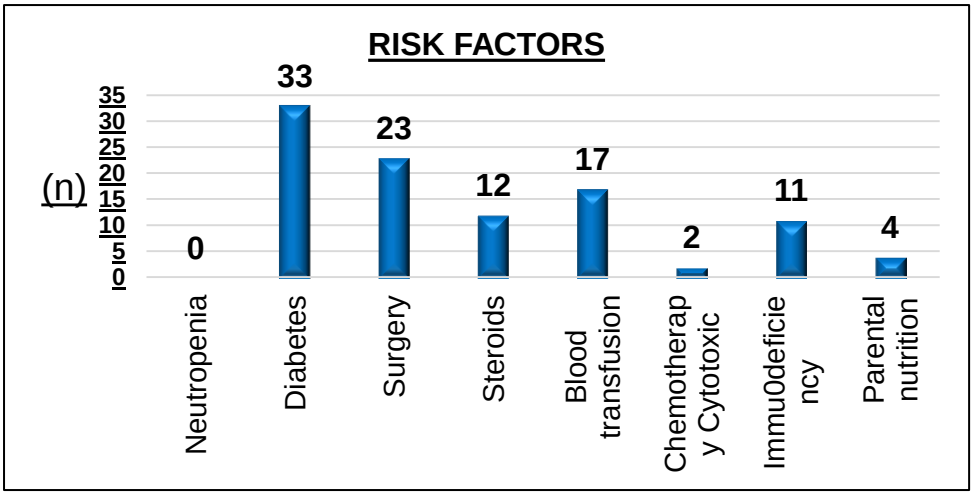


Figure 4.5: Risk Factors

Risk factor data was collected that included underlying diseases. Underlying diseases contribute to infections and can increase the risks and severity of a patients condition. The risks factors identified in Figure 4.5 are known to contribute to the risk of getting an infection.

4.3.3 Hospital acquired infection prevalence rate

Active infections were recorded that was acquired due to admission to the ICU. Hospital acquired infections were considered active on the basis of the following CDC (2012:12) definition:

- “Patient met one of the HAI case definitions on the day of survey
- Patient was receiving antimicrobials for a HAI on the day of survey and the HAI had previously met one of the case definitions between day 1 of antimicrobial treatment and the day of survey”.

According to the CDC (2012:12) “onset of HAI must have occurred within one of the following time frames:

- Day 3 of current admission onwards (day of admission is Day 1)
- Present on admission (or presenting on Day 1 or 2) in patients discharged from hospital (acute or non-acute) in previous 2 days
- Surgical site infection present on admission (or presenting on Day 1 or 2)
- Device-associated infection (pneumonia, UTI, bloodstream infection) following insertion of device (including Day 1 or 2 of admission)” (CDC 2012:12).

The prevalence rate for all the patients resident in the adult ICU on the day of the survey was 44.7%. According to a study done in Saudi Arabia by Balkhy et al. (2006:328) “the majority of infections in the ICU were VAPs (47.6%) followed by line related BSIs and catheter related UTIs at 19% each”. In the same study, 46.7% of the patients admitted to ICU had a HAI (Balkhy et al., 2006), these results correlate with the result found in this study.

4.3.4 HAI prevalence per ICU

As expected the HAI prevalence rates differed across the ICUs. The highest HAI prevalence was in the Burn ICU (100%), followed by the Adult ICU (50%), Trauma ICU (32%) and Maternity ICU with no HAIs.

Table 4.2: ICU Type and patients surveyed

Name of ICU	Total patients (n)	HAI(n)	Prevalence rate %
Trauma ICU	25	8	32
Adult ICU	42	21	50
Burn ICU	5	5	100
Maternity ICU	4	0	0

4.3.5 HAI Categories

The infection categories shown are shown in Figure 4.6 below. Pneumonia showed the highest rate (25 %), followed by bloodstream infection (13.15%), surgical site infections (9.2%) and urinary tract infection (3.9%). The results of this study are compared in details with other studies in Chapter Five.

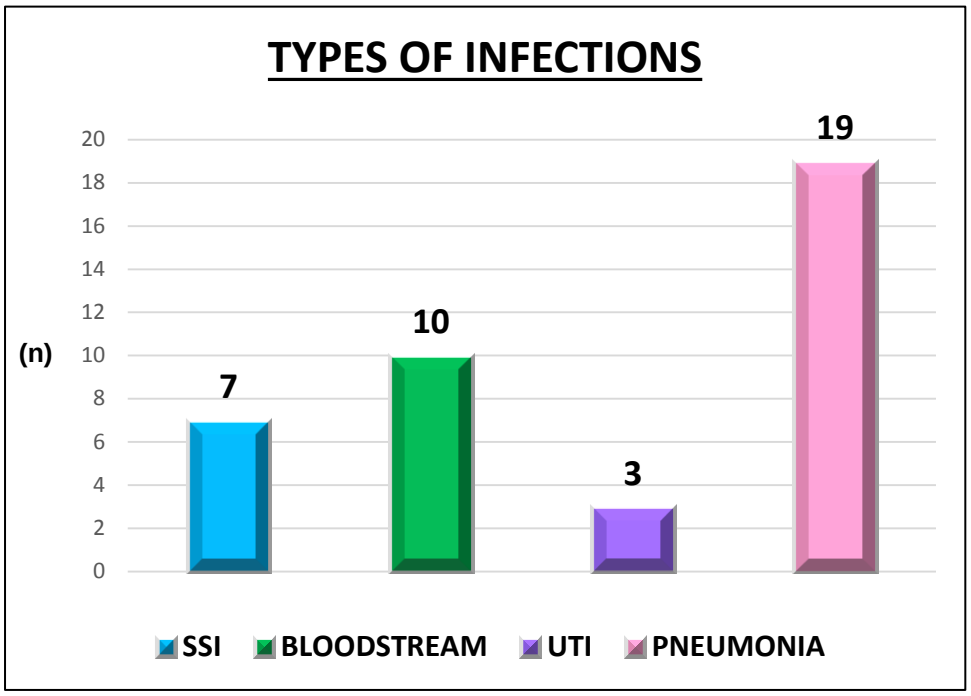
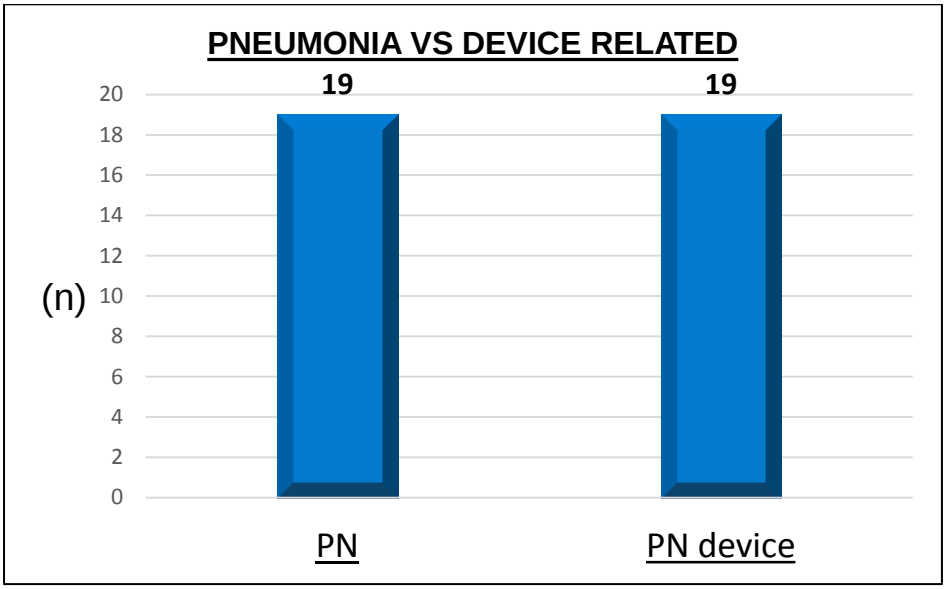


Figure 4.6: Infection categories

a) Pneumonia

The CDC (2012) definitions was applied to identify these infections. A total of 19 pneumonia infections were recorded. Relevant devices were in situ (intubated within 48 hours) before onset of the infections making it all device related infections. As per CDC (2012:6-5) “the definition of pneumonia was subdivided into 5 categories PN1 to PN 5”. See Annexure I. As per CDC (2012:6-5) “PN1 to PN3 required microbiological confirmation and PN 4 and PN5 were defined as clinical pneumonia without microbiological evidence”. In this study all the pneumonias were classified as PN4.



PN = Pneumonia, PN device = Pneumonia related device e.g. ventilator

Figure 4.7: Pneumonia

b) Bloodstream infection

Figure 4.8 relates to BSIs. The CDC (2012) definitions was applied to identify these infections. Two primary and eight secondary BSIs were identified. All of the patients identified with BSI's had a device in situ in the forty-eight hours prior to onset of infection. This is referred to as a catheter related associated bloodstream infection (CLABSI). See Annexure F. for the definition used.

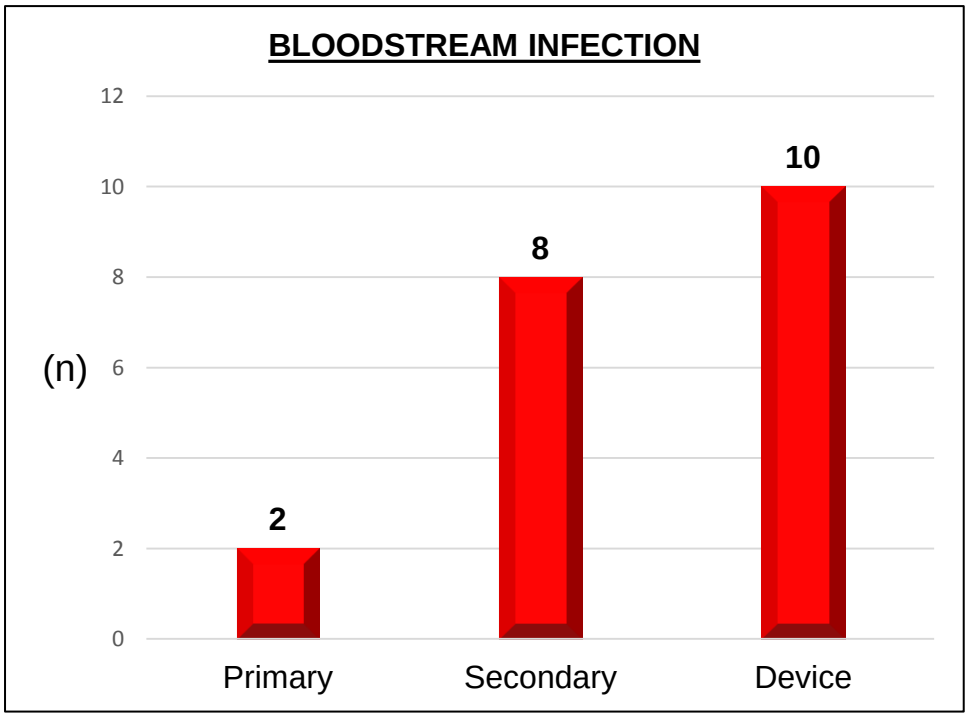


Figure 4.8: Bloodstream infections

c) Urinary tract infections

The CDC (2012) definitions was applied to identify these infections. A total of 4 UTIs were microbiology confirmed. All 4 identified UTIs were device related. This means the infection was identified when a urinary catheter was in situ and is called a catheter associated urinary tract infection (CAUTI). The urinary catheter had to be inserted in the seven days before the beginning of the infection. See Annexure G, for the definition used.

