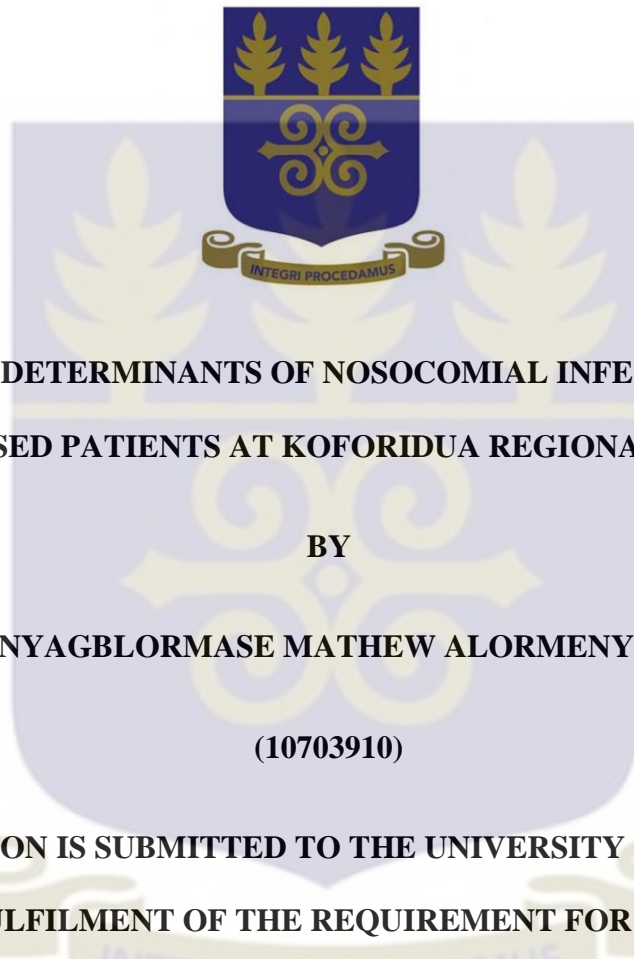


SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA



**TRENDS AND DETERMINANTS OF NOSOCOMIAL INFECTION AMONG
HOSPITALISED PATIENTS AT KOFORIDUA REGIONAL HOSPITAL.**

BY

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**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON
IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF
MASTER OF PUBLIC HEALTH DEGREE**

JULY, 2019

DECLARATION

I, NYAGBLORMASE MATHEW ALORMENYO, hereby declare that, except reference to other peoples' work which has been duly acknowledged, this thesis solely consists of my own work produced from research carried under supervision and that no part has been presented for any degree elsewhere.

Signature

Date.....

NAME OF STUDENT

NYAGBLORMASE MATHEW ALORMENYO

Signature

Date.....

NAME OF SUPERVISOR

DR. CHRIS GUURE

DEDICATION

This thesis is dedicated to my dear wife, Elizabeth and our children Mark, Hosea and Maud

Dzordzoenuku Nyagblormase

ACKNOWLEDGEMENT

I wish to express my heartfelt gratitude and appreciation to all by whose assistance this work became a reality. I therefore, wish to express my sincere gratitude to Dr. Chris Guure, my supervisor who made all the necessary corrections, suggestions, constructive criticisms, directions and journeying with me throughout to the successful completion of this work. To Dr. Mawuli Dzordzormenyo, who always gave me advice and encouragement until this work became successful. To all lecturers of University of Ghana School of Public Health especially the department of Biological Environmental and Occupational Health for their guidance and encouragement.

My warmest gratitude goes to my dear wife Mrs. Elizabeth Nyagblormase who gave me the necessary support and Mr. George A. Nyagblormase, my brother who also helped tremendously in structuring this work, not forgetting the rest of the Nyagblomase family especially Mark, Hosea and Maud Dzordzoenuku, my children.

I will be highly indebted if I forget the roles played by Mr. and Mrs. Gabriel Kudzo Bokor who provided shelter and food throughout my one year stay with them and not also forgetting a friend and a course mate Mrs Bernice Oforu Ntiamoah and her husband for their marvelous support over the year.

I also want to salute the management of Koforidua Regional Hospital, especially the medical Director, Dr. Anim Boamah, the clinical Director, Dr. Cardinal Newton for granting me the permission to use their facility for this research. May the Almighty Father bless you all.

ABSTRACT

Background

Nosocomial infections are a major public health problem worldwide and are on the increase despite significant efforts by hospital infection control measures. Nosocomial infection comprises infection occurring in a patient who is receiving treatment in a health care settings. Infection acquired by health care workers and people visiting the hospital is considered nosocomial infection. These infections affect about 2 million people globally resulting in 5% to 15% of them spending longer stay days in the hospital. In sub-Saharan Africa, incidence of nosocomial infections ranges from 2-49% with patients in intensive care units having up to 35.6%.

Objectives. The objectives of this study were to provide an understanding of the trends and factors associated with nosocomial infection and also to identify the causative agents of these infections by tracing them in the microbial records for the past three years.

Methods. Electronic data of all patients who were admitted and went through any invasive procedures at Koforidua Regional Hospital between the years 2016-2018 were reviewed. Any post –surgery purulent discharges, abscess, and inflammation at the site of surgery, positive urine culture of about 1 or 2 species with at least 10 bacteria / ml with or without clinical manifestation after catheterization were included in the study. Again, respiratory signs such as cough, purulent sputum, new infiltrate on the chest and radiography consistent with infection after or during tracheotomy and any inflammation, lymphagitis and purulent discharges at the site of vascular puncture, septicaemia, fever, rigor and at least one positive blood culture suffered by a patient

were also included in the study. All patients of different ages and sex group that went through any invasive procedures in the hospital within the year under review were included.

Results. The results from the study showed a 1.2% prevalence of nosocomial infection in Koforidua Regional hospital.

It was also observed from the results that patients whose ages were more than 40 years had a nosocomial infection prevalence ranging from 1.2% to 2.1%. With the trends of infection by number of days hospitalized, it was found that patients who were on admission for less than 13 days had infection prevalence between 1% to 4.5% as compared to 13.6 % for patients who were admitted for more than 14 days. In the environment where service was provided, results showed 9.75% infection prevalence at the ICU, 1.49% in female surgical ward and 0.95% in male surgical ward. With the payment methods, results revealed 0.82% infection prevalence for patients who used cash to pay for health service delivery by themselves and 1.37% for patients who depended on the National Health Insurance Scheme (NHIS) for payment. Finally, *staphylococcus* and *streptococcus* were found to be the most prevalent nosocomial bacteria in the facility.

In **conclusion**, the more a person aged, the more the immunity reduced and the higher the vulnerability for infection. Infection in the hospital was also determined by the number of days a patient stayed in the facility. Again, because more potent and quality drugs were purchased by patients who used cash, their level of infection reduced more drastically. Finally, more females were infected than males.

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DEFINITION OF TERMS

Antimicrobial resistance: The capability of a microorganisms to resist the effect of medication that once could successfully treat that microorganism.

Asymptomatic: Not showing any sign or symptoms of disease whether disease is present or not.

Cytomegalovirus (CMV): A virus belonging to the herpesvirus group. It normally causes only mild symptoms but in immunocompromised individual, its effect can be more severe.

Incubation period: The interval between exposure to an infection and the appearance of first symptoms.

Intubation: The insertion of a flexible plastic tube into trachea to keep an open airway that serves as a passage through which medication is administered.

Invasive procedure: Medical practices that invades or enter the body, usually through cutting or puncturing the skin or by inserting equipment into the body.

Microflora: A plant- based microorganism having a demonstrable benefit to the health of the host, by improving digestion, metabolism, immunity or by causing an antibiosis phenomenon.

Nosocomial infection: An infection acquired in health facilities by individuals who visit the health facility for reasons other than getting that infection.

Occupational infection: Any one of the various specific diseases to which workers in a certain occupation are particularly prone.

Susceptibility: Lack of resistance to disease.

Therapeutic: A medication that deals with variety of treatments and healing, especially the use of drugs in the treatment of diseases.

Toxoplasmosis: A disease of mammals and birds due to the protozoa *toxoplasma gondii* which may be transmitted to man.

Tracheotomy tube: A curved tube that is placed into the trachea stoma (the hole made in the neck and the windpipe).

Transplacentally: Passage between mother and fetus in the placenta.

ACRONYMS AND ABBREVIATIONS

CAI	Community Acquired Infections
CAUTI	Catheter Associated Urinary Tract Infection
CLABS	Central Line Associated Bloodstream Infection
HAIs	Hospital Acquired Infections
HCAI	Health Care Associated Infection
ICU	Intensive Care Unit
NI	Nosocomial Infection
SSI	Surgical Site Infection
UTIs	Urinary Tract Infections
VAP	Ventilator Associated Pneumonia
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Nosocomial infections, otherwise known as Hospital Acquired Infections (HAIs) affect a lot of patients worldwide increasing hospitalization, death rate and financial loss.