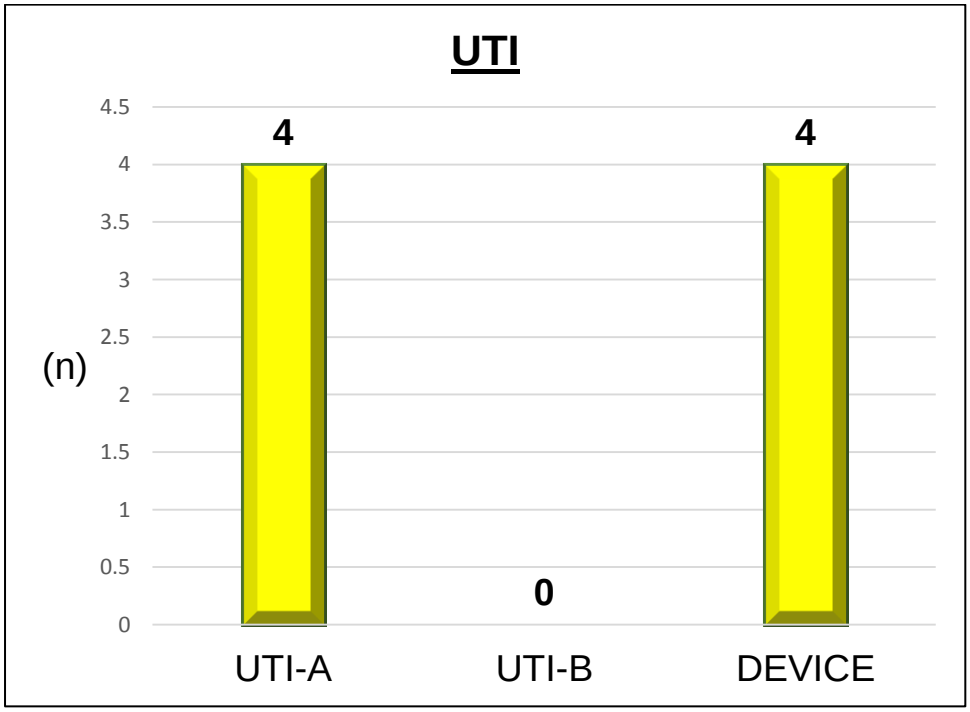


Figure 4.9: Urinary tract infections

d) Surgical site infection

The CDC (2012) definitions was applied to identify these infections. Six SSIs was identified, of which 3 was superficial SSIs and 3 was deep SSIs. No deep/organ space infections were identified.

According to the CDC definitions: “superficial infections occur within 30 days after the operation and infection involves only skin and subcutaneous tissue of the incision. Deep infection occurs within 30 days after the operation if no implant is left in place, or within one year if an implant is in place and the infection appears to be related to the operation and infection involves deep soft tissue (e.g. fascia, muscle) of the incision” (CDC 2012:16-20). Additional signs and symptoms of wound infections also need to be present like redness, swelling, pain, purulent drainage, spontaneously dehiscence of the wound or diagnosis made by consultant clinician. See Annexure E for the definition used.

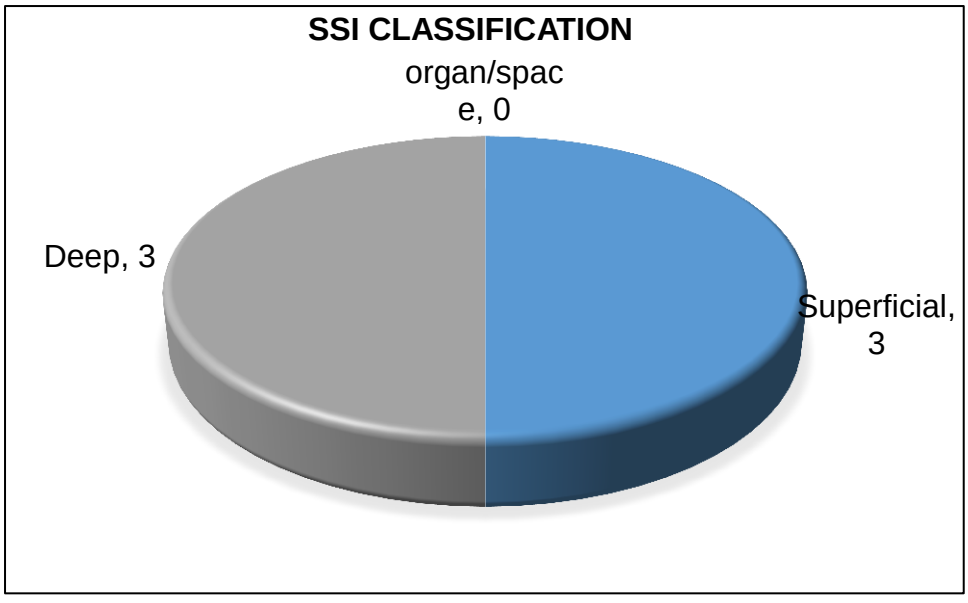


Figure 4.10: Surgical site infections

4.3.6 Antimicrobial treatment and indications

According to the CDC (2012:17) definition: “Data on antimicrobial use was collected if the patient was receiving an antimicrobial for treatment or medical prophylaxis at the time of survey *and/or* received at least one dose of surgical prophylaxis prior to 8 a.m. on the survey day”.

A total of 61.8% of patients received an antimicrobial on the day of the survey. Up to 4 antimicrobials per patient could be recorded on the data sheet. The antimicrobials are divided into first, second, third and fourth indication antimicrobials. The indication for the antimicrobial was also recorded and was categorized under specific, empirical, prophylaxis and other. See the figures below for the indications.

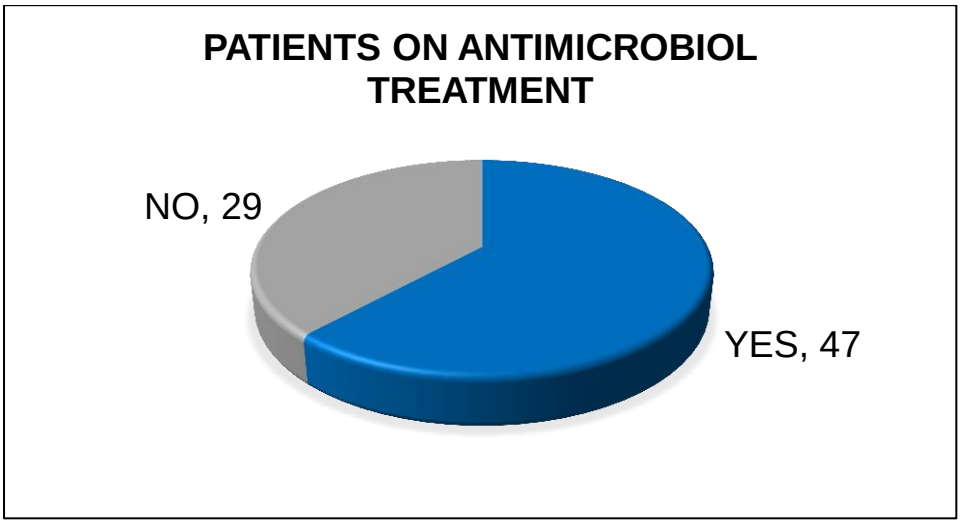


Figure 4.11: Antimicrobial treatment

As per the CDC (2012:17) “The indication for prescription was recorded as treatment of an infection, empirical treatment, surgical prophylaxis (single dose; within 24 hours; >24 hours), or reason other than treatment or prevention of infection”.

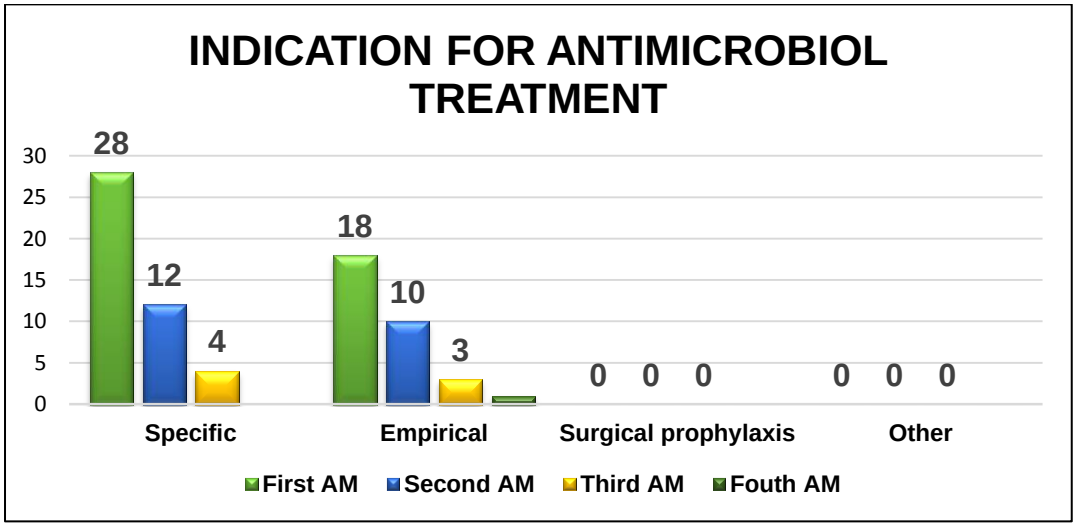


Figure 4.12: Indication for Antimicrobial treatment

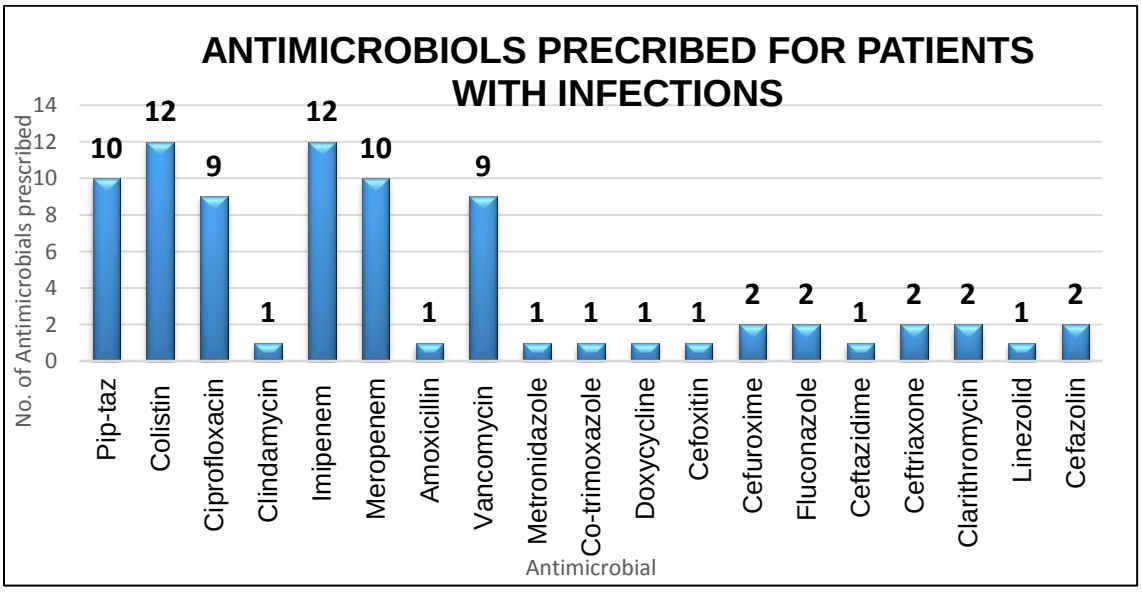


Figure 4.13: Antimicrobials prescribed for patients with infections

The antimicrobiols identiffied during data collections is set out in Figure 4.13. These antimicrobios was prescribed to patients with infections

4.3.7 Microbiology results

Microbiology results had to be available on the day of data collection. Awaited results was not followed up after the collection period. The most frequently recorded group of organisms were *Acinetobacter baumanni*, followed by *Klebsiella pneumoniae* and *Pseudomonas aeruginosa.* Difficulty was experienced as the laboratory reports were not always readily available at the bedside. Physician notes were also used to identify micro-organisms.

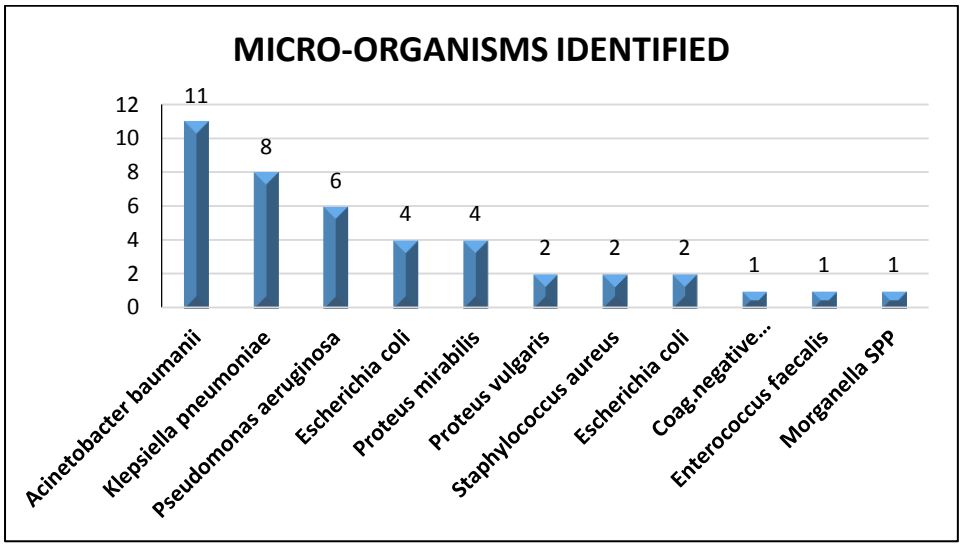


Figure 4.14: Micro-organisms identified

4.4 SUMMARY

Point prevalence surveys ensure representative data. It is also effective in gathering high quality data for infection control purposes. The chapter discussed the descriptive statistics used to describe and analyse the collected data.

The next chapter discusses the limitations in conducting the study and summarises the research findings, conclusions and recommendations.

CHAPTER FIVE

DISCUSSION, LIMITATIONS, RECOMMENDATIONS, AND CONCLUSIONS

5.1 INTRODUCTION

In this final chapter of the study a summary of the main study is presented, including various conclusions that have been deduced from the research findings. This is followed by a discussion on the limitations of the study and recommendations obtained from the results of the study.

5.2 DISCUSSION OF THE STUDY

This report presents the results of the 2016 Point Prevalence Study done in a healthcare facility in Saudi Arabia. The fieldwork was completed during July 2016. The PPS included 76 eligible patients in the ICU.

PPS has been used on several occasions, in different parts of the world, to establish the burden of HAI in healthcare facilities, for example, Northern Ireland, Saudi Arabia, South Africa and Argentina. The study used standardised definitions of the CDC 2012; these are the same definitions used in the studies mentioned above.

The purpose of this study was to determine the situation relating to prevalence rates, risk profiles and risk factors in the ICUs of the selected healthcare facility. In order to fulfil the purpose four objectives were set and were achieved.

The objectives of this research were to:

- Describe HAIs by types of patients and specialties
- Describe the risk factors, such as indwelling devices, surgery and immune suppression risks
- Determine the prevalence rate for the four major infections
- Describe the micro-organisms and AMR profiles for the HAIs identified.

Medical records of all patients resident in the ICU on the day of the survey were reviewed. The medical records were examined for data on the demographics and clinical information needed to complete the data sheet, while applying the standardised definitions.

This study was concerned with active infections. Active infections are acquired during admission to a healthcare facility. According to (Zhang *et al*. (2016:163), "the prevalence of HAIs (defined as the number of infected patients divided by the total number of patients) and the prevalence of a specific infection (defined as the specific infection type of HAI divided by the total number of patients) was assessed during this data collection)".

Although the same method and data sheet was used as in the South African study, comparison with other studies needs to be done with caution due to the difference in sampling strategy, the healthcare facility level, environmental factors and patient population. An example of the latter, as stated by Duse (2006), is that with the South African results the difference in the rates in their study was the fact that half of the admission in the public sector was HIV related.

5.2.1 Objective one: Describe HAI by types of patients and specialties

A total of four adult ICUs namely: Trauma, Burn, Maternity and Adult ICU were included in the study. A total of 76 eligible patients' medical record was reviewed to complete the data sheets. The largest proportion of eligible patients came from the Adult ICU with a total of 42 (n=42). The overall bed occupancy during the survey was 74.5%.

The prevalence rate for all the patients resident in the adult ICUs on the day of the survey was 44.7%. According to a study done in Saudi Arabia by Balkhy et al. in 2006, 46.7% of the patients resident in ICU had a HAI (Balkhy et al., 2006); these results correlate with the results found in this study. HAI prevalence varied across the ICUs used in this study, with the highest HAI prevalence in the Burn ICU (100%), followed by the Adult ICU (50%), Trauma ICU 32% and Maternity ICU with no HAIs. It is expected that a burn ICU HAI rate is high, as these patients are at very high risk because of the loss of skin and which leads to higher exposure to infection. The result of the maternity ICU is also expected as the length of stay is much lower than in other ICUs as it is patients expected to be healthy.

On the day of data collection at each ICU, all patients resident in the ICU were included in the study. Females represented 34.21% of the survey population and males 65.8%. A total of 7 females (26.92%) and 27 males (54%) had HAIs making the males a substantially higher risk group for HAI than the females. Zhang et al. (2016) study also showed that the prevalence of HAI was significantly higher in male patients hospitalised in an ICU (35%). The same higher rates in males was found in the study of Balkhy et al. (2006).

The median age of 45 years was younger than expected. In the study done by Balkhy et al. (2006) the average age was 36.8 years, while in the study of Zhang

et al. (2016) the age of the patients ranged from 2 days to 106 years with an average age of 55.9, which is higher than in this study (Zhang et al., 2016). One patient was unknown as he was admitted unconsciously and was left out of the calculations, including the total sample and the calculation of the mean but was an adult male. The proportion of the population aged less than 24 months was 1.32%. This is unexpected as only adult ICUs were included in this study, but a child that was admitted as a trauma case with severe injuries was in the unit and awaiting transfer to a neonatal ICU when stabilized and was therefore included in this study. A total of 5 children between the age of 2 -15 were also admitted to the ICUs. The reason for the children being present is that the healthcare facility is one of the main trauma facilities in the Kingdom and patients are transferred to the healthcare facility for specialised care.

5.2.2 Objective two: Describe the risk factors such as indwelling devices, surgery and immune suppression risks.

Risk factor data was collected for the underlying disease for all patients as well as other possible risks that can contribute to infections. The patient records were reviewed to identify these risks.

The biggest proportion of patient's admission diagnosis was related to the nervous system, with a total of 38.2%. This corresponds with the head injuries in the Trauma ICU and the fact that the healthcare facility is the biggest trauma unit in the Kingdom of Saudi Arabia. The respiratory system proportion of patients was 23.7%, and the injury and poisoning were third at 19.7%. Trauma patients' length

of stay are on average higher and therefore their risk of infection also increases as their length of stay increases; this is reflected in the results. In the study done by Meric et al. (2005) the primary reason for admission was respiratory (26.7%), followed by neurologic (16.8%) and cardiovascular (15.2%). This correlates with this study as the two highest numbers are also neurologic and respiratory.