Nosocomial infection develops during hospitalization, and is not present or incubating at the time of admission to the hospital. This includes infections acquired as a result of diagnostic or therapeutic procedures, exposure to the hospital environment or contact with its staff (Khan, Baig, & Mehboob, 2017).

Gottschalk (1980) defined nosocomial infection to be a new disease acquired in the hospital by a patient who was admitted for a reason other than that infection. Nosocomial infection infections can also be acquired in the hospital and may be manifesting after the patient has been discharged. Interestingly, staff of the health facilities can acquire this infection as occupational infection.

Asymptomatic patients may be termed to be infected if these organisms are localized in the body fluids or in cerebrospinal fluid. Infections that are acquired by healthcare workers, visitors or other healthcare personnel may also be considered as nosocomial. The situations where infections are not considered nosocomial are those infections that were present or incubating at the time of admission and become complicated. Those infections acquired transplacentally due to some diseases like toxoplasmosis, rubella, syphilis or cytomegalovirus that appear 48 hours after birth are not considered to be nosocomial (Khan, Ahmad, & Mehboob, 2015).

WHO estimated that, approximately 15% of all hospitalized patients suffer from these infections and it accounts for 7% in developed and 10% in developing countries. A study conducted in 55 hospitals of 14 countries representing four WHO Regions (Europe, Eastern Mediterranean, South-East Asia and Western Pacific) and the result showed that, an average of 8.7% of hospitalized patients contracted nosocomial infections with the highest frequencies noted from patients in the South-East Asian and Eastern Mediterranean Regions (10.0 and 11.8%) respectively. The report revealed that in the European and Western Pacific Regions, prevalence rates of 7.7 and 9.0% respectively were recorded. In Africa as stated by Sepideh et al (2011) the burden of HAI is already substantial in developed countries, where it affects from 5% to 15% of hospitalized patients in regular wards and as many as 50% or more of patients in intensive care units (ICUs). In Ghana, the Health-care Associated Infection-Ghana project framework, which is the first national multi-center point prevalence survey was published in 2018 and found an overall rate of hospital acquired infections at 8.2% (Newman 2018). At the Koforidua Regional Hospital, data was not available suggesting that no survey has been conducted to determine the prevalence of NI in the facility.

Hospital acquired infections (HAIs) are additional burdens on individual hospitals and healthcare systems. They can increase the costs of patient care from different economic dimensions, such as those of hospital administrators, third-party payers and patients themselves who pay out of their own resources (De Angelis, Murthy, Beyersmann, & Harbarth, 2010).

Higher costs of HAI are as a result of additional diagnostic tests and treatment, additional hospital days, and complications patients suffer after hospital discharge, among others. The effort to quantify the exact economic burden caused by HAI still remains a challenging issue (Gottschalk, Pitre, & Schuth, 1980).

1.2 Problem Statement

Nosocomial infection affects a significant number of patients all over the world increasing morbidity and mortality rates. Estimates reported by WHO shows that, nearly 15% of all patients admitted into hospitals acquire these infections. During hospitalization, patients come into contact with pathogens through different source environment, healthcare staff, fomite and other infected patients (Khan et al., 2017). The US reports that nosocomial is responsible for 2 million infections and 90,000 deaths per year. In the year 2000, the US Centers for Disease Control and Prevention made an estimation of a total costs of nosocomial infections to be in excess of 5 billion US \$ (Josef Peter Guggenbichler et al). Again, the burden of HAI is already serious in developed countries, where it affects between 5% to 15% hospitalized patients in regular wards and as many as 50% or more of patients in intensive care units (ICUs). In developing countries, the level of the problem remains underestimated or even unknown largely because HAI diagnosis is complex and surveillance activities to guide interventions require expertise and resources even though surveillance systems exist in some developed countries and provide regular reports on national trends of endemic (Sepideh Bagheri, Nejad, 2011). In sub-Saharan Africa, the available data indicates that, the incidence of nosocomial infections ranges between 2% - 49% with patients in intensive care units acquiring the highest rate ranging from 21.2-35.6%. In most lower economic countries of Africa such as Uganda, Burundi, Democratic Republic of Congo, Senegal, Burkina Faso, Tanzania, Ghana , Mali, Cameroon and Gabon, nosocomial infection prevalence have been reported to vary between 1.6% to 28.7% (Mbim, Mbotto, & Agbo, 2016). At the surgical wards in Nigeria and Ethiopia, the total occurrence have been reported to range between 5.7% - 45.8% with Ethiopia having an incidence as high as 45.8%. Definitely, hospital acquired infection has an incidence density equaling 26.7% infection per

1000 patient days in the neonatal surgical patients. Again, 3.4% to 10.9% of nosocomial infection often leads to death in some developed countries even though these figures are suspected to be higher in some developing countries of sub-Saharan Africa (Mbim et al., 2016). From September to October 2009, out of the 907 patients on admission at the Korle-Bu Teaching Hospital, Ghana (on the days of the study), 6.7% had hospital acquired infection. Larbi et al (2018) carried out a multi-centre prevalence survey on hospital acquired infection in Ghana and their research found the microorganism *Escherichia coli* as the only common HAI. However, no mention was made about the determining factors contributing to the infection.

As stated by (Khan et al., 2017), infections can be transferred from the healthcare staff to patients or vice versa and this infections can be acquired in several ways. One way in which infection can be transmitted is exogenous cross-infection in which bacteria are transmitted between patients. It is transmitted through direct contact between patients (hands, saliva droplets or other body fluids). Again, nosocomial infection is also acquired in the air (droplets or dust contaminated by another patient's bacteria), and also via staff contaminated through patient care (hands, clothes nose and throat) who become transient or permanent carriers, subsequently transmitting bacteria to other patients by direct contact during care. Where disease control protocols are observed, infection is acquired via objects contaminated by the patient including equipment, the staff's hands, visitors or other environmental sources such as water, other fluids and food.

This study is therefore to examine the trends and determinants of nosocomial infection in the Koforidua Regional Hospital from 2016- 2018.

1.3 Justification

The most commonly reported intensive care unit cases are nosocomial infections (Martin Wolkerwitz et al 2008). They are mostly found in mechanically ventilated clients with an incidence of about 15 infections per 1,000 ventilation days. Significantly, these infections will be associated with increase in length of hospitalization with its attendant impact on morbidity and mortality. WHO estimates that, approximately 15% of all patients admitted to the hospitals suffer these infections. On admission at hospitals, patients are ignorantly exposed to disease causing organisms through various source environment such as healthcare staff, fomites and other infected patients (Khan et al., 2017). This study tried to examined the determinants and the trends of nosocomial infection in Ghana since the previous few ones done by Larbi et al (2018) did not examined the determinants and trends of nosocomial infection but only a point survey to ascertain the prevalent rate.

1.4 Conceptual Framework

Transmission of nosocomial infection depends on the interplay or interaction between various factors such as the types of available microorganisms, duration of hospitalization and the impact of these factors on the survival of the patient. The identification of the causative agents of these infections, their diagnosis, treatment and preventive methods would help health care providers to understand the outcome of nosocomial infection; whether reaching the morbidity stage and receding or getting to mortality stage.

The gravity and prevalence of nosocomial infections are dependent on a number of prevailing factors which include the immediate environment in which health care is provided, the susceptibility and the immune capacity of the patient and the ignorance of the prevailing infection among health care workers (Khan et al., 2017).

According to Mbim (2016), the colonization of nosocomial agent is enhanced by intrinsic factors such as the use of a specific medication of underlying disease, age, disrupters of the natural barriers as in lesions and injuries. Other prevailing factors such as contaminated water source, resistance to antimicrobial agents, contaminated air condition and invasive procedures have also been cited. In relation to this, it was indicated that patients who were infected earlier on admission were at a higher risk when subjected to invasive procedures (Mxim et al., 2016).

Types and availability of nosocomial pathogens (bacteria, virus, fungal, parasites) are important determining risk factors in nosocomial infection. Most of these pathogens, especially the bacteria belonging to the natural flora of patients can often cause infection when the immunity of these patients are compromised. According to Khan et al (2017), *clostridium defficile*, is a bacterium that has a high risk of transmission from infected patients to others through health care staff on an account of improper washed hands. Again, usual monitoring revealed that viruses were responsible for 5% of all nosocomial infections and fungal parasites would always act as an opportunistic pathogen causing infection in patients with compromised immune system. *Aspergillus Spp.* is a typical example which can infect through environmental contamination (Khan et al., 2017).

Age and sex are some sociodemographic factors that in most of the times influence nosocomial infection. A survey conducted by the National Medicare Patient Safety Monitoring System from 2009–2011 showed that among 85,461 patients, female surgical patients had higher catheter-associated urinary tract infection (CAUTI) rates than male patients. In patients with acute cardiovascular disease, women had higher rates of HAIs (Gottschalk et al., 1980).

As stated by Sheila et al (2011) with regards to age of patients, elderly individuals are at higher risk of developing HAIs, possibly in part because of immunosuppression as a result of age-related decline of the immune system. The higher prevalence of comorbidities in the elderly population likely plays an important role in the development of HAIs. Sex also plays a role in the development of certain HAIs. Additionally, there are strong evidence of an increased risk of CAUTI in females, attributable to anatomic differences that result in a greater propensity for bacterial contamination of the catheter. For Hospital Acquired Infections other than CAUTI, the evidence is limited and sometime conflicting. For example, some studies have reported a higher risk for *Clostridium difficile* infection in males whereas others have not (Sheila et al 2011).

Undoubtedly, HAIs have substantial effects on morbidity and mortality. Quantifying the correct economic stress to HAIs still remains a challenging issue since it is attributable to additional burden incurred by both individuals and hospitals in health care delivery system. They can increase the patients care cost from various economic dimensions such as those of hospital administrators, and patients themselves (De Angelis et al., 2010).

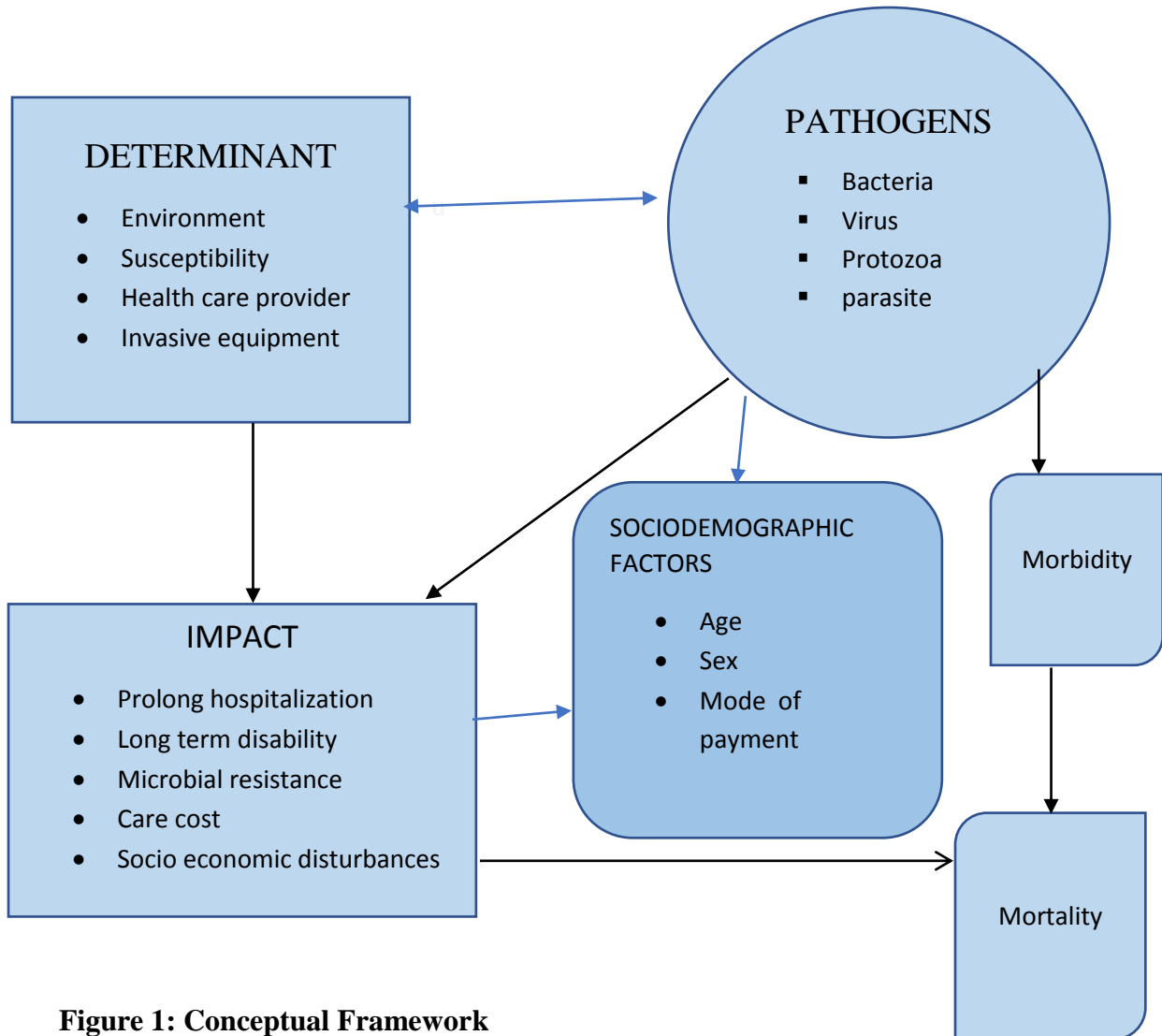


Figure 1: Conceptual Framework

1.5 Research Questions

What are the trends of nosocomial infection in Koforidua Regional Hospital for the past three years?

What are the determinants of nosocomial infection in Koforidua Regional Hospital for the past three years?

What are the specific nosocomial microorganisms that affected the patients?

1.6 Main Objectives

To assess the trends and factors that influence nosocomial infection among hospitalized patients at the Koforidua Regional Hospital over the past three (3) years.

1.7 Specific Objectives

- ❖ To determine the trend of nosocomial infections for the past three years.
- ❖ To identify factors that influence the prevalence of nosocomial infection
- ❖ To identify the various types of the disease causing organisms.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Nosocomial infections are infections that have been caught in a hospital and are caused by disease causing organisms that are resistant to antibiotics, even though any bacteria can cause nosocomial infections (Ambose, 2018). Mulu et al (2012) describe nosocomial infection as infection acquired in a hospital or health facility by a person admitted for a reason other than that infection. This implies that the disease condition was not present in the patient or in gestation at the period of admission (Purohit & Kariya,2016). According to Benenson (1995), cited in WHO/CDS/CSR/EPH/2002.12, nosocomial infections include infections acquired in the hospital but appearing after discharge, and also occupational infections among staff of the facility. These infections are also called hospital acquired infections (HAIs).

Nosocomial infections are major causes of morbidity, mortality, functional disability, emotional suffering, economic burden among the hospitalized patients (Kamat, Fereirra, Savio et al (2008); Endalefar, Gebre-Selasie, Kotisso (2011), and are primary cause of preventable death and disability among hospitalized patients (Boev & Kiss (2017).

Common nosocomial infections are contracted through surgical wounds, urinary tract infections, respiratory infections and blood stream infections. Mulu et al. (2012) indicated that surgical site infections accounted for 17% and bloodstream infections responsible for 14% of cases studied. The group listed the causative organisms as *staphylococcus aureus*, coagulase negative,

staphylococci (CONS) *enterococcus spp* and *Escherichia coli*. Ten secondary and tertiary hospitals surveyed in 2016 in Ghana suggests 8.2% prevalence rate as these contribute to long term disability, burden on hospital facilities, economic burden to individuals and families and antimicrobial resistance. Common vehicles of the infection include surgical site infection, catheter-associated urinary tract infection, ventilator-associated pneumonia and central line associated blood stream infections. Bacteria, viruses and fungal parasites are the common pathogens that cause nosocomial infection. Pathogens that normally involves in nosocomial infection include *Streptococcus Spp*, *Acinetobacter spp*, *enterococci*, *Staphylococci*, *Staphylococcus aureus*, *Escherichia Coli*, *Klebsiella Pneumonia*, *Bacillus cereus* and many more (A.K Larbi et al 2018).

The challenges to the effective treatment of these infections were enumerated by Mulu et al (2012) as antimicrobial resistance to antibiotics, postoperative wound infections by resistant bacteria, poor infection prevention programmes in developing countries, overcrowded hospital environments and irrational prescription of antimicrobial agents. Also, as developed countries have well -structured surveillance systems, that is not so in Africa due to social and healthcare system deficiencies, worsened by deficiency in income. Overcrowding in hospital rooms, understaffing, inadequate infection control practices, guidelines and inadequate trained professionals aggravate the problem (Nejad, Allegranzi, Syed, Ellis and Pitter, 2011).

By what means do in-patients acquire nosocomial infections? Stubblefield (2016) listed prolonged stay in ICU, urinary catheter, how you use antibiotics, compromised immune system, hospital roommates and age (70 years and above).

2.2 Prevalence and Trends

Data on nosocomial infections in hospitals in low income countries are readily not available and in some cases inconsistent (Ahoyo et al 2014), as such the magnitude remains underestimated or unknown due to the complexity in diagnosing Nosocomial Infection. Again, the absence of expertise and resource needed for surveillance is also another factor contributing to the diagnosis of the disease (Nejad, Allegranzi, Syed, Ellis and Pitter, 2011).

Using the HELICs instrument developed by Hospitals in Europe Link for Infection Control through Surveillance, Ahoyo et al (2014) found a prevalence of 19.1% among 3130 patients in Benin. The frequency of infection indicates 48.2% of urinary tract infection, 34.7% of vascular catheter and 24.7% of surgical sites.