Device related infections are major focus in infection prevention as research has shown, therefore, each medical record was surveyed for the presence of indwelling devices. The survey definitions were applied for devices in situ or that were in situ days before the survey. Zang et al. (2016:163) results showed that patients who were exposed to devices had a significantly higher prevalence of HAI. In the study of Balkhy et al. (2006) the most common HAI was also line or device related. Ferreira et al. (2017) found in their study that the risk factors which are relevant to HAIs were males, aged >50 years, with an insertion of a central venous catheter.

Device usage was high overall, as all patients had some kind of device in situ upon data collection. A total of 61.8% of patients had at least 3 devices in situ, increasing their risk of HAI. A total of 48.7% had a central intravascular catheter, 52.6% had a peripheral line, 68.4% were mechanically ventilated and 88.2% of the patients had urinary catheters.

As per the CDC (2012:6-5) definitions, “Lung expansion devices, such as intermittent positive-pressure breathing, nasal positive end-expiratory pressure and continuous nasal positive airway pressure devices were not considered as ventilation unless delivered via tracheostomy or endotracheal intubation”.

5.2.3 Objective three: Determine the prevalence rate for the four major infections

A main focus of this survey was the following HAI: line related bloodstream infection, ventilator associated pneumonias, surgical site infections and catheter related urinary tract infections. HAI prevalence rate was identified for each infection category. Pneumonia showed the highest prevalence rate (25%), followed by bloodstream infection (13.15%), surgical site infections (9.2%) and urinary tract infection (3.9%). In a similar PPS, using the same methodology, in South Africa, “the combined prevalence for the four surveyed infections was 9.7%” (Durlach et al., 2012:220). Compared to the point prevalence study done in Saudi Arabia by Balkhy et al. (2006) the VAP rate in this study is significantly lower than their result of 47.6%.

a) Pneumonia

A total of 19 pneumonia infections were recorded. Relevant devices were in situ (intubated within 48 hours) before onset of the infections making it all device related infections. As per CDC (2012:12) “the definition of pneumonia was subdivided into 5 categories PN1 to PN 5”, see Annexure I. As per CDC (2012:12) “PN1 to PN3 required microbiological confirmation and PN 4 and PN5 were defined as clinical pneumonia without microbiological evidence”.

In this study, all of the pneumonias were classified as PN4. The result of this study’s VAP rate of 23.68% is significantly lower compared to the VAP rate of 47.6% in a PPS done in Saudi Arabia by Balkhy et al. (2006). In the study done by

Zarb et al. (2012), pneumonia accounted for 25.7% of all infections, this correlates with this study.

b) Bloodstream infections

Two primary and eight secondary BSIs were identified during the study. All 10 of these infections identified had a device in situ in the forty-eight hours before the infection was identified. It is called a catheter associated bloodstream infection (CLABSI). In the study done in Saudi Arabia by Balkhy et al. (2006), line-related bloodstream infections in the ICU accounted for the most infections with a total rate of 19%. This is higher than the rate of 13.15% in this study. In the study done by Zarb et al. (2012) on European data, bloodstream infections accounted for 14.2%, which is more in line with the results of this study.

c) Urinary tract infection

A total of 4 UTIs were microbiology confirmed. All 4 identified UTIs were device related and had a urinary catheter “in situ in the seven days prior to onset of infection, i.e. catheter associated urinary tract infection (CAUTI)” (CDC 2012:16-5). The UTIs related to devices in the study by Balkhy et al. (2006) was 19%, significantly higher than the result of this study of 3.9%.

d) Surgical site infections

A total of six SSIs was identified, 3 superficial SSIs and 3 deep SSIs. No deep/organ space infections were identified. According to the CDC definitions, “superficial infections occur within 30 days after the operation and infection involves only skin and subcutaneous tissue of the incision. Deep infection occurs within 30 days after the operation if no implant is left in place, or within one year if an implant is in place and the infection appears to be related to the operation and infection involves deep soft tissue (e.g., fascia, muscle) of the incision” (CDC 2012:15). Additional signs and symptoms of wound infections also need to be present like redness, swelling, pain, purulent drainage, spontaneously dehiscence of the wound or diagnosis made by consultant clinician. These patients fitted the definitions of a SSI. In the study done by Zarb et al. (2012) SSI was the second highest reported infection with a rate of 18.9%.

5.2.4 Objective four: Describe the micro-organisms and AMR profiles for HAIs identified

a) Antimicrobials

As per the CDC (2012:17)’ “data on antimicrobial use was collected if the patient was receiving an antimicrobial for treatment or medical prophylaxis at the time of survey *and/or* received at least one dose of surgical prophylaxis prior to 8 a.m. on the survey day”.

A total of 34 patients were identified with HAIs but a total of 47 patients received antimicrobials. The reason is that some of the patients had community acquired infection and were thus admitted with the infection.

A total of 61.8% of patients received an antimicrobial on the day of the survey. In the study of Zarb et al. (2012), 34.6% of the patients received an antimicrobial, which is significantly lower than in this study. Up to four antimicrobials per patient could be recorded on the data sheet. The antimicrobials were divided into first, second, third and fourth indication antimicrobials. The indications were categorized under specific, empirical, prophylaxis and other. A total of 61.8% of the patients received one antimicrobial, 22% received a second, 9% a third and 3% a fourth antimicrobial. In the Zhang et al. (2016) study, antimicrobials were only prescribed to 34.3% of the patients, 48.2% as treatment and 41.7% used as prophylaxis.

The antimicrobial agents totalled 19. The most prescribed antimicrobials were Colistin and Imipenem. Colistin is known to be used as last resort antimicrobial for resistant Acinetobacter *baumannii*. These finding correlates as *Acinetobacter baumannii* was the most identified pathogen. Other antimicrobials that were in high use were Meronem and Piperacillin-tazobactam. The fact that cephalosporin was highly prescribed is of concern as it is the last resort generation of antimicrobials.

It is essential that nursing also play its role in the antibiotic stewardship programmes as the CDC puts the emphasis on the fact that “antibiotic use is the single most important factor leading to antibiotic resistance” (Manning, 2016:11). Antibiotic stewardship “is a set of inter-professional coordinated strategies to improve antibiotic use, the nurse can assist by ensuring that every patient that gets

an antibiotic gets the right antibiotic, at the right dose, administered through the right route, for the right duration" (Manning, 2016:11).

b) Microbiology results

Microbiology results had to be available on the day of data collection. Awaited results was not followed up after the collection period.

A total of 42 pathogens were identified in this study. The most frequently recorded group of organisms were *Acinetobacter baumannii* (26.2%), followed by *Klebsiella pneumoniae* (19%) and *Pseudomonas aeruginosa* (14.3%). Difficulty was experienced as the laboratory reports were not always readily available at the bedside.

If compared, the study by Zhang et al. (2016:161) had the same main pathogens with "*Pseudomonas aeruginosa* accounting for 18.9%, *Acinetobacter baumannii 17.5% and Klebsiella pneumonia 9.8%".* Balkhy et al. (2006:330) also showed the most frequently isolated pathogens as *"Pseudomonas* aeruginosa (21.3%), *Enterococcus spp* (16.9%), *Klebsiella spp* (10.1%), *Staphylococcus spp,* including methicillin-sensitive *Staphylococcus aureus* and methicillin-resistant *Staphylococcus aureus* (13.5%)". This study does differ from the results of Zarb et al. (2012:5) where their finding showed that their "most commonly isolated micro-organism was *Escherichia coli,* which accounted for 15.2% and *Methicillin Resistant Staphylococcus aureus* (MRSA) for 12.1%".

This study was too small to detect statistical significance between pathogens causing HAI. Compared to other studies it is in line with their findings that Gram-negative bacteria accounts for most HAI.

5.3 Limitations

The following were limitations in the study:

- All the data collection of all four ICUs could not be performed on one day due to time limitations of one researcher
- Medical records data are not always complete and accurate
- Only one public healthcare facility in Saudi Arabia was used. Most of the literature showed bigger studies with the involvement of more than one healthcare facility or a hospital wide coverage
- ICU patients were not compared on length of stay; some might have had a shorter or longer stay putting them into different risk groups
- Because the study was limited to specific ICUs an estimate of the HAI for the healthcare facility in total cannot be calculated
- Laboratory results were not always available at the bedside and access to computers system had to be sought to gain access.
- The findings cannot be generalized because it was done in one hospital

5.4 Recommendations

Healthcare workers should perceive patient safety and clinical outcomes as the primary motivation to reduce HAIs. The prevention of HAI demands a thorough

knowledge of infection rates, sources, risks and micro-organisms. After setting the baseline on HAI prevalence for the facility, priorities can be set to do quality improvement and improve patient safety. Healthcare facilities are very dynamic and changes occur when acute populations change. It is also well known that microorganism's resistant patterns had changed drastically over the last few years. The different type of interventions done in health care facilities also influence infection control point prevalence rates.

Infection control should be set as a high priority at all times in ICU's. The baseline set with this study should set improvement programs in action. A more active surveillance approach to the 4 major infections should be encouraged.

The current HAI incidence surveillance programme should be reviewed. The high rate of VAP necessitate further investigation and more detailed surveys. Secondly, active surveillance on VAP and other infections should take place. A repeated prevalence survey would be definitely useful as this would assist in the change in epidemiology as it occurs in HAI. Results of the surveys would help to monitor the effectiveness of the improvement programmes. Priority areas can then be adapted as they change in the hospital setting.

Nurses are central to and in some ways the most visible part of healthcare services in an ICU. "Nurses have hands-on daily contact with their patients and therefore play a vital role in patient safety and infection control" (Smith and Lockhorst, 2009). Therefore, Nurses are important in doing evidence-based infection control practices to reduce HAI. They have specific responsibilities when it comes to patient care and patient safety of which infection control forms one of the pillars.

With the introduction of Infection Control Link nurses in the ICUs on a 24-hour basis, 7 days a week, patient safety can be ensured through the monitoring of infection control practices, introduction of isolation precautions, if needed, and on the spot training. A study done by Xu et al. (2015: no p) showed that “after the implementation of infection control nurses in each unit, the mortality rate fell from 4.81% to 3.73% and the incidence of VAP reduced from 44.6% to 34.32%”.