In a study in Taiwan, Su et al (2007) documented that the prevalence of nosocomial infections was 17.5%: bloodstream infection, 4.7%, clinical sepsis, 6.3%, pneumonia, 5.1%, urinary tract infections (UTIs), 0.7%, surgical site infection, 0.7%. Intervention-associated infection rate: central intravascular catheter-associated bloodstream infection, 13.7%, Total Parenteral Nutrition(TPN-associated bloodstream infection), 15.8%, ventilator-associated pneumonia, 18.6%, surgical site infection 13.7%, urinary catheter-associated UTI, 17.3%

Purohit & Kariya (2016) reported that nosocomial infections occur among 7 – 12% of patients admitted to hospitals worldwide with more than 1.4 million of them suffering from the infectious complications they acquired in the hospital. In a study, Purohit & Kariya (2016) found that a total of 125 patients were diagnosed positive of nosocomial infections in two years. They observed a male dominance of 53.6% as against 46.4 % female. The most common infection was urinary tract infection (38.4%), followed by surgical infections (25.6%) and sepsis 20%. The most common micro-organism isolated from urinary tract infection and surgical sites was *E. coli*.

Staphylococcus aureus and *Klebsiella* the common organisms isolated from sepsis lower respiratory tract infections.

In Africa Nejad, Allegranzi, Syed, Ellis and Pitter (2011) reported a prevalence of HAI between 2.5% and 14.8% in Algeria, Burkina Faso, Senegal and Tanzania, Ethiopia and Nigeria, and the common infections being surgical site infections, followed by urinary tract infections and hospital acquired pneumonia.

Ahoyo et al (2014) again gave the trend of resistance of causative bacteria to drugs used in treatment. Methiciline resistance among *staphylococcus aureus* was 52.5%, that of Vancomycin among enterococci was 67.5%. Cefotaxim resistance among *Escherichia coli* was 67.6% while ceftazidime resistance among *Acinetobacter baumannii* and *Pseudomonas aeruginosa* was 100% and 68.2% respectively.

Larbi, Larbi-Nkrumah, Owusu et al (2018) conducted point-prevalence survey in 10 hospitals in Ghana representing 32.9% of all acute care beds in Government hospitals. They identified 172 HAI cases among 2107 in patients, representing an overall prevalence of 8.2%, with individual hospital rate ranging from 3.5% to 14.4%. The common HAIs identified were surgical site infections (32.6%), bloodstream infection (19.5%), urinary tract infection (18.5%) and respiratory tract infection (16.3%). The common micro-organism isolated was *Escherichia coli*. This HAI burden, to the researchers, was low when compared to the findings from other low and middle income countries.

Newman (2009) conducted a one day survey of nosocomial infection and community acquired infection in Korle-Bu Teaching hospital and reported 6.7% HAI and 31.6% Community Acquired Infection (CAI).

2.3 Determinant of Nosocomial Infection

Determinants of nosocomial infections are the risk factors that lead to the introduction of the infection into the patient while on admission. Literature show that increased susceptibility (patients already having poor state of health), invasive devices such as intubation tubes, catheter, tracheotomy tubes which have already compromised the body's defense system, medication (e.g use of antacids) and treatment (e.g.) repeated blood transfusion are risk factors. Auriti et al (2010) identified therapeutic procedures as determinants of nosocomial infections in neonatal intensive- care units. Askarian, Yadollahi and Assadian (2011) found bloodstream infection, urinary catheters, intubation and vascular line as important factors in nosocomial infection, including antibiotic administration.

Yallew, Kumie, Yehuala et al (2017) founded the availability of waste materials, low immune status of patients, central vascular catheters, surgery for patients on admission and patients receiving antimicrobial were major determinants of hospital acquired infections.

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The study area for this work was the Regional Hospital, Koforidua in New Juaben Municipality of the Eastern Region of Ghana where the hospital is located. The population of New Juaben Municipality according to the 2010 population and Housing Census is 183,727 representing 6.9 percent of eastern region's 2,633,254 population. The municipality covers an estimated land area of 110 square kilometers, constituting 0.5% of the total land area of the Eastern Region with 48 electoral areas. The municipality shares boundaries with East Akim municipality to the North East, Akuapim North District to the East and South, and Suhum- Kraboa Coalta District to the West. It has an annual rainfall ranging from 50 – 120 inches and 20 – 32 Celsius annual temperature. This municipality lies between latitude 6.09408° N and a longitude 0.25913° W with GPS of 6.0965-0.2581. The inhabitants of the municipality are predominantly formal sector workers, traders and farmers. The municipality is an Akan dominated area with few other tribes such as the Ewes, Krobos and other tribes from the northern regions. It is a regional hospital with major wards such as male surgical and medical wards, female surgical and medical wards, casualty ward, triage area, children (kids) ward intensive care unit, gynaecological ward, labour ward and lying –in ward. The facility also provides other essential services including family planning, dental care services, ENT services, HIV counselling, TB management, ophthalmology and many more. It is a secondary facility on the scales of referral hierarchy with a total bed capacity of 368. Being a secondary health facility where more advanced and complicated cases are seen, the survey is carried out at this facility to gather enough data for this dissertation.

3.2 Study Approach

The study was an analytical type that used secondary data obtained from the records department of the hospital between the years 2016-2018. The electronic records of all available hospitalized patients were retrieved from the records department of the hospital which provided statistically valid data to represent the population of inpatients who were once admitted at the hospital for any invasive procedures between the years 2016 to 2018. The study employed total population census design, where data had been collected on all participating patients and therefore no sample size was determined.

3.3 Study Population

The population of this study consisted of seven thousand and eighty seven (7,087) patients who were hospitalized from January 2016 to December 2018. Out of this, all the available data presented for males and females who were in the facility and had been exposed to any kind of invasive procedures such as intubation, catheterization, surgery and other medical techniques at Koforidua Regional Hospital were examined.

3.4 Sample Size and Sampling Technique

All available patients' data were collected from the male and female surgical wards and intensive care unit for analysis. With the above, electronic folders of these patients were collected from the records department as a secondary data source to ascertain the prevalence, trends and the factors that influenced the presence of nosocomial infection. Total sampling method was adopted to consider all available participating patients in the survey which represented clear trends and

determinants of nosocomial infection. No sample size determination was done since the survey sought to include all available participants.

Medical and nurses charts of the hospitalized patients provided by physicians and nurses were also reviewed.

Documented microbial data were also acquired from the microbiology department of the hospital for confirmation of the presence of nosocomial infection. A licensed software stata /IC 15 was used to analyze the data.

3.5 Data Collection Tool and Technique

The medical records of patients who have ever gone through any invasive procedures such as surgery, catheterization, tracheotomy and central blood stream line invasion at Koforidua Regional Hospital between the years 2016-2018 were retrieved. The patients included all age groups (adults and children) and both sexes. A descriptive analysis by medical practitioner (physician) was employed to examine the records bearing the definition of nosocomial infection in mind; “infection occurring in the patients after admission at the hospital that was neither present nor incubating at the time of admission”.

3.6 Inclusion criteria

Inclusion criteria that served as the guiding principle included:

- Surgical site- any purulent discharge, abscess and spreading inflammation at the surgical site during a month of the operation.
- Urinary infection- positive urine culture of about 1 or 2 species with at least 10 bacteria/ml with or without clinical manifestation.

- Respiratory infection- respiratory signs characterized by at least two of the following signs during hospitalization; cough, production of purulent sputum, new infiltrate on the chest and radiography consistent with infection
- Vascular catheter- inflammation, lymphangitis, purulent discharges at the site of insertion of the catheter, septicaemia, fever, rigors and at least one positive blood culture.

Information on those who were identified as “cases” were traced to their biological (microbial) records to identify the type of causative agent. This included infections acquired in the hospital and any other settings where patients received health care and appeared even after discharge and so one of the cardinal inclusion criteria was that, there must be an occurrence of infection at least 48 hours after hospitalization without evidence that the infection was present or incubating before admission.

3.7 Exclusion criteria

The exclusion criteria for this study included:

- The infections that were present at the time of admission and became complicated when the pathogen or symptoms changed resulting to a new infection.
- The infections that were acquired transplacentally due to some diseases such as toxoplasmosis, rubella and syphilis that appear 48 hours after birth.

Outcome variable

The dependent variable in the study was Nosocomial infection. All patients who were infected more than 48 hours after admission to the hospital were defined to have Nosocomial infection.

Independent variable

The independent variable in the study were, Age of patient, Sex of patient, Ward patient was admitted into, payment method for healthcare services, length of stay and year patient was admitted. Information on the independent variable is summarized in the table below.

Variable	Variable description	Scale of measurement	Categories
Age in years	Age of the patients at the time the patient was admitted into the hospital	Both continuous/ categorical (Ordinal)	<20 years 20-29 years 30-39 years 40-49 years 50-59 years 60-69 years 70-79 years >79 years
Sex	Sex of patients	Categorical (Nominal)	Male Female
Ward	The ward the patient was admitted into.	Categorical (Nominal)	Female ward Male ward ICU
Payment method	Method of payment of hospital bills by patients	Categorical (Nominal)	Private cash Public sponsored (NHIA)
Length of stays	Length of stay in days the patient was admitted in the hospital.	Continuous / categorical (ordinal)	<7 days 7-13 days 14-20 days 21-27 days >27 days
Year of admission	The years the patients was admitted into the hospital	Categorical (ordinal)	2016 2017 2018

3.8 Ethical Consideration.

Ethical clearance and approval was sought from Ghana Health Service Ethics Review Committee (GHSERC) with the approval Reference Identification number GHS-ERC 046/ 03/19 and Eastern Regional Directorate of the Ghana Health Service Koforidua. At the Regional Hospital, Koforidua, the research site, permission was sought from the head of administration and the medical director of the facility. Introductory letter from the Department of Biological Environment and Occupational Health of the School of Public Health, University of Ghana Legon was submitted to the institution where the study was conducted for permission to conduct the study.

Two scheduled meetings were held with the heads of both records and bacteriology departments of the hospital where the details of the study was explained to them.

Even though the researcher did not come into contact with any patients during the study, information gathered in their respective folders was coded and kept confidential.

CHAPTER FOUR

RESULT PRESENTATION

INTRDUCTION

This chapter presents results from the 7,087 reviewed electronic folder (data) of patients admitted at the male surgical ward, female surgical ward and Intensive Care Unit (ICU) of the Regional Hospital, Koforidua. The chapter presents the results of the descriptive characteristics of the patients, the prevalence rate of nosocomial infection in the hospital, the trends of the infection across ages, wards, sex of the patients and the yearly distributions. It further identify the microorganisms responsible for the infections, discussion of the results and gives recommendation.

Chi square and multinomial logistic regression was used to analyze the data focusing on the association between the invasive procedures and the probability or vulnerability of acquiring nosocomial infection. The study seeks to understand the trends and the determinants of these infections within the three years period

4.1 Descriptive Characteristics of the Study Participants

The study retrieved seven thousand and eighty seven (7,087) folders of the patients for the male surgical ward, female surgical ward and the intensive care units comprising 4,508 (63.61%) males and 2,579 (36.39%) females. The age characteristics of the patients cut across all ages with the average mean age of patients being between 45.41 ± 19.52 . A total number of 613, representing 8.65% patients were less than 20 years. The highest number of patients amounting to 1,229 (17.34%) were aged between 30-39 years amounting to 1,229 (17.34%). Again, 365 of the patients representing 5.15% were aged more than 79 years.

The wards that were involved in the study included the female surgical ward with a total admission of 2,579 (36.01%), male surgical ward with 4,494 (63.41%) and the Intensive Care Unit (ICU) with 41 (0.58%) across all the three years (table 4.1).

Over the years, some of the patients used varied methods to pay for the health services they received. Within the three year period, a total of 2,190 patients representing 30.9% paid for health service delivery out of their pockets (cash and carry) while 4,897, representing 69.1% used public sponsored cash (NHIS) to pay for service (see the table 4.1 above). Here, the choice of either private cash or public cash to pay for health service depended wholly on individual's conviction and affordability.

One way or the other, patients got infected through invasive procedures they went through while instruments, equipment, logistics and bed lining served as a vehicle for the infection. Concerning the length of stay (days) on hospital admission 4,838 (68.27%) stayed on hospital admission less than 7 days, 154 (2.17%) was hospitalized more than 27 days and the majority of the patients who stayed between 8-26 days were evenly distributed.

Finally, reference to table 4.1 shows the distribution of the annual admission of patients in the facility. The analysis of the yearly distribution helped the researcher appreciate the dynamics over the three year period. The admission figure for the year 2016 stood at 2,537, representing 35.8%. The year 2017 recorded 2,506 inpatients, representing 35.36%, while the total admission in 2018 was 2,044 patients, representing 28.84%. This data rather show a gradual decline in admission over the three year period despite population increase that was expected to increase hospital admission.

Table 4.1: Descriptive Characteristics of Study Patients.

Variables	Frequency	Percentage
Age : mean + SD	45.41 + 19.52	
Age group (years)		
<20	613	8.65
20-29	1,173	16.55
30-39	1,229	17.34
40-49	1,171	16.52
50-59	1,038	14.65
60-69	926	13.07
70-79	572	8.07
>79	365	5.15
Sex		
Female	2,579	36.39
Male	4,508	63.61
Ward		
Female surgical	2,552	36.01
ICU	41	0.58
Male surgical ward	4,494	63.41
Payment method		
Private cash	2,190	30.9
Public sponsored (NHIA)	4,897	69.1
Length of stay (days): median (LQ, UQ)	4 (3, 8)	
Length of stay (days)		
<7 days	4,838	68.27
7-13 days	1,634	23.06
14-20 days	335	4.73
21-27 days	126	1.78
>27 days	154	2.17
Year		
2016	2,537	35.8
2017	2,506	35.36
2018	2,044	28.84

SD: standard deviation. LQ: lower quartile. UQ: upper quartile.

4.2 Prevalence of Nosocomial Infection among Patients

Out of the total number of 7,087 patients' electronic folders reviewed across the 3 years, the result shows a prevalence rate of 1.2% nosocomial infection in the hospital. Table 4.2 presents the yearly figures and the prevalence rate.

Table 4.2: Prevalence and Trend of Nosocomial infection among patients

Year	Total admitted	Number infected	Prevalence	95% CI
2016	2,537	18	0.71	(0.42, 1.12)
2017	2,506	32	1.28	(0.88, 1.80)
2018	2,044	35	1.71	(1.20, 2.37)
2016-2018	7,087	85	1.2	(0.96, 1.48)

4.3 The trends of Nosocomial infection from 2016 to 2018.

Within the three year period, there were 2,537 patients in 2016 out of which 18 (0.71%) had nosocomial infection. In 2017, 2,506 folders were reviewed out of which 32 representing 1.28% had nosocomial infection. Again in 2018, 2,074 folders were reviewed, 34 (1.71%) were nosocomial cases. Figure 4.1 below shows the trends of the infection throughout the three years

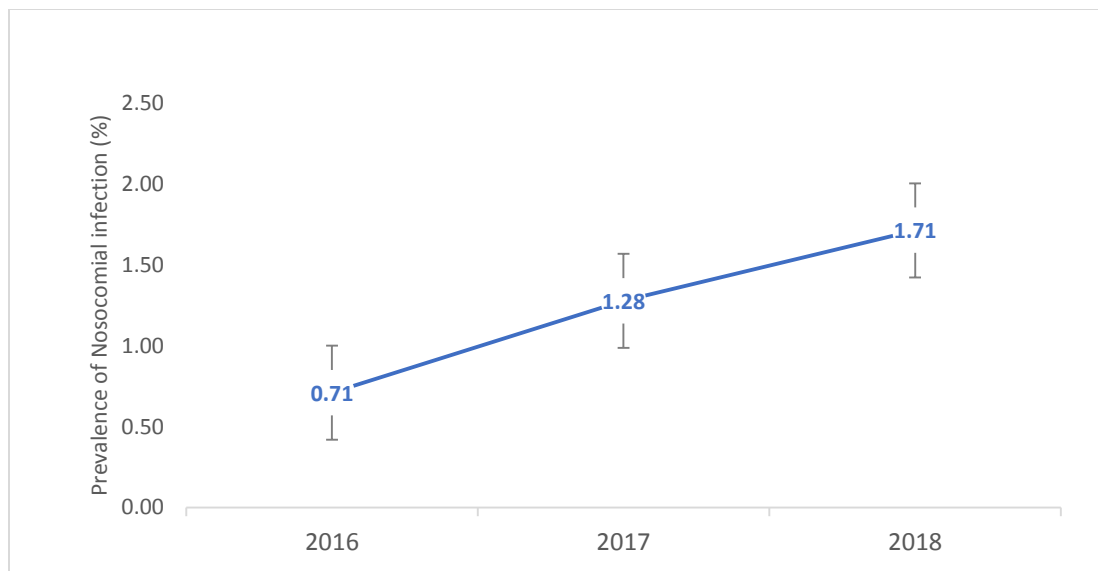


Figure 4.1: The trend of Nosocomial infection from 2016 to 2018.

4.4 Trend of Nosocomial Infection from 2016 to 2018 among Patients

Results showing the trends of nosocomial infection within age groups indicated 0% in 2016, 0.89% in 2017 and 0.63% in 2018 for patients less than 20 years. Again, there were 1.65% in 2016, 1.57% from 2017 and 0.85% in 2018 for patients who were more than 75 years while the ages between 20-79 years have their infection percentages evenly distributed.