Intensive training of link nurses on evidence-based knowledge will ensure that they are skilled for the implementation of these practises. This will ensure continuation of quality care for ICU patients. These link nurses can assist in patient and family education, starting with the promotion of hand and personal hygiene. Link nurses y can play a vital role in the implementation on IPC bundles. They can also oversee IPC practises and promote of hand hygiene of personnel. Link nurses can play a key role in the morning huddle in each unit to discuss infectious patients, risks and devices.

Education and training can be given for the implementation of tools and methods to reduce HAI rates. With the specific 4 infections, a program to reduce the usage of device and subsequently reducing device days can be implemented. This can be done by the bundle approach.

Targeted education through daily staff briefings (huddle) in nursing units can improve the awareness of infection control issues and implementation of infection control bundles for prevention of infection. This huddle can also be used to identify patients on the unit with risk factors, for example, discontinuation of Foleys catheter to reduce catheter related infections.

The introduction of a more direct reporting system for the infection control department could be very useful. A short report about patients with signs and symptoms of any possible infections can be sent to the infection control department on a daily basis, for example, at 7am covering the previous 24-hours. These patients can then be followed up by the infection control practitioners and discussed with the physicians. This report can also be used in the huddle during hand-over.

The re-introduction of an antibiotic stewardship programme to reduce the use of antimicrobials in the institution should take place. Clear policies and guidelines need to be in place for the HCF on antimicrobial prescription.

Nursing can play a crucial part in antimicrobial stewardship. Nurses need to be aware of the antibiotic resistant bacteria and their spread. Nursing perspective and active engagement are crucial for antibiotic stewardship programmes (Manning, 2016:11). By giving support and training to nurses, specific to the interpretation of results and antimicrobials, it could be ensured that antimicrobial treatment is in line with microbiology results. Nurses can ensure that antimicrobials are prescribed for appropriate duration by reminding the physicians when antimicrobials are prescribed for longer than necessary Nurses can also promote de-escalation when laboratory results indicate it. Nurses are involved in patient safety with antibiotic administration for example, giving the right dose at the right time. This can be achieved through competencies and skills training. The focus can be started by training the link nurses in each area.

Nurses can ensure that cultures are performed before antibiotics are started. The emphasis should also be on the best practice sample collection method by

ensuring competencies and skills through training. This type of training and focus can be part of the quality improvement programme based on the results of this study.

Manning's (2016:13-15) suggestions regarding nursing and antibiotic stewardship can be encouraged and implemented in the facility. These suggestions from Manning include the following:

- "Ensure pertinent information about antibiotics at the point of care
- Question the administration route
- Reassess antibiotic therapy after 2-3 days
- Review antibiotic if patient develops C*lostridium difficile* infections
- Reconcile antibiotics during patient transitions".

Infection control practitioners should play the most significant role in infection prevention and control. Infection practitioners need to be skilled in monitoring, auditing, analysing and reporting of data. Education also form part of the infection control practitioners focus areas. Their role includes antibiotic stewardship by monitoring antimicrobial prescribing and resistance patterns. Through an active surveillance programme, the infection control practitioners can provide feedback to the physicians on the usage of antibiotics and the resistance. With the resistance information available it would be easier for the doctors to prescribe antibiotics empirically.

The following recommendations should be considered for further nursing research:

- Compliance and implementation of nursing strategies to reduce HAI

- Reduction of HAI specific to patients with indwelling devices and high-risk factors.

5.5 CONCLUSION

HAI is recognised as a public threat. Patient safety are crucial in a healthcare facility including the prevention of infections. Several points may be concluded from this study. An important baseline rate has been established in the healthcare facility in Saudi Arabia and needs to be done in other provinces to be compared. This point prevalence study has provided a baseline against which future prevalence studies can be compared and provides valuable information towards the implementation of quality improvement programmes.

Infection control, once seen as the infection control practitioner's responsibility, has transitioned now to be the responsibility of all healthcare workers. The nursing personnel play a major role in the prevention of infections, as they spend 24 hours a day next to the patient bed. The segment of nursing compared to other healthcare professionals is the largest and is essential in preventing and controlling HAIs and improving patient safety. Nursing management can introduce a quality improvement programme based on the findings of the study. To reduce HAI, an active link nurse programme can assist in the implementation and evaluation of the quality improvement programme.

Finding from this point prevalence studies provide information to review if any changes happened in the burden of HAI. It also identifies possible changes in epidemiology. The data set the baseline to measure the success of infection control programmes, to identify areas of improvement, set performance goals and

to meet public reporting. The identified baseline can set the scene for policy changes and adaption of interventions. It can also orchestrate the implementation of an antimicrobial stewardship program.

Point prevalence survey studies results can differ in the same ICUs. Results can differ due to things like the time of year, patient volume and service load, the different lengths of stay, sizes of the study, and the population's risk and diagnosis.

Despite the limitations mentioned above, the study added valuable data on the HAI of the ICUs. The data generated is remarkably similar to studies done in Saudi Arabia and other eastern countries.

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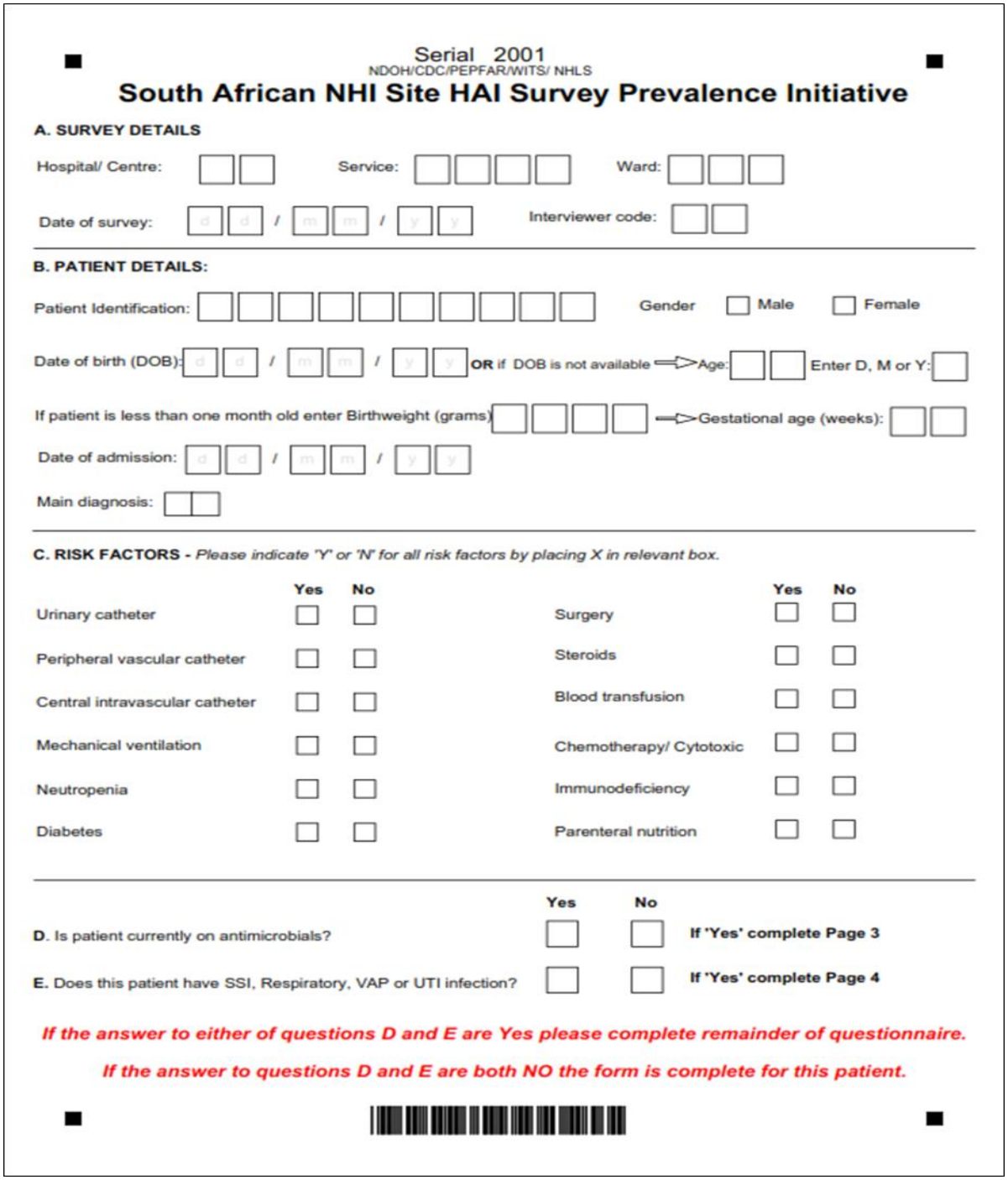
Annexures

Annexure A

Structured record review data sheet



Serial 2001
NDOH/CDC/PEPFAR/WITS/ NHLS

South African NHI Site HAI Survey Prevalence Initiative

A. SURVEY DETAILS

Hospital/ Centre: ☐☐ Service: ☐☐☐☐ Ward: ☐☐☐

Date of survey: d d / m m / y y Interviewer code: ☐☐

B. PATIENT DETAILS:

Patient Identification: ☐☐☐☐☐☐☐☐☐☐ Gender ☐ Male ☐ Female

Date of birth (DOB): d d / m m / y y **OR** if DOB is not available ⇨ Age: ☐☐ Enter D, M or Y: ☐

If patient is less than one month old enter Birthweight (grams) ☐☐☐☐ ⇨ Gestational age (weeks): ☐☐

Date of admission: d d / m m / y y

Main diagnosis: ☐☐

C. RISK FACTORS - *Please indicate 'Y' or 'N' for all risk factors by placing X in relevant box.*

	Yes	No		Yes	No
Urinary catheter	☐	☐	Surgery	☐	☐
Peripheral vascular catheter	☐	☐	Steroids	☐	☐
Central intravascular catheter	☐	☐	Blood transfusion	☐	☐
Mechanical ventilation	☐	☐	Chemotherapy/ Cytotoxic	☐	☐
Neutropenia	☐	☐	Immunodeficiency	☐	☐
Diabetes	☐	☐	Parenteral nutrition	☐	☐

	Yes	No	
D. Is patient currently on antimicrobials?	☐	☐	**If 'Yes' complete Page 3**
E. Does this patient have SSI, Respiratory, VAP or UTI infection?	☐	☐	**If 'Yes' complete Page 4**

If the answer to either of questions D and E are Yes please complete remainder of questionnaire.

If the answer to questions D and E are both NO the form is complete for this patient.

Serial 2001
NDOH/CDC/PEPFAR/WITS/ NHLS

F. Antimicrobials: *Record all antimicrobials (up to 4 antimicrobial) patient is on at time of survey.*

Antimicrobial 1: ☐☐☐☐☐☐☐ ⇨ Indication 1: ☐ Specific ☐ Empirical ☐ Surgical prophylaxis ☐ Other

Antimicrobial 2: ☐☐☐☐☐☐☐ ⇨ Indication 2: ☐ Specific ☐ Empirical ☐ Surgical prophylaxis ☐ Other

Antimicrobial 3: ☐☐☐☐☐☐☐ ⇨ Indication 3: ☐ Specific ☐ Empirical ☐ Surgical prophylaxis ☐ Other

Antimicrobial 4: ☐☐☐☐☐☐☐ ⇨ Indication 4: ☐ Specific ☐ Empirical ☐ Surgical prophylaxis ☐ Other

G. Surgical Site Infection (SSI) ⇨ ☐ Yes ☐ No

Date of operation: d d / m m / y y

Date of SSI at least 2 days after operation

Date of SSI: d d / m m / y y

Was SSI present at admission: ☐ Yes ☐ No SSI type ☐ Superficial ☐ Deep ☐ Organ / Space

SSI culture result ☐ *Enter 1 - 4*
1=Positive **2**=Negative **3**=Not done
4=Culture requested but no Laboratory information available on the time of the survey

H. Bloodstream Infection (BSI) ⇨ ☐ Yes ☐ No

Date of BSI d d / m m / y y BSI type ☐ Primary ☐ Secondary

Relevant device *in situ* before onset ☐ Yes ☐ No

BSI culture result ☐ *Enter 1 - 4*
1=Positive **2**=Negative **3**=Not done
4=Culture requested but no Laboratory information available on the time of the survey

I. Urinary tract infection (UTI) ⇨ ☐ Yes ☐ No

Date of UTI d d / m m / y y UTI type ☐ Symptomatic UTI-A ☐ Symptomatic UTI-B

Relevant device *in situ* before onset ☐ Yes ☐ No

UTI culture result ☐ *Enter 1 - 4*
1=Positive **2**=Negative **3**=Not done
4=Culture requested but no Laboratory information available on the time of the survey

J. Pneumonia (PN) ⇨ ☐ Yes ☐ No

Date of PN d d / m m / y y PN type ☐ PN1 ☐ PN2 ☐ PN3 ☐ PN4 ☐ PN5

Relevant device *in situ* before onset ☐ Yes ☐ No

PN culture result ☐ *Enter 1 - 4*
1=Positive **2**=Negative **3**=Not done
4=Culture requested but no Laboratory information available on the time of the survey

Serial 2001

NDOH/CDC/PEPFAR/WITS/ NHLS

This page refers to 1-system infection, the related pathogen and the related antibiogram.

If patient has a second system infection record infection culture results on Page 4.

If patient has more than 2 system infections use additional extension sheet.

K. Culture relates to: ☐ Surgical site ☐ Bloodstream ☐ Urinary tract ☐ Pneumonia

Enter only 2 clinically significant pathogens isolated for this infection. See protocol Page 28 for ESKAPE rules.

1st Pathogen isolated	S	R	**2nd Pathogen isolated**	S	R
Amikacin	☐	☐	Amikacin	☐	☐
Amoxicillin	☐	☐	Amoxicillin	☐	☐
Amphotericin B	☐	☐	Amphotericin B	☐	☐
Ampicillin	☐	☐	Ampicillin	☐	☐
Azithromycin	☐	☐	Azithromycin	☐	☐
Cefazolin	☐	☐	Cefazolin	☐	☐
Cefixime	☐	☐	Cefixime	☐	☐
Cefotaxime	☐	☐	Cefotaxime	☐	☐
Cefoxitin	☐	☐	Cefoxitin	☐	☐
Ceftazidime	☐	☐	Ceftazidime	☐	☐
Ceftriaxone	☐	☐	Ceftriaxone	☐	☐
Cefuroxime	☐	☐	Cefuroxime	☐	☐
Chloramphenicol	☐	☐	Chloramphenicol	☐	☐
Ciprofloxacin	☐	☐	Ciprofloxacin	☐	☐
Clarithromycin	☐	☐	Clarithromycin	☐	☐
Clindamycin	☐	☐	Clindamycin	☐	☐
Cloxacillin	☐	☐	Cloxacillin	☐	☐
Colistin	☐	☐	Colistin	☐	☐
Co amoxyclav	☐	☐	Co amoxyclav	☐	☐
Co trimoxazole	☐	☐	Co trimoxazole	☐	☐
Doxycycline	☐	☐	Doxycycline	☐	☐
Ertapenem	☐	☐	Ertapenem	☐	☐
Erythromycin	☐	☐	Erythromycin	☐	☐
Fluconazole	☐	☐	Fluconazole	☐	☐
Fusidic acid	☐	☐	Fusidic acid	☐	☐
Gentamycin	☐	☐	Gentamycin	☐	☐
Imipenem	☐	☐	Imipenem	☐	☐
Itraconazole	☐	☐	Itraconazole	☐	☐
Linezolid	☐	☐	Linezolid	☐	☐
Meropenem	☐	☐	Meropenem	☐	☐
Metronidazole	☐	☐	Metronidazole	☐	☐
Ofloxacin	☐	☐	Ofloxacin	☐	☐
Penicillin	☐	☐	Penicillin	☐	☐
Pip Taz	☐	☐	Pip Taz	☐	☐
Rifampicin	☐	☐	Rifampicin	☐	☐
Teicoplanin	☐	☐	Teicoplanin	☐	☐
Tobramycin	☐	☐	Tobramycin	☐	☐
Trimethoprim	☐	☐	Trimethoprim	☐	☐
Vancomycin	☐	☐	Vancomycin	☐	☐



Annexure B

Codes for main diagnosis of patient

Code	Main ICD-9 MC diagnoses codes
01	Infectious and parasitic diseases
02	Neoplasms
03	Endocrine, nutritional and metabolic diseases, and immunity disorders
04	Diseases of the blood and blood-forming organs
05	Mental disorders
06	Diseases of the nervous system and sense organs
07	Diseases of the circulatory system
08	Diseases of the respiratory system
09	Diseases of the digestive system
10	Diseases of the genitourinary system
11	Complications of pregnancy, childbirth, and the puerperium
12	Diseases of the skin and subcutaneous tissue
13	Diseases of the musculoskeletal system and connective tissue
14	Congenital anomalies
15	Certain conditions originating in the peri-natal period
16	Symptoms, signs, and ill-defined conditions
17	Injury and poisoning

Annexure C

Ward Codes

Ward type	**Ward code**
Critical care specialties (ICU):	
Main (General)	GICU
Maternity	MICU
Trauma	EICU
Burn	BICU

Annexure D

Algorithm for the definition of HAI (ECDC, 2012)

<table>
<tr><th>ONSET OF HAI</th><th></th><th>CASE DEFINITION</th></tr>
<tr><td>Day 3 onwards</td><td rowspan="9">AND</td><td rowspan="3">Meets the case definition on the day of survey</td></tr>
<tr><td>OR</td></tr>
<tr><td>Day 1 (day of admission) or day 2: SSI criteria met at any time after admission (including previous surgery 30 d/ 1 year)</td></tr>
<tr><td>OR</td><td rowspan="3">OR</td></tr>
<tr><td>Day 1 or day 2 AND patient discharged from acute care hospital in preceding 48 hours</td></tr>
<tr><td>OR</td></tr>
<tr><td>Day 1 or day 2 AND patient discharged from acute care hospital in preceding 28 days if CDI2 present</td><td rowspan="3">Patient is receiving treatment[3] AND HAI has previously met the case definition between day 1 of treatment and survey day</td></tr>
<tr><td>OR</td></tr>
<tr><td>Day 1 or day 2 AND patient has relevant device inserted on this admission prior to onset</td></tr>
</table>

Annexure E

Definitions of infection: Surgical Site infection (ECDC, 2012)

Surgical site infection (SSI): This question should be answered by marking an "X" inside the appropriate boxes (Yes/No).

Date of operation: Indicate the date of operation in the appropriate blocks provided. (dd/mm/yy)

Date of SSI: It refers to the date when the symptoms related to the SSI started, *a minimum of two days after the operation*. If this information is not available, fulfil with the day of sample withdraw. Still if this information is not available fulfil with the date of onset of antibiotic therapy for the SSI (no matter whether it was empirical or specific treatment). (dd/mm/yy)

Present on the time of admission: Signs and symptoms of SSI was present on admission to the hospital:

Notes:

The following SSI may be present on admission to hospital:

- Any SSI type diagnosed in a patient admitted to his hospital having been discharged from an acute hospital in the preceding 48 hours.
- SSI diagnosed in a patient admitted to this hospital and the infection is related to a non-implant surgery performed within 30 days prior to admission or implant surgery performed within 12 months prior to admission

Superficial incisional (SSI-S)

Infection occurs within 30 days after the operation and *infection involves only skin and subcutaneous tissue of the incision* and at least ONE of the following is present:

1. Purulent drainage with or without laboratory confirmation, from the superficial incision.

2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.

3. At least ONE of the following signs or symptoms of infection: pain or tenderness, localised swelling, redness, or heat and superficial incision are deliberately opened by surgeon, unless incision is culture-negative.

4. Clinical diagnosis of superficial incisional SSI made by consultant clinician.

Deep incisional (SSI-D)

Infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissue (e.g., fascia, muscle) of the incision and at least ONE of the following:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site.

2. A deep incision spontaneously dehiscence or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38º C), localised pain or tenderness, unless incision is culture-negative.

3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.

4. Diagnosis of deep incisional SSI made by consultant clinician.

Organ/Space (SSI-O)

Infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g., organs and spaces) other than the incision which was opened or manipulated during an operation and at least ONE of the following:

1. Purulent drainage from a drain that is placed through a stab wound into the organ/space.

2. Organisms isolated from an aseptically-obtained microbiological culture of fluid or tissue in the organ/space.

3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.

4. Diagnosis of organ/ space SSI made by consultant clinician.

Reporting instructions: Report vaginal cuff infections as SSI-O if diagnosed within 30 days of hysterectomy.

SSI Culture: Report:

1=Positive culture; 2=Negative culture; 3=Culture not done; 4=Culture requested but no laboratory information available on time of the survey.

Annexure F

Definitions of infection: Bloodstream infections

Bloodstream infection (BSI): This question should be answered by marking an "X" inside the appropriate boxes (Yes/No).

Date of BSI: Date of onset of Bloodstream infection' or the date whether the specimen was send away for culture. (DD/MM/YY)

BSI: Laboratory-confirmed bloodstream infection

- ONE positive blood culture for a recognised pathogen (e.g., *Staphylococcus aureus, Escherichia coli, Candida albicans* etc.) [If any doubt regarding what constitutes a recognised pathogen, please discuss with microbiology]

or

- Patient has at least ONE of the following signs or symptoms: fever (>38°C), chills or hypotension

and

TWO positive blood cultures for a common skin contaminant** (the same organism must have been isolated from two separate blood culture samples, usually taken within a 48-hour period).

**Skin contaminants = Coagulase-negative staphylococci, Micrococcus spp., Propionibacterium acnes, Bacillus spp., Corynebacterium spp.

Primary BSI:

Catheter-related BSI: Primary BSI due to infection of either a Peripheral Vascular Catheter (PVC) or Central Vascular Catheter (CVC).

Secondary BSI:

BSI arising secondary to an infection elsewhere in the body.

When the same micro-organism was cultured from both the blood and another infection site or strong clinical evidence exists that the patient's BSI developed secondary to another infection site, invasive diagnostic procedure or foreign body.

Pulmonary infection resulting in BSI (S-PUL)

Urinary tract infection resulting in BSI (S-UTI)

Surgical site infection resulting in BSI (S-SSI)

Note: Secondary BSI is reported as a separate HAI, in addition to the primary infection, if the primary infection matches the relevant HAI case definition.

Relevant devices in situ before onset:

HAI which occurs in a patient with a relevant device that was used within a defined period before the onset of clinical signs or symptoms of infection (even intermittently)

Notes:

The term *"device-related*" is used only for BSI:

Catheter-related infection, where the relevant device is peripheral or central vascular catheter and the vascular catheter was in situ within 48 hours of the onset of signs and symptoms of catheter related infection

Note that other HAI related to devices (e.g. ventriculitis due to external ventricular drain) are recorded as BSI but are not recorded as device associated)

Bloodstream Culture: - Report:

1=Positive culture; 2=Negative culture; 3=Culture not done; 4=Culture requested but no laboratory information available on time of the survey.

Annexure G

Definitions of infection: Urinary tract infections

Urinary tract infection (UTI): This question should be answered by marking an "X" inside the appropriate boxes (Yes/No).

Date UTI: Date of onset of urinary tract infection. The date the specimen was sent for culture. (DD/MM/YY)

UTI-A: microbiologically confirmed symptomatic UTI

Patient has at least ONE of the following signs of symptoms with no other recognised cause: fever (>38°C), urgency, frequency, dysuria, or suprapubic tenderness and patient has a positive urine microbiology culture report. That is, ≥ 10^5 micro-organisms per ml of urine with no more than two species of micro-organisms detected in the same urine sample.

UTI-B: not microbiologically confirmed symptomatic UTI

Patient has at least TWO of the following with no other recognised cause: fever (>38°C), urgency, frequency, dysuria, or suprapubic tenderness and at least ONE of the following:

a. Positive dipstick for leukocyte esterase and/or nitrite

b. Pyuria – White blood cells (WBC) or pus cells seen on

Reporting instructions: For urinary tract infection, only fill in one subcategory (where more than one UTI definition is met by the patient), prioritise urinary tract infection *as UTI-A>UTI-B.*

Relevant devices in situ before onset:

UTI which occurs in a patient with a relevant device that was used within a defined period before the onset of clinical signs or symptoms of infection (even intermittently)

Notes:

The term *"device-related"* is used in UTI's:

UTI where the relevant device is urinary catheter and urinary catheter was in situ within *seven days of the onset of the signs and symptoms of infection.*

UTI Culture: Report:

1=Positive culture; 2=Negative culture; 3=Culture not done; 4=Culture requested but no laboratory information available on time of the survey

Annexure H

Definitions of infection: Respiratory tract infections

Pneumonia (PN): This question should be answered by marking an "X" inside the appropriate boxes (Yes/No).

Relevant devices in situ before onset: HAI which occurs in a patient with a relevant device that was used within a defined period before the onset of clinical signs or symptoms of infection (even intermittently)

Notes: The term *"device-related"* is used only for PN where the relevant device is intubation and the endotracheal tube was in situ within 48 hours of the onset of signs and symptoms of pneumonia

Respiratory tract Culture: - Report: 1=Positive culture; 2=Negative culture; 3=Culture not done; 4=Culture requested but no laboratory information available on time of the survey.

Annexure I

Definitions of infection: Pneumonia

Pneumonia (PN):

Rx

Two or more serial chest X-rays or CT-scans of lungs with suggestive image of pneumonia for patients with underlying cardiac or pulmonary disease. In patients without underlying cardiac or pulmonary disease, one definitive chest X-ray or CT-scan is sufficient.

Symptoms

And at least ONE of the following

- Fever > 38 °C with no other cause
- Leukopenia (<4000 WBC/mm^3) or leucocytosis (≥ 12 000 WBC/mm^3)

And at least ONE of the following

(Or at least TWO if clinical pneumonia only = PN 4 and PN 5)

Microbiology

- New onset of purulent sputum, or change in character of sputum (color, odor, quantity, consistency)
- Cough or dyspnea or tachypnoea
- Suggestive auscultation (rales or bronchial breath sounds), rhonchi, wheezing
- Worsening gas exchange (e.g., O_2 desaturation or increased oxygen requirements or increased ventilation demand)

And according to the used diagnostic method

a – Bacteriologic diagnostic performed by:

Positive quantitative culture from minimally contaminated lower respiratory tract (LRT) specimen (PN1)

- Broncho alveolar lavage (BAL) with a threshold of ≥ 10^4 colony-forming units (CFU)/ml or ≥ 5 % of BAL obtained cells contain

Microbiology

intracellular bacteria on direct microscopic exam (classified on the diagnostic category BAL).

- Protected brush (PB Wimberley) with a threshold of $>10^3$ CFU/ml
- Distal protected aspirate (DPA) with a threshold of $> 10^3$ CFU/ml

Positive quantitative culture from possibly contaminated LRT specimen (PN 2) (PN 2)

- Quantitative culture of LRT specimen (e.g. endotracheal aspirate) with a threshold of 10^6 CFU/ml

b – Alternative microbiology methods (PN 3)

- Positive blood culture not related to another source of infection
- Positive growth in culture of pleural fluid
- Pleural or pulmonary abscess with positive needle aspiration
- Histologic pulmonary exam shows evidence of pneumonia
- Positive exams for pneumonia with virus or particular micro-organism detected: *Legionella spp.*, *Aspergillus spp.*, mycobacteria, *Mycoplasma spp.*, *Pneumocystis spp.*)
  - Positive detection of viral antigen or antibody from respiratory secretions (e.g., EIA, FAMA, shell vial assay, PCR)
  - Positive direct exam or positive culture from bronchial secretions or tissue
  - Seroconversion
  - Detection of antigens in urine (Legionella pneumophila, Streptococcus pneumoniae)

c – Others

- Positive sputum culture or non-quantitative LRT specimen culture (PN 4)
- No positive microbiology (PN 5)
- Reporting instructions: For pneumonia, only fill one subcategory (where more than one PN definition is met by the patient, priorities recorded pneumonia definition as: PN1>PN2>PN3>PN4>PN5)

Annexure J

Generic antimicrobial code list (ECDC, 2012)

Antimicrobial generic name	
Amikacin	J01GB06
Amoxicillin	J01CA04
Amoxicillin and enzyme inhibitor – co-amoxiclav	J01CR02
Amphotericin B (parenteral)	J02AA01
Ampicillin	J01CA01
Anidulafungin	J02AX06
Azithromycin	J01FA10
Aztreonam	J01DF01
Benzathine benzylpenicillin	J01CE08
Benzylpenicillin	J01CE01
Caspofungin	J02AX04
Cefaclor	J01DC04
Cefadroxil	J01DB05
Cefalexin	J01DB01
Cefazolin	J01DB04
Cefixime	J01DD08
Cefotaxime	J01DD01
Cefpodoxime	J01DD13

Antimicrobial generic name	
Ceftazidime	J01DD02
Ceftriaxone	J01DD04
Cefuroxime	J01DC02
Chloramphenicol	J01BA01
Ciprofloxacin	J01MA02
Clarithromycin	J01FA09
Clindamycin	J01FF01
Colistin (injection, infusion)	J01XB01
Colistin (oral)	A07AA10
Daptomycin	J01XX09
Doripenem	J01DH04
Doxycycline	J01AA02
Ertapenem	J01DH03
Erythromycin	J01FA01
Ethambutol	J04AK02
Flucloxacillin	J01CF05
Fluconazole	J02AC01
Flucytosine	J02AX01
Fosfomycin	J01XX01
Fusidic acid	J01XC01
Gentamicin	J01GB03

Antimicrobial generic name	
Griseofulvin	D01BA01
Imipenem and enzyme inhibitor	J01DH51
Itraconazole	J02AC02
Ketoconazole	J02AB02
Levofloxacin	J01MA12
Linezolid	J01XX08
Lymecycline	J01AA04
Mecillinam	J01CA11
Meropenem	J01DH02
Methenamine	J01XX05
Metronidazole (oral, rectal)	P01AB01
Metronidazole (parenteral/IV)	J01XD01
Micafungin	J02AX05
Minocycline	J01AA08
Moxifloxacin	J01MA14
Nalidixic acid	J01MB02
Neomycin enteral (oral)	A07AA01
Neomycin parenteral (IV)	J01GB05
Nitrofurantoin	J01XE01
Norfloxacin	J01MA06
Nystatin	A07AA02

Antimicrobial generic name	
Ofloxacin	J01MA01
Paromomycin	A07AA06
Phenoxymethylpenicillin	J01CE02
Piperacillin and enzyme inhibitor – piperacillin-tazobactam	J01CR05
Pivmecillinam	J01CA08
Polymyxin B enteral (oral)	A07AA05
Polymyxin B parenteral (IV)	J01XB02
Posaconazole	J02AC04
Procaine benzylpenicillin	J01CE09
Rifampicin	J04AB02
Rifaximin	A07AA11
Spiramycin	J01FA02
Streptomycin (parenteral)	J01GA01
Sulfadiazine	J01EC02
Sulfadiazine and trimethoprim	J01EE02
Sulfamethoxazole and trimethoprim (co-trimoxazole)	J01EE01
Teicoplanin	J01XA02
Temocillin	J01CA17
Terbinafine	D01BA02
Ticarcillin and clavulanic acid	J01CR03
Tigecycline	J01AA12

Antimicrobial generic name	
Tinidazole enteral (oral, rectal)	P01AB02
Tinidazole parenteral (IV)	J01XD02
Tobramycin	J01GB01
Trimethoprim	J01EA01
Vancomycin enteral (oral) [Treatment of *C. difficile* infection only]	A07AA09
Vancomycin parenteral (IV)	J01XA01
Voriconazole	J02AC03

Annexure K

Micro-organism list (ECDC, 2012)

Family	Micro-organism	MO-code
Gram-positive cocci	Staphylococcus aureus	STAAUR
	Coagulase negative staphylococci, include Coagulase-negative Staphylococci, Staphylococcus epidermidis, Staphylococcus haemolyticus and any other non-aureus species	STACNS
	Streptococcus pneumoniae or pneumococcus	STRPNE
	Streptococcus agalactiae or Group B streptococcus	STRAGA

	Streptococcus pyogenes or Group A streptococcus	STRPYO
	Other beta haemolytic streptococci – group B, Group C or Group G streptococcus	STRHCG
	Streptococcus spp. specified	STROTH
	Streptococcus spp.,	STRNSP
	Enterococcus faecalis	ENCFAE
	Enterococcus faecium	ENCFAI
	Enterococcus spp.,	ENCOTH
	Gram-positive cocci,	GPCNSP
	Other Gram-positive cocci specified	GPCOTH
Gram-negative cocci	Moraxella catarrhalis	MORCAT
	Moraxella spp., other	MOROTH
	Moraxella spp., not specified	MORNSP
	Neisseria meningitidis	NEIMEN
	Neisseria spp., other specified	NEIOTH
	Neisseria spp., not specified	NEINSP
	Gram-negative cocci, not specified	GNCNSP
	Other Gram-negative cocci	GNCOTH
Gram-positive bacilli	Corynebacterium spp.	CORSPP
	Bacillus spp.	BACSPP

	Lactobacillus spp.	LACSPP
	Listeria monocytogenes	LISMON
	Gram-positive bacilli, not specified	GPBNSP
	Other Gram-positive bacilli	GPBOTH
Enterobacteriaceae Gram-negative bacilli	Citrobacter freundii	CITFRE
	Citrobacter koseri (previous diversus)	CITDIV
	Citrobacter spp., other	CITOTH
	Citrobacter spp., not specified	CITNSP
	Enterobacter cloacae	ENBCLO
	Enterobacter aerogenes	ENBAER
	Enterobacter agglomerans	ENBAGG
	Enterobacter sakazakii	ENBSAK
	Enterobacter gergoviae	ENBGER
	Enterobacter spp., other	ENBOTH
	Enterobacter spp., not specified	ENBNSP
	Escherichia coli	ESCCOL
	Klebsiella pneumoniae	KLEPNE
	Klebsiella oxytoca	KLEOXY
	Klebsiella spp., other	KLEOTH
	Klebsiella spp., not specified	KLENSP

	Proteus mirabilis	PRTMIR
	Proteus vulgaris	PRTVUL
	Proteus spp., other	PRTOTH
	Proteus spp., not specified	PRTNSP
	Serratia marcescens	SERMAR
	Serratia liquefaciens	SERLIQ
	Serratia spp., other	SEROTH
	Serratia spp., not specified	SERNSP
	Hafnia spp.	HAFSPP
	Morganella spp.	MOGSPP
	Providencia spp.	PRVSPP
	Salmonella enteritidis	SALENT
	Salmonella Typhi	SALTYP
	Salmonella Paratphi	SALTYM
	Salmonella spp., not specified	SALNSP
	Salmonella spp., other	SALOTH
	Shigella spp.	SHISPP
	Yersinia spp.	YERSPP
	Other Enterobacteriaceae, specified	ETBOTH
	Enterobacteriaceae, not specified	ETBNSP
Other Gram-negative bacilli	Acinetobacter baumannii	ACIBAU

	Acinetobacter calcoaceticus	ACICAL
	Acinetobacter haemolyticus	ACIHAE
	Acinetobacter lwoffii	ACILWO
	Acinetobacter spp., excluding above	ACIOTH
	Pseudomonas aeruginosa	PSEAER
	Stenotrophomonas maltophilia	STEMAL
	Burkholderia cepacia	BURCEP
	Pseudomonadaceae family, other	PSEOTH
	Pseudomonadaceae family, not specified	PSENSP
	Haemophilus influenzae	HAEINF
	Haemophilus parainfluenzae	HAEPAI
	Haemophilus spp., other	HAEOTH
	Haemophilus spp., not specified	HAENSP
	Legionella spp.	LEGSPP
	Achromobacter spp.	ACHSPP
	Aeromonas spp.	AEMSPP
	Agrobacterium spp.	AGRSPP
	Alcaligenes spp.	ALCSPP
	Campylobacter spp.	CAMSPP
	Flavobacterium spp.	FLASPP
	Gardnerella spp.	GARSPP
	Helicobacter pylori	HELPYL

	Pasteurella spp.	PASSPP
	Gram-negative bacilli, not specified	GNBNSP
	Other Gram-negative bacilli, specified and non-Enterobacteriaceae	GNBOTH
Anaerobic bacilli	Bacteroides fragilis	BATFRA
	Bacteroides other	BATOTH
	Clostridium difficile	CLODIF
	Clostridium spp. other	CLOOTH
	Propionibacterium spp.	PROSPP
	Prevotella spp.	PRESPP
	Anaerobes, not specified	ANANSP
	Other anaerobes specified	ANAOTH
Other bacteria	Mycobacterium, atypical/non-tuberculosis	MYCATY
	Mycobacterium tuberculosis complex TB is not reported in the PPS – Do not report *M. tuberculosis* complex or antimicrobial treatment for suspected or confirmed active or latent *M. tuberculosis* complex infection	MYCTUB
	Chlamydia spp.	CHLSPP
	Mycoplasma spp.	MYPSPP
	Actinomyces spp.	ACTSPP
	Nocardia spp.	NOCSPP
	Other bacteria	BCTOTH

Fungi	Candida albicans	CANALB
	Candida glabrata	CANGLA
	Candida krusei	CANKRU
	Candida parapsilosis	CANPAR
	Candida tropicalis	CANTRO
	Candida spp., other specified	CANOTH
	Candida spp., not specified	CANNSP
	Aspergillus fumigatus	ASPFUM
	Aspergillus niger	ASPNIG
	Aspergillus spp., other specified	ASPOTH
	Aspergillus spp., not specified	ASPNSP
	Other yeasts	YEAOTH
	Fungi other	FUNOTH
	Filaments other	FILOTH
	Other parasites	PAROTH

Annexure L

Ethical Clearance certificate

R14/49 Ms Lizette de Beer

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160365

NAME: (Principal Investigator)	Ms Lizette de Beer
DEPARTMENT:	Nursing Department King Saud Medical City, Riyadh, Saudi Arabia
PROJECT TITLE:	Hospital Aquired Infections in Intensive Care Units in Saudi Arabia
DATE CONSIDERED:	01/04/2016
DECISION:	Approved unconditionally
CONDITIONS:	Title Change (20/06/2016)
SUPERVISOR:	Viv Herbert
APPROVED BY:	Professor P. Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	20/06/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 10004,10th floor, Senate House/2nd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/We fully understand the the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to resubmit to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. in this case, the study was initially review in March and will therefore be due in the month of March each year.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

IRB Registration number

Kingdom of Saudi Arabia
Ministry of Health
King Saud Medical City

المـملكة العـربية السـعودية
وزارة الـصحة
مدينة الملك سـعود الطبية

مدينة الملك سعود الطبية
King Saud Medical City
INSTITUTIONAL REVIEW BOARD (IRB)

- Memorandum -

IRB Registration Number with KACST, KSA: **H-01-R-053**

Date: May 26, 2016

Proposal Reference No.	: **H1RI-08-May16-01**
Proposal Title	: Hospital Acquired Infections in Intensive Care Units in Saudi Arabia
Type of Review	: Initial Review
Category of Approval	: Expedited
Date of IRB Approval	: 26/05/2016 19/08/1437
Date of IRB Approval (Expiration)	: 25/05/2017 29 /08/1438

Dear Ms. Lizette De Beer,

We are pleased to inform you that the above-referenced research proposal has been reviewed and was approved. The IRB committee found that the research met the applicability criteria and was eligible for expedited review. However, to commence the collection of data a permission letter must be issued from the Director of the Research Center first.

This approval is valid for one year from the date of IRB review when approval is granted. The approval will no longer be in effect on the date listed above as the IRB expiration date. *Please note that you are obligated to send a progress report to the IRB committee after 12 months; and required to submit a Final Report within a year from the date of this memo (or earlier in the case the study has completed). All records relating to the research (including signed consent forms) must be retained and available for audit for at least 3 years after the research has ended.*

It is the responsibility of all investigators and research staff to promptly report to the IRB any serious, unexpected and related adverse events and potential unanticipated problems involving risks to subjects or others.

We wish you every success in your research endeavors.

DR. MOUNTASSAR ALMOUSHDAD
MICU CONSULTANT
C.2252

Dr. Hesham Al Mashat
Chairman
Institutional Review Board (IRB)
King Saud Medical City
Riyadh, KSA

Dr. Muteb A. Muteb
Director
Research Centre
King Saud Medical City
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