The trend of infection among the sexes over the three year period shows 874 admissions with 9 patients representing 1.02% infected among females in 2016, 1,645 admissions with the same 9 patients consisting 0.54% were infected among males in the same year. Though each sex recorded the same number of infection (9 cases), they had different percentages due to differences in the number of admissions. In 2017 there were 934 female admissions with 15 patients (1.58%) infected and 1,540 male admissions with 17 patients (1.09) having the infection. Similarly, there were 729 admissions with 18 (2.41%) infection among females in 2018 and 1,280 male admission with 17 (1.31%) infection in the same year. See table 4.3 below.

Table 4.3: Trend of Nosocomial Infection from 2016 to 2018 among Patients

	2016		2017		2018	
	Total	Infected	Total	Infected	Total	Infected
	admitted	n (%)	admitted	n (%)	admitted	n (%)
Total	2,519	18 (0.71)	2,474	32 (1.28)	2,010	34 (1.66)
Age group						
<20 years	229	0 (0)	223	2 (0.89)	158	1 (0.63)
20-29 years	440	2 (0.45)	417	5 (1.18)	306	3 (0.97)
30-39 years	442	2 (0.45)	410	6 (1.44)	365	4 (1.08)
40-49 years	421	5 (1.17)	414	5 (1.19)	322	4 (1.23)
50-59 years	347	3 (0.86)	374	4 (1.06)	305	5 (1.61)
60-69 years	329	1 (0.3)	308	3 (0.96)	272	13 (4.56)
70-79 years	192	3 (1.54)	203	5 (2.4)	165	4 (2.37)
>79 years	119	2 (1.65)	125	2 (1.57)	116	1 (0.85)
Sex						
Female	874	9 (1.02)	934	15 (1.58)	729	18 (2.41)
Male	1,645	9 (0.54)	1,540	17 (1.09)	1,280	17 (1.31)
Ward						
Female surgical	876	9 (1.02)	927	14 (1.49)	711	15 (2.07)
Male surgical ward	1,643	9 (0.54)	1,539	17 (1.09)	1,269	17 (1.32)
Icu	0	0 (0)	8	1 (11.11)	29	3 (9.38)
Payment method						
Private cash	824	6 (0.72)	789	7 (0.88)	559	5 (0.89)
Public sponsored (NHIA)	1,695	12 (0.7)	1,685	25 (1.46)	1,450	30 (2.03)
Length of stay						
<7 days	1,694	7 (0.41)	1,646	9 (0.54)	1,474	8 (0.54)
7-13 days	587	5 (0.84)	605	14 (2.26)	406	17 (4.02)
14-20 days	131	2 (1.5)	120	6 (4.76)	72	4 (5.26)
21-27 days	43	2 (4.44)	47	2 (4.08)	28	4 (12.5)
>27 days	64	2 (3.03)	56	1 (1.75)	29	2 (6.45)

4.5 Graphical Representation Based on Sex

One characteristic feature here is the presentation of the sex of the participating patients. The graph below shows that, even though more males were hospitalized than females, the infection rate among female patients were higher than males and increased steadily with the years.

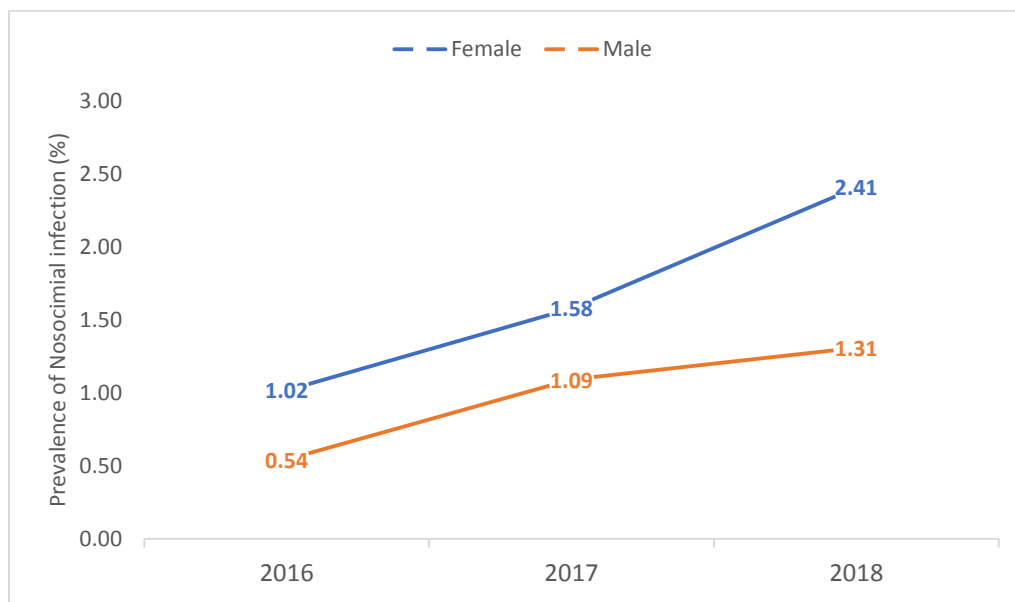


Figure 4.2: Trend of Nosocomial Infection from 2016 to 2018 by Sex of Patients.

Same result from the trend of sex is translated into the 3 wards (units) where the health care was provided (male surgical, female surgical wards) except the intensive care unit (ICU) which houses both sexes.

In 2016, no data were retrieved from I.C.U due to the unavailability of data with infection rate of 0%. In 2017, 8 admissions were made with 1 (11.11%) infection rate and 29 admissions with 3 representing 9.38% infection in 2018.

Analysis of the data about the trends of infection with regards to payment method revealed that 876 patients who used private cash (cash and carry) to pay for services, only 6 (0.72%) were infected and 1,695 who used public sponsored cash (NHIS) to pay for service delivery, 12

(0.7%) were infected in 2016. In 2017, 789 used private cash and 7 (0.88%) were infected, while 1,685 spent public sponsored cash and 25 (1.46%) were infected. Finally the 559 patients who used private cash while on admission in 2018, only 5 (0.89) were infected while 1,450 who used NHIS while on admission, 30 (2.03) were infected. See figure 4.3.

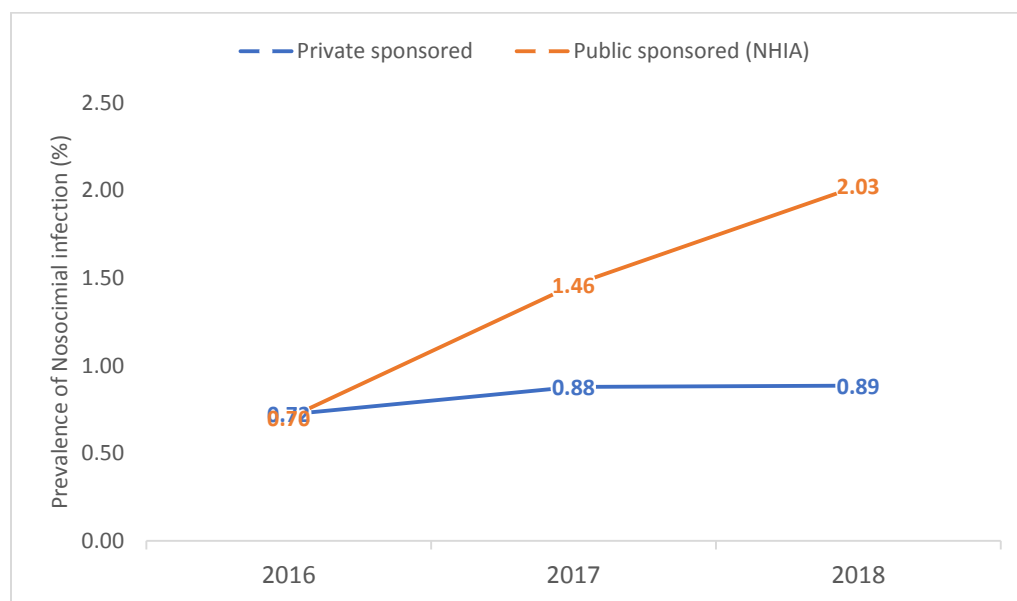


Figure 4.3: Trend of Nosocomial infection from 2016 to 2018 by payment method of patients.

Concerning the trend of nosocomial infection by payment method of patients, the result indicated that there was a high infection rate among patients who used public sponsored services (NHIS), rising from 0.70% in 2016 through to 2.03 in 2018 than patients who used private sponsored cash (cash and carry) with insignificant rise from 0.7% in 2016 through to 0.89 in 2018.

Another significant trend of infection was the length of stay on hospital admission. The analysis indicated that in 2016, 1,694 participant stayed in the hospital less than 7 days and 0.41% had the infection. In 2017 and 2018, patients who stayed on hospital admission less than 7 days had an

infection of 0.54% each. Again those who stayed in the hospital more than 27 days had 3.03% in 2016, 1.75% in 2017 and 6.45% in 2018.

4.5 Factors Influencing the Prevalence of Nosocomial Infection

The binary logistic regression model was used to determine the factors associated with factors influencing the prevalence of Nosocomial infection.

From the Adjusted binary logistic regression model, none of the patients in the older age group had significant odds of being infected when compared to patients who were less 20 years (p-value >0.05). However, in the unadjusted model, the odds of having Nosocomial infection was about 4 times significantly higher for patients in the age group 60-69 years [UOR: 3.80, 95% CI: 1.11-13.03, p-value = 0.034] and 70-79 year [UOR: 4.36, 95% CI: 1.22-15.52, p-value = 0.023] when compared to those less than 20 years.

From the unadjusted model, the odds of having Nosocomial infection was 1.7 times higher for females compared to males [UOR:1.72, 95% CI: 1.12-2.64, p-value=0.013] whereas the odds was not significantly different for females compared to males in the adjusted model.

The unadjusted odds of having Nosocomial infection was significantly higher for patients in the ICU [UOR: 7.15, 95% CI: 2.43-21.06, p-value <0.001] compared to those in the female ward and significantly lower for patients in the male ward [UOR: 0.64, 95% CI: 0.41-0.99, p-value = 0.046] also compared to those in the female ward. In the adjusted model, the odds of having Nosocomial infection was about 12 times significantly higher for patients in the ICU ward [UOR: 11.89, 95% CI: 3.54-40.01, p-value <0.001] compared to patients in the female ward.

In both the unadjusted and adjusted binary logistic regression model, the odds of having Nosocomial infection was significantly higher for those who stayed longer in the health facility.

Also the Adjusted odds of having Nosocomial infection was about 1.8 times and 2.5 times higher for those patients admitted in 2017 [AOR: 1.75, 95% CI: 0.97-3.14, p-value = 0.061] and 2018 [AOR: 2.52, 95% CI: 1.40-4.53, p-value = 0.002] respectively compared to those admitted in 2016. See table 4.4 below.

Table 4.4: Binary logistic regression model of factors influencing the prevalence of Nosocomial infection.

Outcome	Unadjusted odds ratio		Adjusted odds ratio	
	UOR [95% CI]	P-value	AOR [95% CI]	P-value
Age				
<20	1.00 [reference]		1.00 [reference]	
20-29	1.75 [0.48-6.38]	0.397	2.09 [0.56-7.77]	0.273
30-39	2.00 [0.56-7.13]	0.283	1.77 [0.49-6.41]	0.386
40-49	2.46 [0.70-8.59]	0.158	2.12 [0.59-7.55]	0.248
50-59	2.38 [0.67-8.46]	0.181	1.77 [0.49-6.47]	0.386
60-69	3.8 [1.11-13.03]	0.034*	2.83 [0.8-10.05]	0.107
70-79	4.36 [1.22-15.52]	0.023*	3.24 [0.88-11.97]	0.078
>79	2.82 [0.67-11.89]	0.157	1.86 [0.43-8.12]	0.406
Sex				
Male	1.00 [reference]		1.00 [reference]	
Female	1.72 [1.12-2.64]	0.013*	7.37 [0.52-104.3]	0.14
Ward				
Female surgical	1.00 [reference]		1.00 [reference]	
ICU	7.15 [2.43-21.06]	<0.001***	11.89 [3.54-40.01]	<0.001***
Male surgical ward	0.64 [0.41-0.99]	0.046*	4.89 [0.34-70.28]	0.244
Payment method				
Private cash	1.00 [reference]		1.00 [reference]	
Public sponsored (NHIA)	1.67 [0.99-2.82]	0.053	1.25 [0.72-2.20]	0.429
length of stay				
<7 days	1.00 [reference]		1.00 [reference]	
7-13 days	4.52 [2.69-7.6]	<0.001***	4.56 [2.68-7.75]	<0.001***
14-20 days	7.45 [3.69-15.04]	<0.001***	7.19 [3.5-14.79]	<0.001***
21-27 days	13.6 [5.99-30.9]	<0.001***	14.18 [6.14-32.74]	<0.001***
>27 days	6.73 [2.53-17.88]	<0.001***	6.81 [2.52-18.37]	<0.001***
Year				
2016	1.00 [reference]		1.00 [reference]	
2017	1.81 [1.01-3.23]	0.045*	1.75 [0.97-3.14]	0.061
2018	2.44 [1.38-4.32]	0.002**	2.52 [1.40-4.53]	0.002**

UOR: unadjusted odds ratio. AOR: adjusted odds ratio. CI: confidence interval. *: p<0.05. **: p<0.01.

*****: p<0.001**

4.6 Nosocomial infection bacterial among the infected patients

Figure 4.4 below represents the bacteria and their percentages that are responsible for the infection in the wards. *Staphylococcus* and *streptococcus* form the major infectious micro-organisms, with 29.4% and 24.7% respectively. *Salmonella* and *lactobacillus* form there least with 1.2% while *enterococci*, *klebsiella*, *E-coli* and *Enterobacter* were evenly distributed. See chart.

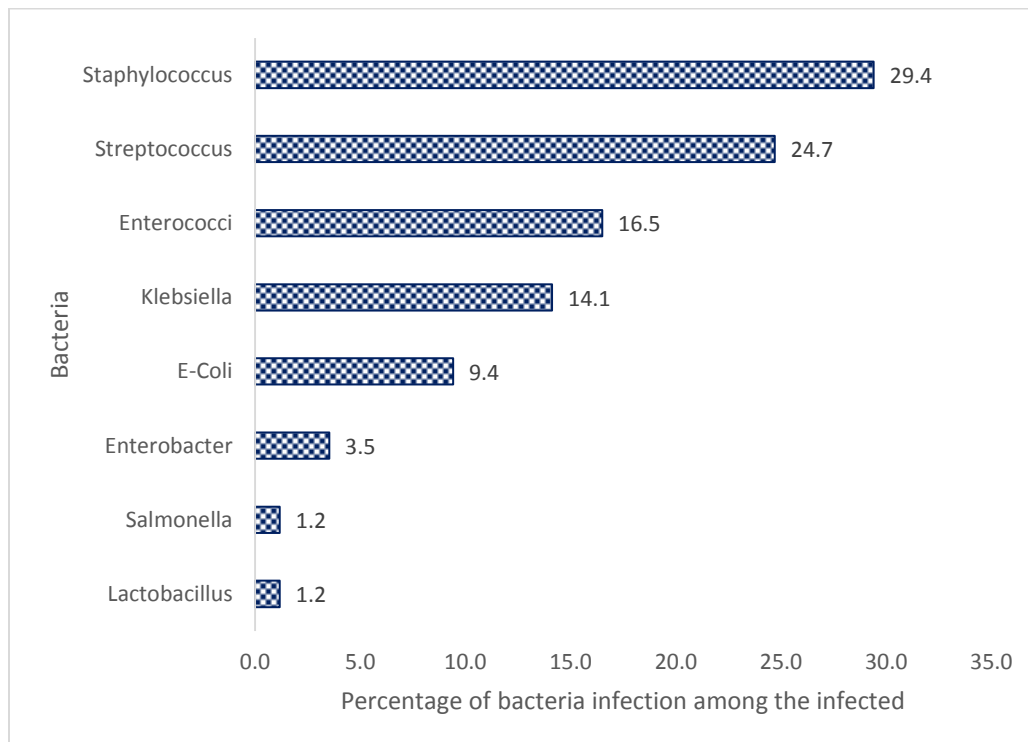


Figure 4.4: Nosocomial infection bacteria among the infected

CHAPTER FIVE

DISCUSSION

5.1 Prevalence

Indication from the analysis of the electronic data from 2016 – 2018 showed that there was a 1.2% prevalence of nosocomial infection in the facility. This infection involved a total of 85 out of 7,087 patients over 3 years period with a percentage increase from 0.71% in 2016, 1.28% in 2017 to 1.71% in 2018. Purohit & Kariya (2016) reported that nosocomial infections occur among 7 – 12% of the hospitalized patients globally with more than 1.4 million people suffering from the infectious complications acquired in the hospital. Ahoyo et al (2014) also found a prevalence of 19.1% among 3,130 patients in Benin. Newman (2009) conducted a one day survey of nosocomial infection and community acquired infection in Korle-Bu Teaching hospital and reported 6.7% HAI. The low level of infection realized in the current study could be attributed to either adherence to infection prevention protocols by healthcare providers or physicians' failure to fully document medical procedures carried out on the patients. Again, the data analyzed was limited to only three departments and not the entire facility hence the low prevalence rate. In the study however, the gradual increase in trend of the infection from 0.71% in 2016 to 1.28% in 2018 is a projected evidence that, if infection prevention and control measures are not adhered to, an increase number of hospitalized patients will have nosocomial infection consistently.

According to (Khan et al., 2017), with high burden of nosocomial infections and antimicrobial resistance, healthcare facility administrations and infection control committees find it very difficult to reach the goal of eliminating the infections. Taking sound and healthy measures to deliver health through infection control methods could help control transmission of these

infections by engaging infection prevention methods. Proper training of healthcare workers for biosafety, proper waste management and healthcare reforms and creation of general public awareness of these endemic infections could aid in reducing nosocomial infections.

5.2. Trends of Nosocomial Infection

Descriptive characteristics of the study patients showed that 8.65% of the population was below the ages of 20 years, and the number infected in this category was only 3, representing 0.49%. In another words, patients of ages less than 39 years have percentage infection ranging from 0.49% to 0.98%. Again, from the ages between 40-79 years, the infection rate built up from 1.2% to 2.1%. The result above indicates that the more a person ages, the more the immune system is compromised and the more one is prone to infection. In 2012, Avci M. et al conducted an outcome analysis of Hospital Acquired Infection (HAIs) among the elderly who were more than 65 years (≥ 65) and compared the result to patients between the ages of 18- 64 years. The result indicated the incidence of nosocomial infection among the elderly patients to be high (2.49%) as compared to 1.64% in the younger patients.

In this study, one interesting trend of nosocomial infection is found with the sex of the patients. The analysis revealed that even though more males had hospital admission (4,508) than females (2,579), more females acquired the infection by 1.63% more than their male counterparts who suffered 0.95% infection. Reasons for inclined male admission over female admission in the surgical wards and ICU include assaults, stabs, gunshot wounds, accidental injuries and falls as males are noted for risky behaviors than females. The scientific reasons why even though more males were admitted than female but the later had more infection could not be explained and suggests that other factors could be involved in the development of nosocomial infections.

The wards (units) are distinctive environment where healthcare is provided and also provides space for interaction between disease causing organisms, medical instruments, logistics and patients.

The trending situation of HAIs in the wards shows more cases at the Intensive Care Unit than the other two wards even though it registered the least population of 41 patients over the three year period accounting for 9.76% of the infection rate.

As noted by Dhillon et al (2019), there are several predisposing factors to contributing to the condition of patients on admission at the ICU. Seriously ill patients in the ICU have increased chance of invasive catheters, devices or undergo surgery that can disrupt the skin barrier. Patients who sustain burn injuries also develop HAIs as a result of the eruption of physical barrier (www.infectioncotroltoday.com.)

Another infection trending is seen in the payment method where the cash and carry and NHIS are used to pay for health service delivery. In the analyzed report, patients under public sponsored service who were infected were 67 representing 1.37% while only 18 patients consisting of 0.82% who used private cash to pay for their health service suffered nosocomial infection. Why patients who used cash and carry method to pay for health service were the least to acquire nosocomial infection is not known but it is suggested that, quality and potent medicines are often prescribed to this category of patients to purchase by themselves rather than most drugs enrolled on the public sponsored schemes that are perceived to be substandard. This factor however requires thorough investigation.

5.3 Determining Factors Influencing Nosocomial Infection

One of the determining factors influencing the prevalence of HAIs is the length of stay on hospital admission. Analyzing what determined Hospital Acquire Infection, the result shows that those patients who stayed in the hospital between 7-13 days had an infection rate of between 1% to 4.52% and those who stayed between 14 through to 28 days or more suffered 13.6% infection. Data set for the analysis revealed that patients who had HAIs were those who spent high number of days in the hospital (those who stayed more than 27 days had 6.45% in 2018 as compared to 0.54% of those who stayed less than 7 days in 2018) and are being managed for other critical conditions other than the HAIs. (Khan et al., 2017) show that increased hospitalization and susceptibility (patients already having poor state of health) through invasive devices such as intubation, catheterization and tracheotomy which have already compromised the body's defense systems, medication (e.g use of antacids) and treatment options such as repeated blood transfusion are risk factors. Auriti et al (2010) identified therapeutic procedures as determinants of nosocomial infections in intensive- care units.

Another determinant of nosocomial infection is the ward or the environment in which the care was provided. According to (Shah & Gharbia, 1999), some of the key factors that have led to increasing nosocomial infection rates in hospital environment include low handwashing by staff after contact with patients, sicker and more immunocompromised patients in hospitals. Infrastructure repairs and renovations to aging hospitals and new construction on existing ones creates risk of airborne fungal diseases caused by dust and spores released during demolition and construction. Further, increasing antimicrobial use in hospital and long-term care facilities creates a large reservoir of resistant microbial strains. Microorganisms can also be transmitted directly from person to person in the form of droplets in the air. When droplets are produced

during a cough or sneeze, a cloud of infectious particles is released into the air, resulting in potential exposure of susceptible persons within three feet of the source person and *Aspergillus* is a typical example. Waterborne infections are also spread through direct contact as in cases of hydrotherapy, ingestion of contaminated water, indirect contact, and inhalation of aerosols dispersed from water sources. It is suggested that regular cleaning, maintenance, and testing of water systems and point-of-use fixtures is important for preventing the spread of waterborne infections such as Legionnaires' disease (Shah & Gharbia, 1999). In the analysis, the infection in the male and female surgical wards were 0.96% and 1.49% respectively while the prevalence in the ICU, where more invasive procedures are done was 9.76%, an indication that infection from nosocomial infection is as a result of exposure to invasive procedures and the hospital environment in presence of responsible microorganisms.

5.4 availability of nosocomial infection microorganisms

The fact that patients stay longer at health facilities or undergo an invasive procedure does not guarantee acquisition of HAIs unless there is the presence of disease causing organism. The results reported variety of microorganisms that were responsible for these infections and they included *staphylococcus*, *streptococcus*, *E-coli*, *klebsiella*, *enterococci*, *Enterobacter*, *salmonella* and *lactobacillus*. The high prevalence level of *staphylococcus* and *streptococcus* were probably due to antibiotic drug resistance. Ahoyo et al (2014) gave the trend of resistance of causative bacteria to drugs used in treatment. Methiciline resistance among *staphylococcus aureus* was 52.5%, that of Vancomycin among *enterococci* was 67.5%. Cefotaxim resistance among *Escherichia coli* was 67.6% while ceftazidine resistance among *Acinetobacter baumannii* and *Pseudomonas aeruginosa* was 100% and 68.2% respectively

Staphylococcus and *streptococcus* were the organisms the analyzed data showed to be highly prevalent in the facility with the prevalence values of 29.4% and 24.7% respectively. This high values were due to an antibiotic drug resistance strains. Bal AM (2005) stated that, *staphylococcus* is a major cause of infection and nearly 80% remain resistant to penicillin and flucloxacillin. Further, D Passali(2016) maintain that failure of penicillin to eradicate *streptococci* from the throat occurs in up to 35% of patients suffering pharyngo-tonsillitis and various reasons have been advanced such as interference by aerobic and anaerobic commensals, penicillin tolerance and reinfection.

CHAPTER SIX

CONCLUSION

To sum up, it is real that patients who spent more than 7 days in the hospital are likely to acquire infection in the hospital which otherwise was not the reason for their admission.

Hospital Acquired Infections could lead to an additional financial crisis on individuals, hospitals and healthcare systems. Hospital Acquired Infection can be able to increase the costs burden of patient care from different economic perspectives such as cost of medication, additional diagnostic tests and treatment, extra hospital days, and complications after discharge from the hospital.

Again, there was an evidence of more infection among female patients than male patients even though more male patients were admitted than the female patients.

On the other hand, admission and the environment (wards) significantly found to be the factors determining the prevalence of the infection.

6.1 Study Limitation

During careful review of the electronic folders, it was realized that doctors failed to document all necessary medical procedures that was performed on the patients. This practice limited the researcher to fully identify all the legible cases leading to recording less prevalence rate as compared to all other previous studies.

Another limitation to this study was the inability of the researcher to collect data from all the departments of the hospital but was limited to data from only three departments (male and female surgical wards and the intensive care unit). Therefore, results from these sections of the hospital were used to represent the entire hospital.

Even though the dataset provided information on the patients for the analysis, educational and marital status were not provided.

6.2 RECOMMENDATION

Based on the result and discussion presentation in chapters five and six, it is recommend that:

1. Infection prevention advocacy should be intensified in order to achieve zero HAIs in near future. It is also recommended that more infection prevention and control measures be intensified in the health facilities to reduce the yearly increase rate of infection.
2. Doctors should write detailed medical procedures and infection history of patients to help determine the actual prevalence of the infections. (it is possible that the prevalence rate would have been more than 1.2% if all the procedures were written).
3. We recommend that extra and effective care be given to the elderly patients on admission to prevent the infection.

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APPENDIX I: ETHICAL CLEARANCE

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.



MyRef. GHS/RDD/ERC/Admin/App
Your Ref. No.

19/287

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9th July, 2019

Mathew Alormenyo Nyagblormase
University of Ghana
School of Public Health
Legon

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	GHS-ERC 046/03/19
Project Title	Trends and Determinants of Nosocomial Infection among Hospitalized Patients at the Koforidua Regional Hospital.
Approval Date	9 th July, 2019
Expiry Date	8 th July, 2020
GHS-ERC Decision	Approved

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.
- Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra