PREVALENCE OF HOSPITAL-ACQUIRED INFECTIONS AMONG IN-PATIENTS AT THE UNIVERSITY OF BENIN TEACHING HOSPITAL

BY

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DECLARATION

I hereby declare that this project work titled '**PREVALENCE OF HOSPITAL-ACQUIRED INFECTIONS AMONG IN-PATIENTS AT UNIVERSITY OF BENIN TEACHING HOSPITAL (UBTH)'** was conducted under the supervision of PROF. O. H. OKOJIE & DR. N. MOKOGWU, and has not been submitted anywhere else for the award of a degree or certificate.

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CERTIFICATION

This is to certify that this research study titled '**PREVALENCE OF HOSPITAL-ACQUIRED INFECTIONS AMONG IN-PATIENTS AT UNIVERSITY OF BENIN TEACHING HOSPITAL (UBTH)'** was carried out by **OYINDUBA GREGORY SUOWARI** with matriculation number **MED1807497** under supervision of Prof. O. H. Okojie & Dr. N. Mokogwu, in the Department of Public Health and Community Medicine, School of Medicine, College of Medical Sciences, University of Benin, Benin City, Edo State, Nigeria as part of the requirements for the award of Bachelor of Medicine, Bachelor of Surgery (MBBS) degree.

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DEDICATION

I dedicate this work to God Almighty, who has brought me this far in my pursuit of becoming a medical doctor. This project is also dedicated to my father, Engr. Oyinke Suowari, my mother, Mrs. Yvonne Suowari and my siblings – Oyinebi, Oyinabobo and Oyindoubra – for their endless love and encouragement as they have been my pillars over the years, and have contributed immensely to my project. I also dedicate this project to my guardians during my stay in Benin, Dr. & Dr. (Mrs.) Egbo for their guidance and support. I also dedicate this project to my extended family, friends, colleagues, and other well-wishers. May this work serve as the stepping stone for all good that is to come.

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LIST OF ABBREVIATIONS

AIDS	**-**	Acquired Immune Deficiency Syndrome
AMR	-	Antimicrobial resistance
CAUTI	-	Catheter-associated urinary tract infection
CDC	**-**	Centres for Disease Control and Prevention
CI	-	Confidence Interval
ECDC	-	European Centre for Disease Prevention and Control
HAI	-	Hospital-acquired infection
ICU	-	Intensive care unit
IPC	-	Infection Prevention and Control
KII	**-**	Key Informant Interview
LMICs	-	Low- and middle-income countries
LUTH	-	Lagos University Teaching Hospital
NHSN	**-**	National Healthcare Safety Network
NICU	-	Neonatal Intensive Care Unit
NRC	-	Non-response calculation
OR	-	Odds Ratio
PPS	-	Point prevalence survey
RR	-	Risk Ratio
RSUTH	-	Rivers State University Teaching Hospital
SCBU	-	Special Care Baby Unit
SSI	-	Surgical site infection
UBTH	-	University of Benin Teaching Hospital
UTI	-	Urinary tract infection
WHO	-	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Antibiotic stewardship: The coordinated effort to optimise antibiotic prescribing by selecting the right drug, dose, route, and duration.

Antimicrobial resistance: The ability of a micro-organism to stop an antimicrobial drug from working against it.

Broad-spectrum antibiotic: An antimicrobial agent that is effective against a wide variety of pathogenic bacteria.

Clinical surveillance: The prospective, systematic identification of infections through case ascertainment, microbiology review and clinical criteria.

Comorbidity: The presence of one or more additional conditions occurring with a principal diagnosis that may affect outcome, treatment or recovery.

Fomite: Inanimate objects or surfaces that can transmit pathogens from one person to another.

Hospital-acquired infections: Infections that occur in patients while receiving care in hospitals, with the infections not being present or within incubation period at the time the patients are admitted.

Immunocompromise: State in which the ability of the immune system to fight disease(s) is reduced or absent.

Immunosenescence: Gradual deterioration of the immune system that occurs naturally with advanced age.

Infection: The invasion and multiplication of pathogens that are either normally absent within the body or normally present at a different location in the body, resulting in diseases or harm to the host.

In-patients: People who are admitted to a hospital or healthcare facility for treatment, care or observation.

Mixed-methods research A research approach that collects, analyses, and integrates both quantitative and qualitative data within a single study or series of studies.

Multi-drug resistance: A condition in which a microorganism is able to withstand the pharmaceutical actions of multiple antimicrobial drugs of different chemical classes that were previously effective against it.

Pathogen: Microorganism that can cause disease or harm to a host.

Prevalence: The total number of cases of a specific disease, condition, or health-related event existing in a defined population at a particular point in time or over a specified period.

Principal diagnosis: The diagnosis established, after study, to be chiefly responsible for occasioning a patient's admission to the hospital and the primary focus of clinical management during the current episode of care.

Source removal: The act of eliminating materials or devices that are reservoirs of infection.

Sterilization: The process of destroying all forms of microbial life and their spores.

Tertiary healthcare: Specialized consultative health care usually for in-patients and those on referral from primary or secondary medical care personnel, in a facility that has personnel and facilities for advanced medical investigation and treatment.

ABSTRACT

Background: Hospital-acquired infections (HAIs) present a major threat to patient safety, treatment outcomes, and healthcare sustainability globally, with a disproportionately higher burden in low- and middle-income countries (LMICs). Despite the critical role of tertiary health centres in specialized care, comprehensive data establishing both the precise prevalence of HAIs and the institutional capacity of reporting mechanisms remain scarce in many regional facilities. This study was conducted to investigate the epidemiological burden of HAIs and evaluate the existing surveillance reporting structures at the University of Benin Teaching Hospital (UBTH), Benin City, Nigeria.

Methods: A sequential mixed-methods cross-sectional design was deployed across diverse clinical wards at UBTH. For the quantitative phase, a sample size of 429 in-patients was selected utilizing a multi-stage sampling approach incorporating proportional allocation and simple random sampling. Data were gathered via researcher-administered structured questionnaires, clinical records, and laboratory reviews. Quantitative analysis was performed using descriptive statistics, chi-square tests, and binary logistic regression to isolate independent predictors. For the qualitative phase, purposive sampling was used to conduct seven (7) Key Informant Interviews (KIIs) with clinical consultants, nursing leadership, and infection control officers. Qualitative data were processed using thematic analysis via NVivo software.

Results: The quantitative survey achieved a 100% response rate across the 429 participants. The confirmed point prevalence of HAIs was 5.8% (n = 25), with an additional 0.2% (n = 1) categorized as suspected cases, while 93.9% (n = 403) showed no evidence of infection. Among the 25 confirmed cases, catheter-associated urinary tract infections (CAUTIs) were the most frequent clinical presentation at 48.0% (n = 12), followed by surgical site infections

(SSIs) at 16.0% (n = 4), hospital-acquired pneumonia at 12.0% (n = 3), non-catheter-associated UTIs at 12.0% (n = 3), puerperal sepsis at 8.0% (n = 2), and burn area infections at 4.0% (n = 1). Multivariable binary logistic regression revealed that the lengths of hospital stay (OR = 1.067, 95% CI: 1.033–1.102, $p < 0.001$) and active urethral catheterization (OR = 6.233, 95% CI: 2.316–16.772, $p < 0.001$) were the only statistically significant independent predictors of acquiring an infection. Socio-demographic factors (such as age and sex) and chronic client comorbidities showed no significant independent associations ($p > 0.05$). Qualitatively, key informants highlighted a critical operational deficit: a formalized, hospital-wide infection reporting protocol for frontline clinicians is practically absent. Surveillance remains an entirely manual, paper-based tracking process conducted independently by an under-resourced Infection Prevention and Control (IPC) unit due to a complete lack of digital infrastructure, technical training, and routine departmental feedback loops. Despite these barriers, there was universal consensus on the institutional value of a centralized reporting framework for establishing data-driven benchmarks and enhancing active antimicrobial stewardship.

Conclusion: This study demonstrates that while the recorded point prevalence of HAIs at UBTH is relatively modest, it is significantly and independently driven by modifiable hospital-level exposures—specifically device utilization and prolonged admission windows—rather than immutable patient comorbidities. Crucially, the integrity of this epidemiological data is actively limited by a fragmented, manual reporting apparatus. To mitigate this burden and ensure patient safety, UBTH must transition away from paper-reliant tracking toward an integrated, hospital-wide electronic surveillance architecture alongside mandatory clinical care bundles and structured departmental data feedback loops.

Keywords: Hospital-Acquired Infections, Nosocomial Surveillance, Catheter-Associated Urinary Tract Infections, Risk Factors, Mixed-Methods, Nigeria.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

An infection occurs when a pathogen enters a person's body, multiplies and causes a bodily reaction[1]. The presence of disease in an individual prompts a visit to a hospital for treatment and care, however, people may acquire infections while visiting the hospital.

Hospital-acquired infections (HAIs) are infections that patients get during their stay in the hospital and they usually occur 48 hours or more after admission into a hospital[2].

Hospital-acquired infections may also be referred to as nosocomial infections. The term nosocomial comes from two Greek words: *nosus*, meaning disease, and *komeion*, meaning to take care of [3]. A more encompassing term, 'healthcare-associated infections', includes infections acquired in the hospital likewise those from other healthcare facilities like nursing homes[4]. Its broader scope includes healthcare workers (such as doctors & nurses) as well as patients' visitors to the list of people that could acquire and transmit pathogens responsible for nosocomial infections[5-8].

Common nosocomial pathogens include: Staphylococcus aureus, Pseudomonas aeruginosa, Enterococci spp., enteric gram-negative bacilli (Escherichia, Klebsiella, Enterobacter and Serratia), Clostridium difficile, Acinetobacter spp., Candida spp., and to a lesser extent, some viruses like rhinovirus[5]. Many organisms causing hospital-acquired infections are often multidrug-resistant; and are therefore harder to treat[9].

Various factors predispose patients to having hospital-acquired infections. These factors may be broadly classified into two (2), namely: patient-related factors and hospital-related factors. Patient-related factors are the characteristics of a patient and/or the conditions a patient has or experiences, that increases the likelihood of getting a HAI. They include age, poor nutritional status, presence of comorbidity, immunocompromise, presence of inserted devices e.g.

prosthetics etc[4]. On the topic of age, HAIs are more common in neonates and elderly as a result of relative levels of natural immunocompromise[10,11]. Likewise, patients with diseases like diabetes mellitus (DM) or Acquired Immune Deficiency Syndrome (AIDS), and even those placed on medication that suppress the immune system have some degree of immunocompromise, predisposing them to HAIs[11].

Hospital-related factors refer to the environmental, procedural and organisational factors within a hospital that increase the likelihood of getting a HAI. They include prolonged hospitalization, surgical procedures and device insertion, poor hand hygiene, poor ventilation, overcrowding, contaminated water supply, broad spectrum antibiotic use, blood transfusion, inadequate sterilization of potential fomites e.g. medical equipment, dressing packs etc[11-13].

The pathogens mentioned earlier cause various types of hospital-acquired infections, the common ones in this region being surgical site infections (SSIs), urinary tract infections (UTIs) and respiratory tract infections (RTIs). Others include gastrointestinal infections, skin infections, puerperal fever and bacteraemia[14].

The most common organisms that cause SSIs include Staphylococcus aureus with others being Escherichia coli, Klebsiella spp., Pseudomonas spp., and Proteus spp[15]. Klebsiella spp. and Escherichia coli are the most common pathogen involved in hospital-acquired UTIs[16]. Streptococcus pneumoniae and Haemophilus influenzae are the most common pathogens involved in hospital-acquired RTIs. The opportunistic pathogens Aspergillus spp. and Pneumocystis spp. contribute to RTIs in the immunocompromised as well[17].

Prevention of hospital-acquired infections is a priority for the well-being of the patient. Various prevention and control measures have been made over time to curb the problem of HAIs. They can be grouped under five (5) levels of prevention, namely: primordial, primary, secondary, tertiary and quaternary levels.

Primordial prevention refers to measures that prevent the development of risk factors for particular conditions. In the context of HAIs, strategies that strengthen healthcare infrastructure include adequate hospital design and general health awareness. Ensuring hospitals are structured with standard wards with proper ventilation and optimal bed capacity could prevent the occurrence of HAIs[18,19]. Also, educating the public on the risks that unnecessary hospitalization/delay discharges pose in getting HAIs can help to discourage the notion and prevent HAIs[20].

Primary prevention aims to prevent disease before it occurs by reducing exposure risk to already vulnerable patients. It mainly consists of hand hygiene and antibiotic stewardship.

Hand hygiene plays a key role in primary prevention of HAIs as it is an inexpensive and effective method especially if done before and after touching a patient[21]. Other correct aseptic practices like equipment disinfection and sterilization should be done in conjunction with hand hygiene, especially in areas like the sterilization department and surgical theatres[22].

Another HAI primary prevention method is antibiotic stewardship. Surgical procedures, device insertions and tissue biopsies increase the risk of a patient getting a hospital-acquired infection. This risk can be minimized by administering the right prophylactic antibiotic at the right dosage and duration[23]. Other primary prevention strategies like environmental sanitation, improving ventilation of wards/theatres and limiting number of visitors could be of help in reducing nosocomial infections[24]. Good oral care e.g. regular brushing of teeth, and oropharyngeal suction help to reduce hospital-acquired infections like ventilator-associated pneumonia by reducing the oral flora that may be aspirated into the respiratory tree and exhibit pathogenicity[25].

Secondary level focuses on early diagnosis and prompt treatment, thus comprises daily monitoring and surveillance, screening and source removal[24]. Daily ward rounds by healthcare staff creates an avenue for systematic review in each patient. recent symptom

complaints and newly elicited signs not in line with existing diagnoses could indicate the presence of HAIs. Early detection through such routine assessments enables timely intervention and treatment[26]. In addition, continuous monitoring by infection control teams facilitates the early identification of infection trends, helping to prevent further transmission or outbreaks[27,28]. Routine screening for drug-resistant nosocomial pathogens in high-risk patients should also be implemented to enhance early detection and containment[29].

In situations where medical devices e.g. a blocked urinary catheter or infected intravascular catheter, are identified as sources of infection, they should be removed promptly. If complications like sepsis have already occurred, they should be appropriately managed[30]. Thus, source removal may serve as a secondary method of preventing HAIs when performed early. Where source removal occurs after complications have already developed, the purpose shifts to minimising disability and supporting rehabilitation, thereby performing a tertiary method of prevention role[24.31].

Quaternary prevention involves protecting patients from unnecessary treatment modalities[32]. In the context of HAIs, this involves two (2) strategies. First, antimicrobial stewardship which reduces the occurrence of antimicrobial resistance (AMR). Multi-drug-resistant organisms are usually implicated in HAIs. As such, avoiding overprescription/administration of antibiotics is an effective quaternary prevention strategy for HAIs[33,34]. Also, limiting invasive procedures until they are absolutely necessary and utilization of non-invasive alternatives whenever possible is another effective quaternary prevention strategy for HAIs. For example, a patient that can tolerate oral intake should not be receiving intravenous supplementation and drugs; unless the available drug formulation is specific to that route[34].

Hospital acquired infections reflect both patient vulnerability and gaps in infection prevention and control (IPC) practices.

1.2 Problem Statement

Hospital-acquired infections remain a challenge in healthcare delivery, particularly in developing countries like Nigeria, where infection control practices may be inadequate. Despite the role of tertiary hospitals like the University of Benin Teaching Hospital (UBTH) in providing specialized care, there is limited data on the prevalence and patterns of these infections within the institution. This lack of evidence hinders the development of effective prevention strategies and the implementation of infection control measures tailored specifically to the hospital.

The overall burden of HAIs affects hundreds of millions of patients. In high-income countries, approximately 7 out of every 100 hospitalized patients acquire at least one HAI, but in low-and middle-income countries (LMICs), this figure rises to 15 per 100 patients. On average, 1 in every 10 patients with HAI will die from it[35]. In low-and middle-income countries collectively, HAIs are estimated to contribute to 9.5 million deaths annually, with one-third of these deaths occurring in children[36]. Hundreds of millions of patients are affected by HAIs annually, leading to increased healthcare costs, morbidity, and mortality with 1 in every 10 patients with HAIs dying from said HAI[35]. The burden is well pronounced in LMICs due to factors such as limited resources, inadequate IPC measures, and overcrowded healthcare facilities[37].

Sadly, the existence of strong evidence of certain preventive measures and established protocols like hand hygiene protocols is taken for granted as many healthcare workers, overestimate their hand hygiene compliance[38]. This gap between knowledge and practice results in suboptimal adherence to infection prevention guidelines[39,40].

Hospital-acquired infections also make up a huge economic burden on healthcare systems. In 2016, the United States spent an estimate of $7.2 - $14.9 billion in direct healthcare cost[41]. In LMICs, where cost estimates are scarce, the financial impact is more profound as a result of

limited healthcare budgets and absence of strong insurance schemes. Many of the countries rely heavily on out-of-pocket payments which places a burden on individuals, resulting in costly health expenditure and restricted access to care[42,43].

Hospital-acquired infections have serious implications on patient health, healthcare systems and public health. The effects of these infections can have direct consequences on patient health and economic standing. Patient health consequences include increased patient morbidity and mortality, prolonged hospital stays and recovery periods, elevated risk of complications, and psychosocial effects like anxiety and depression[44,45,46].

Economic consequences on the other hand include higher treatment costs (due to extended care and additional interventions) and increased financial burden on healthcare systems[47].

Furthermore, HAIs often involve pathogens resistant to multiple antibiotics, contributing to (AMR), complicating treatment and control efforts[48,49]. Antimicrobial resistance is thus a matter of public health importance and also a detriment to patient health.

Despite the established global and national burden of HAIs, there is a lack of published point-prevalence survey or systematic HAI surveillance data exists for UBTH or any tertiary health facility in Edo State.

1.3 Justification

Hospital-acquired infections pose a challenge to patient safety and healthcare quality, particularly in tertiary institutions like UBTH. This study aims to gather baseline data and improve body of knowledge on the prevalence and determinants of HAIs within UBTH, and use said data to critique the effectiveness of protocols put in place to reduce the occurrence of HAIs in UBTH. It is anticipated that the findings of this study will serve as base evidence in the long-term goal of improving adherence of hospital staff and visitors towards prevention practices of hospital acquired infections, thereby enhancing patients' overall quality of care at

UBTH. The limited data on the prevalence of HAIs among patients admitted to UBTH highlights the need for targeted research to bring about effective interventions. Also, by characterizing the current HAI reporting system through qualitative methods, the hospital can benchmark its surveillance capacity against established standards and generate recommendations for system improvement.

This study holds relevance for both clinical practice and public health initiatives. Such improvements aid in minimizing the prevalence of hospital-acquired infections which continue to pose a serious challenge within healthcare settings.

Beyond the hospital, the study contributes meaningfully to public health by supporting efforts to reduce HAIs. which as earlier stated, improves patient outcomes.

1.4 Research Questions

In order to achieve the comprehensive purposes outlined above, this study will address the following research questions:

1. What is the prevalence of HAIs among UBTH in-patients?
2. What are the most common types of HAIs observed among UBTH in-patients?
3. What patient-related and hospital-related risk factors are mainly associated with the occurrence of HAIs at UBTH?
4. What are the systems currently in place for the reporting of HAIs at UBTH, and how effective are they?

1.5 Objectives

1.5.1. General Objective

To assess the prevalence, risk factors, and impact of hospital-acquired infections among in-patients at the University of Benin Teaching Hospital (UBTH).

1.5.2. Specific Objectives

1. To determine the prevalence of HAIs among in-patients at UBTH.
2. To identify the most common types of HAIs occurring within the hospital.
3. To assess patient-related and hospital-related risk factors associated with HAIs.
4. To ascertain the availability and usefulness of the systems currently in place for the reporting of HAIs at UBTH.

CHAPTER TWO

LITERATURE REVIEW

2.1 Prevalence of Hospital-Acquired Infections Among In-patients

In 2023, a systematic review and meta-analysis comprising of 400 studies was carried out with the aim of analysing the global prevalence of hospital-acquired infections (HAIs). The studies were conducted in over 20 countries across different continents e.g. Switzerland, Spain, China, Cyprus, Jordan, Lebanon, Sudan, Ethiopia etc., with a population of 29,159,630 hospital in-patients between 2000 and June 2021. Its findings revealed global prevalence of HAIs was 0.14% with an annual increase of 0.06% in HAI rates[50]. The meta-analysis made use of a multistage review process comprising of identification, screening, eligibility and inclusion in selecting the studies. The broad inclusion criteria used in accepting different types of studies while enhancing comprehensiveness, may affect its reliability. The review also excluded a large proportion of studies that passed the eligibility process on the basis of the articles not being written in English. This could affect the generalizability of the study as well.

In 2022, a retrospective prevalence study was carried out with the aim of determining the prevalence of healthcare-associated infections among inpatients. The study was carried out among 7,833 in-patients in a tertiary hospital in Casablanca, Morocco. Study findings revealed an overall HAI prevalence of 2.39% in 2018, which dropped to 1.41% in 2021.[51] The study was however limited because it relied on existing hospital records, and thus weakened by underreporting or missing data.

In 2022, a systematic review and meta-analysis comprising of 15 studies which aimed to estimate the pooled prevalence of HAIs and types of HAIs among hospitalized in-patients in

Africa was published. The studies were conducted in over eight (8) countries in the North, South, East and West African regions e.g. Tunisia, Ethiopia, South Africa, Benin-Republic etc., with a population of 11,272 hospital in-patients, between January 2010 and March 2022. Its findings revealed prevalence of HAIs was 12.76%, with ICUs and neonatal wards having the highest HAI rates[52]. The meta-analysis made use of a multistage review process comprising of identification, screening, eligibility and inclusion. The review, however, utilized only articles written in English which could affect its generalizability.

A point-prevalence study, conducted in November 2021 at Rivers State University Teaching Hospital (RSUTH), Port-Harcourt aimed to identify hospital-acquired infections and their antimicrobial management in RSUTH. A total of 100 hospital in-patients were surveyed from adult and paediatric medical and surgical wards and neonatal intensive care unit (NICU). The study findings revealed 10% of patients had HAIs with sepsis and skin/soft tissue infections each accounting for 30% of HAIs[53]. The study utilized a small sample size which may have affected the power of the study and its ability to obtain valid results.

2.2 Common Types of Hospital Acquired Infections Among In-patients in Tertiary Hospitals

In 2016, a point-prevalence study was conducted in a teaching hospital in Rome, Italy with the aim of analysing the prevalence and types of HAIs in the hospital. A total of 2,840 hospital in-patients were surveyed from medical and surgical departments. Findings revealed HAI prevalence was 4.79% with the most frequent HAIs being respiratory tract infections (35%), surgical site infections (22.2%), urinary tract infections (19.4%), and bloodstream infections (17.2%)[54]. The study utilized a large sample size and spanned nine (9) years which

boosted its data reliability. However, this study was done in a single centre, thus affecting its generalizability.

In 2024, a multicentre point-prevalence survey was conducted to assess the prevalence and types of healthcare-associated infections (HAIs) among in-patients in acute care hospitals. The study included 1,259 patients with HAIs from hospitals in Lombardy, Italy, surveyed in 2022. The most common infections were bloodstream infections (18.9%), urinary tract infections (17.1%), SARS-CoV-2 (17.0%), pneumonia and lower respiratory tract infections (16.7%), surgical site infections (11.0%), and gastrointestinal infections (7.4%).[55] This multicentre survey provides current data across different hospitals, making the results more generalizable. The large sample size improves accuracy, and including SARS-CoV-2 reflects recent trends. However, because it only captures one point in time, it cannot show how infections develop over time or identify causes. The study's inclusion of SARS-CoV-2 inflated the overall HAI prevalence figure and may disrupt comparisons with pre-pandemic data as well as other settings studies in which SARS-CoV-2 is not classified as a nosocomial infection.

In 2024, a systematic review and meta-analysis was published after evaluation of 92 studies that aimed to assess the prevalence, risk factors, and antimicrobial resistance patterns of HAIs in African tertiary hospitals. The studies were conducted in 20 African countries e.g. Ethiopia, Tanzania, Egypt, Nigeria, South Africa, Rwanda etc., with a population of 81,968 hospital in-patients, between 2010 and 2022. The study findings revealed common HAIs being surgical site infections, urinary tract infections and bloodstream infections[56]. The meta-analysis made use of a multistage review process comprising of identification, screening, eligibility and

inclusion. The review's findings are constrained by the uneven distribution of data as one - third of the data was obtained from just one (1) country.

In 2016, a prospective cohort study was conducted at the Lagos University Teaching Hospital (LUTH), Lagos, Nigeria, and aimed to determine the incidence, clinical outcomes, and risk factors associated with ICU-acquired infections. A total of 71 ICU patients were surveyed. The study findings revealed high incidence of ICU-acquired infections, with significant morbidity and mortality, with common infections being ventilator-associated pneumonia, and bloodstream infections[57]. The study was limited to a single ICU, which may not generally reflect other settings.

2.3 Patient-related and hospital-related risk factors associated with HAIs

In 2023, a meta-analysis was published after evaluation of 58 studies (from 41 regions in the 21 provinces of China) that aimed to identify common patient-related and hospital-related risk factors associated with HAIs. A study population of 1,211,117 hospital in-patients, between 2001 and 2022. The study findings revealed 29,737 patients had HAIs with major significant patient-related risk factors being age > 60 years, male gender, immunosuppression, and chronic diseases. Major hospital-related factors included invasive device use (haemodialysis), and prolonged hospital stays (> 15 days)[58]. The meta-analysis made use of a multistage review process comprising of identification, screening, eligibility and inclusion to select studies of various study designs. By incorporating studies within a period of 21 years, it allows for highlighting risk factor trends over time however, improvements in healthcare practices within the same time frame could affect its applicability.

A longitudinal study was conducted in 2018 at a tertiary hospital in Jimma, Ethiopia with the aim of determining the incidence, prevalence and risk factors of HAIs in the medical centre. A total of 992 in-patients were surveyed and included in the final analysis. The study findings revealed incidence of HAIs to be 19.41%, with the major risk factors identified being previous hospitalization, surgical procedures and underlying chronic illnesses[59]. The study was limited to a single tertiary facility, hindering generalization for primary and secondary health facilities.

In 2020, a prospective cohort study was carried out with the aim of determining the incidence and identifying patient-related and hospital-related risk factors for hospital-acquired infections (HAIs) among paediatric inpatients. The study was carried out among 448 hospitalised paediatric patients in a teaching hospital in southeast Ethiopia from November 2018 to June 2019. Study findings revealed significant risk factors associated with HAIs included: length of hospital stay greater than six days (adjusted RR 2.58, 95% CI 1.52–4.38) and underlying severe acute malnutrition (adjusted RR 2.83, 95% CI 1.61–4.97).[60] The study design allowed accurate relationship assessment between exposures (e.g., prolonged stay, malnutrition) and HAI development, and the use of standard CDC definitions makes it comparable to other studies. However, the study lacked detailed hospital-related factors such as staff adherence to infection control practices, which could influence HAI risk.

A point-prevalence study was conducted in three (3) acute care hospitals in Northern Nigeria in the year 2020. a total of 321 in-patients were surveyed. The study aimed to determine the point prevalence and risk factors associated with HAIs in acute care hospitals. Findings revealed that point-prevalence of HAIs was 14.3% with associated risk factors like intubation during hospitalization. However, there was no association between gender and duration of stay[61]. The study design limits insight into trends overtime.

2.4 Availability and effectiveness of HAI reporting/surveillance systems

A retrospective observational study published in 2019 was conducted at a tertiary hospital in Beijing, China. A total of 633,990 in-patients over a period of five (5) years were surveyed. The study aimed to quantify the five-year incidence trend of all healthcare-associated infections (HAIs) using a real-time HAI electronic surveillance system in a tertiary hospital. Findings revealed a total of 23,361 HAI cases identified over 6,242,375 patient-days. The study demonstrated that continuous electronic surveillance based on existing hospital electronic databases provided a practical means of measuring hospital-wide HAI incidence[62]. The study was limited to a single hospital, which may affect the generalizability of the findings. Also, the retrospective nature of the study may limit data accuracy and completeness.

In 2022, a retrospective descriptive analysis was carried out with the aim of assessing the usefulness of a real-time automatic nosocomial infection surveillance system for reporting and guiding prevention of hospital-acquired infections (HAIs). The study was carried out among 114,647 in-patients (including 2,242 HAI cases) in a large tertiary hospital in China from January 2017 to December 2019. Study findings revealed that the adoption of the system improved the accuracy and timeliness of HAI case collection and reporting, and that enhanced reporting through the system was useful in guiding clinicians in HAI prevention and control.[63]

The use of a large sample size, long study period, and focus on multiple types of HAIs strengthen the study's relevance. However, as a single-institution study, generalizability to other settings - especially those with limited electronic infrastructure - may be limited. Furthermore, the retrospective design may have been subject to documentation biases.

A 2016 observational study was conducted at a private teaching hospital in South Africa. The study aimed to report on the establishment and outcomes of a unit-specific surveillance system for hospital-acquired infections based on international standards. Findings revealed implementation of active unit-specific surveillance led to significant reductions in ICU-related ventilator-associated pneumonia (42%) and central line-associated bloodstream infections (100%) over a 3-year period. The study highlighted considerable variations in device-associated infection rates and utilization ratios between wards, emphasizing the importance of unit-specific surveillance[64]. The lack of specific patient numbers reported limits the ability to assess the scale of the surveillance system's impact.

A 2018 study review using secondary data was conducted at tertiary hospital in North-western Nigeria. A total of 518 in-patients were surveyed out of all patients admitted on the basis of having HAIs. The study review aimed to describe the results of a 2-year surveillance data in a tertiary hospital in Nigeria. Findings revealed a high burden of HAIs and a need for effective antibiotic stewardship program as well as prospective HAI surveillance on a national scale[65].

The study review involved retrospective data extraction which could affect its credibility.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

This study was conducted at the University of Benin Teaching Hospital (UBTH), a tertiary healthcare institution located in Egor Local Government Area, Benin City, Edo State, Nigeria. Nigeria, located in West Africa, is the most populous country on the continent, with over 200 million inhabitants and a diverse mix of ethnic groups, languages, and cultures[66]. It has 36 states and its Federal Capital Territory - Abuja. The country is broadly divided into six (6) geopolitical zones, with Southern Nigeria comprising the South-East, South-South, and South-West regions[67]. The southern part of the country is known for its economic vitality, driven by oil and gas production in the Niger Delta, thriving commercial hubs like Lagos, and agricultural and industrial activities[68].

Edo State is an inland state situated in the South-South region of Nigeria, and is one of the country's thirty-six (36) states, with Benin City serving as its capital and largest urban centre. The state's economy is anchored in agriculture, oil production, and solid minerals, with cassava, yam, maize, and rubber among its key agricultural outputs[69].

Benin City is one of the oldest and most historically significant cities in the country. It serves as a major urban centre in the Niger-Delta region and has a diverse population estimated to be over 1.5 million as of the 2023 projection, reflecting both urban growth and migration trends in Nigeria[70]. The city is well connected through road and air transport networks and boasts of several prominent health facilities such as Edo Specialist Hospital and the University of Benin Teaching Hospital.

The University of Benin Teaching Hospital (UBTH) was established on May 12, 1973 and is one of Nigeria’s foremost tertiary healthcare institutions. It is a federal government hospital affiliated with the University of Benin and serves as a teaching, research, and referral centre

for Edo State and surrounding states such as Delta, Ondo, Kogi, and Bayelsa[71]. The hospital has a bed capacity of over 900, with multiple departments including Internal Medicine, Surgery, Obstetrics and Gynaecology, Paediatrics, Mental Health, Dentistry, Radiology, Family Medicine, Ophthalmology, Public Health and Community Medicine, and Pathology. Specialized units include a Special Care Baby Unit (SCBU), Adult Intensive Care Unit (ICU), Burns and Plastic Surgery Unit, Dialysis Centre, and a Comprehensive Emergency Department. UBTH has various in-patient wards including eight (8) surgical wards – including one (1) ophthalmology ward, four (4) medical wards, two (2) paediatrics wards, two (2) maternity wards, one (1) gynaecology ward, one (1) oncology ward and one (1) psychiatric ward. The hospital also operates an Infection Prevention and Control (IPC) Committee and boasts of other clinical departments like Pharmacy, Physiotherapy, Paramedic medicine and Occupational Therapy. UBTH also runs two (2) schools namely; UBTH College of Nursing, and Institute of Health Sciences and Technology[71].

3.2 **Study Design**

A sequential mixed-methods cross-sectional design, incorporating both quantitative and qualitative approaches, was used for the study. The quantitative component assessed the prevalence, types, and risk factors of hospital-acquired infections (HAIs) among in-patients at University of Benin Teaching Hospital (UBTH). The qualitative component explored the availability, structure, and effectiveness of HAI reporting systems using Key Informant Interviews (KII) among relevant hospital personnel. In the sequential design, quantitative data was collected and analysed first, then followed up with qualitative data collection and analysis before the interpretation stage. The mixed methods design was chosen because the research objectives are multi-dimensional in nature, some requiring numerical measurement (prevalence and risk factors) and others requiring an in-depth understanding of human

experience, institutional processes, and systemic functionality. This qualitative part was designed to complement and enrich the quantitative findings by providing more context that numbers alone cannot capture.

3.3 Study Duration

The study was carried out from March 2025 till March 2026. During this 12-month period, the first nine months were used for conceptualization and initial write-up. Data collection, analysis and discussion was done in the remaining months.

3.4 Study Population

Quantitative component: The population comprised of in-patients admitted into selected UBTH wards during the study period.

Qualitative component: The qualitative study population comprised key informants with relevant experience about systems and protocol in UBTH, such as consultants in the various departments of the hospital, ICU and IPC personnel.

3.4.1 Selection Criteria

3.4.1.1 Inclusion Criteria

Quantitative component

In-patients must have been admitted for at least 48 hours in the hospital.

In-patients must be in general wards, at the time of the survey.

Qualitative component

Staff directly involved or had supervisory responsibility in clinical care, infection prevention, HAI management or reporting.

Staff been in their role for a minimum of one (1) year, ensuring familiarity with hospital systems.

3.4.1.2 Exclusion Criteria

Quantitative component

In-patients must not have been referred from a peripheral facility where they had been admitted for more than 48 hours.

Psychiatric ward in-patients were not included in the study due to the significant difference in care model.

Qualitative component

Staff unavailable during data collection.

3.5 Sample Size Determination

Quantitative component

Sample size was calculated using the Cochran's formula[72]:

$$n = \frac{(\mathbb{Z}^2 \cdot p \cdot q)}{d^2}$$

Where: n = minimum study population number

$\mathbb{Z}$ = 1.96 (standard normal deviation at 95% confidence level)

p = 0.5 (conservative estimate for population proportion)

q = (1 – p) = 1 – 0.5 = 0.5

d = 0.05 (constant degree of freedom)

Inputting the values;

$$n = \frac{(1.96^2 \times 0.5 \times 0.5)}{0.05^2}$$

$$n = \frac{0.9604}{0.0025}$$

$$n = 384.13 \simeq 384$$

Thus, the initial sample size is 384 in-patients.

The use of p = 0.50 maximises the required sample size and thereby ensures that the study is not underpowered relative to any plausible true prevalence within the local range.

Qualitative component: Approximately 7-15 key informants will be interviewed. However, data collection will continue until the major thematic domains are adequately explored and no new emerges, i.e. until data saturation is reached.

3.6 Sampling Technique

Quantitative component: A stratified random sampling technique was used as the in-patient population was divided into wards. Proportional allocation was carried out across all wards used, after which simple random sampling via balloting, was used in selecting the in-patients for the study. Questionnaires were administered to patients in the general wards. In-patients who met the inclusion criteria were selected until the desired sample size was reached.

Step 1: Selection of wards

UBTH has various in-patient wards including seven (7) surgical wards, four (4) medical wards, two (2) paediatrics wards, two (2) maternity wards, one (1) gynaecology ward, one (1) ophthalmology ward, one (1) oncology ward and one (1) psychiatric ward. Due to the significant difference in care model from typical in-patient wards, psychiatric ward in-patients were not included in the study.

Step 2: Proportional Allocation

Proportional allocation was used to distribute the target sample across the selected hospital wards. This is to ensure that each hospital ward was represented based on the number of patients it contributed to the total hospital population. Wards with higher number of occupied beds had more patients selected for the study, while wards with fewer occupied beds had fewer participants selected. The number of patients' beds in each ward (N) was counted days prior to data collection after which the total of patients' beds in selected wards (ΣN). The number of patients selected from each ward (x) was calculated using the formula:

$$x = \frac{N}{\Sigma N} \times n$$

where: n = 384 (initial sample size)

ΣN = 469 (total of patients' beds in selected wards)

To account for possible patient discharge or non-participation before data collection, a 10% non-response rate was expected. The sample size for each ward was therefore increased using the formula for non-response calculation (NRC) as follows:

$$wa = \frac{x}{1 - e}$$

where: e = 0.1 (non-response percentage; 10%)

This ensured the final sample size was adequate despite potential losses.

Step 3: Selection of Respondents

Within each ward, eligible in-patients were selected using simple random sampling, until the final sample size is met. If a selected patient was discharged or unavailable at the time of contact, they were replaced by the next eligible patient on the ward list and the replacement recorded.

Qualitative component: Purposive sampling will be used to select participants with relevant knowledge and experience of HAI reporting systems. Participants were selected because they could speak meaningfully about the topic.

3.7 Tools and Methods for Data Management

3.7.1 Data Collection

Quantitative component

Data were collected using a questionnaire adapted from validated instruments from the European Centre for Disease Prevention and Control (ECDC) and Global Point Prevalence Survey (Global-PPS) protocols, which guide the collection of data on HAI prevalence, infection types, patient characteristics, and risk factors.[73,74] The Global-PPS also provides validated tools for monitoring HAIs and antimicrobial use across hospitals worldwide.[74] These sources were used to ensure that the data collected are reliable and comparable with other studies. The questionnaire included sections on patient demographics, hospital admission details, and risk factors such as invasive devices, recent surgery, comorbidities, and current antimicrobial use. It also captured information on active infections, infection type, date of onset, and culture results. Finally, the questionnaire recorded whether the infection was acquired in the hospital and the outcome at the time of data collection. Standard definitions from ECDC and Global-PPS were used, such as defining HAIs as infections that appear more than 48 hours after admission.[73,74]

Using this approach ensures that the study uses a validated, internationally recognized method to assess HAI prevalence and related risk factors, while also allowing comparison with other hospital-based studies. Patient case notes and laboratory results will also be reviewed for the purpose of this study as well, with confirmed diagnosis from a supervising physician or infectious disease specialist where necessary.

Qualitative component

For the qualitative component of the study, data were collected using a semi-structured interview guide based on the study's fourth specific objective alongside supervisor's input. The interview guide consisted of open-ended and probing questions organized to explore several key domains, specifically focusing on HAI knowledge and availability of HAI reporting systems, alongside current reporting procedures and workflows, and the functionality of said system. Furthermore, the discussions will address challenges in reporting, data use and feedback mechanisms, and suggestions for improvement.

Regarding the procedure, the interviews will be conducted face-to-face, in a private, quiet setting within UBTH, with each session lasting between 15 and 30 minutes. With participants' consent obtained, all interview sessions were audio-recorded. Additionally, field notes were also taken simultaneously during the process to capture non-verbal cues and immediate impressions. Participants were assured that recordings would be used solely for research purposes and would be destroyed upon completion of the study. The semi-structured guide was used to direct the conversation while allowing sufficient flexibility for informants to elaborate on issues they considered important. Probing techniques such as clarifying probes ("Can you explain what you mean by that?") and elaborating probes ("Can you tell me more?"), were used to deepen the richness of responses. Interviews were conducted in English, the official language of the institution and the professional medium of communication among the study population.

3.7.2 Tools

Quantitative component: Data were be obtained with the aid of structured, researcher-administered questionnaires, alongside in-patient case notes and laboratory results & data analysis software. Patients were not asked to self-complete the questionnaire as the

questionnaire served as a standardised form through which data collectors recorded relevant clinical information from available medical records and clinical staff. This approach was adopted because some variables captured are sourced exclusively from clinical documentation and cannot be accurately self-reported by patients.

Section A: Instructions for data collector

This section provides clear guidance to the data collector on how to interpret each question, apply definitions correctly and accurately fill out the questionnaire. It also helps to minimize the differences in understanding between data collectors ensuring comparability of data obtained across different in-patients.

Section B: Consent script

This section serves to ensure adherence to ethical principle of informed consent as all patients partaking in this study are made aware of participating by their own choice.

Section C: Patient/Admission Data

This section captures background information on each patient. It includes demographic data (e.g. age, sex), hospital ID number, date and reason for admission, duration of hospital stay, ward type and underlying conditions present in order to identify patient-related risk factors associated with HAIs, and allow for comparison between ward types.

Section D: Exposure and device use

This section is designed to gather information on patient history of invasive procedures e.g. medical device insertion, and other potential sources of infection during their hospital stay. This includes data on use of urinary catheters, central or peripheral intravenous lines, ventilators etc., and surgeries in order to identify the modifiable hospital-related risk factors

that may contribute to HAI development. It can also provide information necessary in evaluation of adherence to IPC protocols.

Section E: Antimicrobial therapy and laboratory results

This section documents information on use of antimicrobials with relevant lab findings in patients so as to assess pattern of antimicrobial use, determine appropriateness of antimicrobial therapy and detect possible cases of AMR. Culture findings and antibiotic susceptibility patterns also help to validate infection diagnoses. and monitor antimicrobial surveillance.

Section F: Current infection status

This section aims to document whether patients currently have any infections acquired during their hospital stay and to characterize those infections. It provides information on the presence, type, and site of HAIs, in order to determine the distribution of HAIs within the study population and infection trends in various wards.

Section G: Data Collector Information

This section serves to document details about the individual responsible for completing the questionnaire. This includes the data collector's initial and designation, so as to ensure accountability and traceability.

Qualitative component: Data will be obtained with the aid of structured, self-administered interview guides, alongside password protected audio recording devices, voice transcription software and thematic coding software, NVivo. Each participant was assigned a unique

identifier code (e.g., KII-01, KII-02) to ensure anonymity in all transcripts and research outputs. No identifying information was attached to interview files or field notes. Verbatim transcription of all audio recordings was performed by the researcher within 24 hours of each interview to preserve accuracy and prevent recall bias. Transcripts were cross-checked against the audio recordings for completeness and accuracy before analysis.

3.7.3 Validity and Reliability

Quantitative component: To ensure standardization of the questionnaire, it will be pretested using 10% of the initial sample size at Edo Specialist Hospital.

Qualitative component: For the qualitative component, several methods will be employed to ensure rigor and reliability. This includes the use of an interview guide to maintain consistency throughout the data collection process. A pilot test was conducted with two individuals outside the eventual informants.

3.7.4 Research Assistant

Research assistant(s) will be recruited for the purpose of this study with proper standardization of the questionnaire. These research assistants will be medical students of the University of Benin and they will be trained on how to administer the questionnaire.

3.7.5 Data Analysis & Presentation

Quantitative component

Measurement/Scoring of variables

Yes=1, No=0, Not Applicable=98

Unknown/Uncertain=99

HAI present at survey: Yes=1, No=0, Suspected=2, Unknown=99

Sex: Male=1, Female=2

HAI types: Use numeric codes (SSI=1, CAUTI=2, CLABSI=3, HAP=4, Other=5)

Diabetes mellitus=1, Chronic kidney disease=2, HIV/AIDS=3, Malignancy=4, COPD=5, Heart disease=6, Immunosuppressive therapy=7, Obesity=8, None=0

Statistical Analysis

Data gathered was collated and screened for completeness after which they will be serially entered into IBM SPSS version 27.0 software for analysis before scoring.

Descriptive statistics such as frequencies and percentages were used to summarize prevalence of HAIs. Results obtained will be presented using frequency distribution tables and charts. Chi-square tests were applied to applied to examine associations between sociodemographic, medical and hospital-related variables, and hospital acquired infections.

Qualitative component

The qualitative data was analysed using thematic analysis. A deductive approach guided by the study objective was utilized following the six-phase framework described by Braun and Clarke. This process followed a systematic series of steps, beginning after the verbatim transcription of the interviews. Familiarization with the collected data before moving on to the coding of the transcripts. The analysis will then proceed with the searching, review and definition of themes and sub-themes, ultimately ending in the interpretation of the findings. The qualitative strand was analysed through thematic coding using NVivo, for organisation, retrieval, and comparison of coded transcripts.

Unit of analysis

The unit of analysis was a meaningful segment of text expressing a perception, experience, explanation, or interpretation related to the availability and usefulness of HAI reporting systems at UBTH.

Trustworthiness and Rigour

The rigour of the qualitative strand was strengthened through the following procedures.

Credibility

Credibility was enhanced through inclusion of more than one (1) participant categories and use of verbatim quotations in the analysis.

Dependability

Dependability was supported by use of a semi-structured guide, consistent procedures across interviews and discussions; and systematic documentation of data collection and analysis processes.

Confirmability

Confirmability was strengthened by grounding all themes in participant narratives, maintaining an audit trail of coding and theme development and avoiding unsupported interpretations.

Transferability

Transferability was enhanced by detailed description of the study context and clear reporting of participant categories.

3.8 Ethical Consideration

Ethical approval and permission to carry out the study will be obtained from the Health Research Ethics Committee of the University of Benin Teaching Hospital prior to data collection (seen in Appendix). Informed consent (obtained from people >18 years) or informed assent (obtained from parent(s) of people <18 years) was obtained before administering the questionnaires. Permission from the ward managers and unit head doctors in charge of the wards was obtained prior to data collection. The respondents were informed that they have the right to withdraw from the study at any time and that withdrawal poses no loss or harm.

For the qualitative aspect, participants were clearly informed of their right to withdraw at any point without consequence. All data was anonymized. No participant's name or identifying information appeared in any research document. No foreseeable harm was anticipated from participation in this study. Interviews were designed to be non-intrusive and professionally respectful. No incentives or coercive measures were used to secure participation as well.

3.9 Limitations of Study

This study was subject to several limitations that should be considered when interpreting the findings. In the quantitative component, some HAIs may have been missed or underreported, since it majorly relied on patient records and ward reports. This means that infections not documented in the case notes or not captured by a microbiological culture would not have been identified. The low culture-taking rate across the study population compounds this limitation considerably, as many infections meeting clinical but not microbiological criteria were necessarily excluded from the confirmed HAI count under the standard case definition applied. Additionally, because data collection was conducted over a short period at a single point in time, the findings may not represent HAI rates across different seasons or clinical periods, and any seasonal fluctuations in infection occurrence would not be captured.

In the qualitative component, the potential for social desirability bias is there in the interview-based design and may have been amplified by the power differential between the researcher — a junior within the institutional hierarchy — and the senior clinical informants being interviewed. Informants may have moderated their accounts of reporting failures or system deficiencies to present institutional practices in a more favourable light than the reality warrants. Some informants may also have been subject to recall bias, particularly when asked to reflect on historical practices or the timing of system changes. The final number of qualitative informants, while achieving reasonable thematic coverage, also carries the risk of premature data saturation, particularly given the low diversity among the professional cadres represented and the potential depth imbalance between informants arising from time constraints during the interviews.

CHAPTER FOUR

RESULTS

4.1 Quantitative Analysis - Data Presentation

A total of four hundred and twenty-nine (429) in-patients participated in this study with all questionnaires retrieved giving a response rate of 100%. The results are presented as follows:

Section A: Socio-demographic characteristics, in-patient medical history & invasive procedure history

Section B: Exposure & device use

Section C: Anti-microbial therapy and laboratory results

Section D: Current infection status

SECTION A:

SOCIO-DEMOGRAPHIC FACTORS, PHYSICAL CHARACTERISTICS, IN-PATIENT MEDICAL HISTORY & INVASIVE PROCEDURE HISTORY

Table 1: Socio-demographics of in-patients

Variable	Frequency (n=429)	Percent (%)
Age group (years)		
< 18	82	19.1
18 – 40	154	35.9
41 – 60	93	21.7
> 60	100	23.3
Mean ± SD = 39.42 ± 23.88		
Sex		
Female	238	55.5
Male	191	44.5
Ward		
Surgical	194	45.2
Obstetrics & Gynaecology	87	20.3
Medical	84	19.6
Paediatrics	36	8.4
Oncology	28	6.5
Length of stay (days)		
2 - 7	253	59.0
8 – 14	107	24.9
> 14	69	16.1
Median length of stay (IQR) = 7.0 (4.0 – 11.0)		

A total of 429 in-patients were enrolled in the study. The largest age group was 18–40 years, comprising 154 (35.9%) participants, followed by those aged over 60 years at 100 (23.3%), those aged 41–60 years at 93 (21.7%), and those under 18 years at 82 (19.1%). The mean age was 39.42 ± 23.88 years. Female patients predominated, accounting for 238 (55.5%) of the sample compared with 191 (44.5%) males. The surgical ward accommodated the highest proportion of patients at 194 (45.2%), followed by the obstetrics and gynaecology ward at 87

(20.3%) and the medical ward at 84 (19.6%), with paediatrics and oncology accounting for 36 (8.4%) and 28 (6.5%) patients respectively. The majority of patients had a short hospital stay of 2–7 days, representing 253 (59.0%) of participants, whilst 107 (24.9%) remained for 8–14 days and 69 (16.1%) stayed beyond 14 days. The median length of stay was 7.0 days (IQR: 4.0–11.0).

Table 2: Key Informant Profile

Code	Department / Role	Years in current role at UBTH	Professional Cadre
KII-01	Obstetrics & Gynaecology — Consultant, Unit Head	~14 yrs	Medical Consultant
KII-02	Paediatrics — Consultant, Unit Head	~25 yrs	Medical Consultant
KII-03	Medical Microbiology — Consultant Clinical Microbiologist	~11 yrs	Medical Consultant /Academic
KII-04	Infection Prevention & Control (IPC) Unit	~5–6 yrs	Senior Nursing Officer
KII-05	Anaesthesia / Critical Care — Consultant Anaesthesiologist & ICU Coordinator	~7 yrs	Medical Consultant
KII-06	Consultant General Surgeon	~16 yrs (Consultant)	Medical Consultant
KII-07	Internal Medicine (Clinical Pharmacology, Therapeutics & Toxicology) — Honorary Consultant	~10 yrs	Medical Consultant

Qualitative Analysis Participant Profile: Seven key informants participated in the study. Their roles, departments, and years of experience are summarised in the table below. Participants are identified by anonymous codes (KII-01 to KII-07) throughout this document.

Table 3: Physical characteristics of in-patients

Variable	Frequency (n=429)	Percent (%)
BMI		
Underweight (<18.5)	78	18.2
Normal (18.5 - 24.9)	292	68.1
Overweight (25.0 - 29.9)	46	10.7
Obese (≥ 30.0)	13	3.0
Mean ± SD = 22.13 ± 3.44		
MUAC in cm (n=31) *		
SAM (<11.5)	1	3.2
MAM (11.5 - 13.4)	4	12.9
Normal (≥13.5)	26	83.9
Mean ± SD = 13.96 ± 0.78		

* Patients from 6 – 59 months of age

Physical characteristics were assessed for all enrolled patients. BMI classification revealed that the majority of patients fell within the normal range (18.5–24.9 kg/m²), accounting for 292 (68.1%) of participants, whilst 78 (18.2%) were underweight, 46 (10.7%) were overweight, and 13 (3.0%) were obese. The mean BMI was 22.13 ± 3.44 kg/m². Mid-upper arm circumference (MUAC) was assessed in 31 patients aged 6–59 months; of these, 26 (83.9%) had a normal MUAC, four (12.9%) had moderate acute malnutrition (MAM), and one (3.2%) had severe acute malnutrition (SAM), with a mean MUAC of 13.96 ± 0.78 cm.

Table 4: In-patient medical history

Variable	Frequency (n=429)	Percent (%)
Medical History (n=177)		
Hypertension	111	25.9
Diabetes Mellitus	41	9.6
Peptic Ulcer Disease	29	6.8
HIV/AIDS	14	3.3
Sickle Cell Disease	6	1.4
Heart Disease (HF, ASD etc.)	10	2.3
COPD	3	0.7
Asthma	3	0.7
Chronic Kidney Disease	6	1.4
Chronic Liver Disease	0	0.0
Immunosuppressive therapy	6	1.4
Malignancy	10	2.3
SLE	2	0.5
Epilepsy	3	0.7
Arthritis	2	0.5

Of the 429 enrolled in-patients, 177 (41.3%) had at least one documented pre-existing medical condition. All frequencies and percentages in this table are calculated relative to the total sample of 429 in-patients, not relative to the subset with any comorbidity, as individuals may have had more than one comorbidity. Hypertension was the most prevalent comorbidity, recorded in 111 (25.9%) patients, followed by diabetes mellitus in 41 (9.6%) and peptic ulcer disease in 29 (6.8%). Less frequent conditions included HIV/AIDS in 14 (3.3%), heart disease in 10 (2.3%), and malignancy in 10 (2.3%), whilst chronic kidney disease, sickle cell disease, and immunosuppressive therapy were each present in six (1.4%) patients. COPD, asthma, and epilepsy were each recorded in three (0.7%) patients, with SLE in two (0.5%) and arthritis in two (0.5%). No patient had chronic liver disease. As individual patients may

have had more than one comorbidity, the percentages reflect the proportion of the total sample with each condition.

Table 5: Invasive procedure history

Variable	Frequency	Percent (%)
Clinical Interventions (n=176)		
Surgical procedures	165	93.8
Non-surgical invasive procedures (dialysis, lumbar puncture etc.)	11	6.3

Of the 429 in-patients, 176 (41.0%) had undergone a clinical intervention during their admission. Among those who had any intervention, surgical procedures were overwhelmingly more common, accounting for 165 (93.8%) of cases. Non-surgical invasive procedures, including dialysis and lumbar puncture, were undertaken in the remaining 11 (6.3%) patients.

SECTION B:

EXPOSURE & DEVICE USE

Table 6: Presence of inserted devices

Variable	Frequency (n=429)	Percent (%)
Clinical Devices (n=402) *		
Peripheral IV cannula	387	90.2
Urethral catheter	108	25.2
Surgical drains (chest tube, wound/stoma drains, etc.)	25	5.8
Nasogastric tube	12	2.8
Central IV cannula	7	1.6
Endocervical catheter	7	1.6

***** Multiple response question

Clinical devices were present in 402 (93.7%) of the 429 in-patients at the time of the survey. The peripheral intravenous cannula was the most frequently encountered device, present in 387 (90.2%) patients. The urethral catheter was the next most common, recorded in 108 (25.2%) patients, followed by surgical drains in 25 (5.8%), nasogastric tubes in 12 (2.8%), central intravenous cannulae in seven (1.6%), and endocervical catheters in seven (1.6%). Individual patients could have more than one device simultaneously.

SECTION C:

ANTI-MICROBIAL THERAPY AND LABORATORY RESULTS

Table 7: Antimicrobial therapy and Laboratory Cultures

Variable	Frequency (n=429)	Percent (%)
Antibiotic Status (at survey time)		
Yes	325	75.8
No	104	24.2
Antibiotic used (n=325) *		
Metronidazole	169	52.0
Ceftriaxone	100	30.8
Amoxicillin-Clavulanic acid	66	20.3
Levofloxacin	59	18.2
Ceftriaxone-Sulbactam	58	17.8
Gentamicin	31	9.5
Ciprofloxacin	15	4.6
Clindamycin	14	4.3
Cefuroxime	14	4.3
Cefixime	10	3.1
Others (clarithromycin, azithromycin, meropenem, vancomycin, doxycycline, fluconazole etc.)	27	8.3
Culture status taken		
Yes	105	24.5
No	324	75.6
Culture specimen (n=105) *		
Urine (Mid-stream/Catheter)	66	62.9
Blood	23	21.9
Wound swab	20	19.0
Sputum	19	18.1
Stool	7	6.7
Pleural fluid	6	5.7
Endocervical swab	5	4.8
Cerebrospinal fluid	4	3.8
Ascitic Fluid	2	1.9
Others (skin scrapings, throat swab etc.)	4	3.8

At the time of the survey, 325 (75.8%) patients were receiving antibiotic therapy, whilst 104 (24.2%) were not. Among those on antibiotics, the most commonly administered agent was metronidazole, used in 169 (52.0%) of antibiotic-treated patients, followed by ceftriaxone in 100 (30.8%), amoxicillin–clavulanic acid in 66 (20.3%), levofloxacin in 59 (18.2%), and ceftriaxone–sulbactam in 58 (17.8%); individual patients may have received more than one agent. Laboratory cultures were obtained in 105 (24.5%) patients. Urine was the most frequently collected specimen, sampled in 66 (62.9%) of those cultured, followed by blood in 23 (21.9%), wound swabs in 20 (19.0%), and sputum in 19 (18.1%).

SECTION D:

CURRENT INFECTION STATUS

Table 8: Current infection status

Category	Frequency (n = 429)	Percentage (%)
HAI status		
Confirmed HAI	25	5.8
Suspected HAI	1	0.2
Without HAI	403	93.9
HAI type (n=25)		
Catheter Associated UTI	12	48.0
Surgical site infection	4	16.0
Hospital Acquired Pneumonia	3	12.0
Non-Catheter Associated UTI	3	12.0
Puerperal sepsis	2	8.0
Burned Area Infections	1	4.0

Of the 429 in-patients surveyed, HAI was confirmed in 25 (5.8%) and suspected in one (0.2%), whilst the remaining 403 (93.9%) had no evidence of HAI. Among the 25 confirmed HAI cases, catheter-associated urinary tract infection (CAUTI) was the most frequent type, accounting for 12 (48.0%) cases, followed by surgical site infection in four (16.0%), hospital-acquired pneumonia in three (12.0%), non-catheter-associated UTI in three (12.0%), puerperal sepsis in two (8.0%), and burn area infection in one (4.0%). The suspected HAI case was excluded from the confirmed HAI group for all subsequent analyses, consistent with ECDC Global-PPS guidance that only confirmed HAI cases meeting the standard clinical and microbiological criteria be included in prevalence calculations. As such, the suspected case is only reported descriptively.

Table 9: Socio-demographics and Hospital Acquired Infections (HAI)

Variables	HAI Status		Test statistics	p-value
	No (n=404) Freq (%)	Yes (n=25) Freq (%)		
Age (years)				
< 18	77 (93.9)	5 (6.1)	a=5.262	0.154
18 – 40	150 (97.4)	4 (2.6)		
41 – 60	86 (92.5)	7 (7.5)		
> 60	91 (91.0)	9 (9.0)		
Sex				
Female	228 (95.8)	10 (4.2)	a=2.575	0.109
Male	176 (92.1)	15 (7.9)		
Length of Stay (days)				
2 – 7	249 (98.4)	4 (1.6)	a=26.428	**<0.001***
8 – 14	98 (91.6)	9 (8.4)		
> 14	57 (82.6)	12 (17.4)		
Ward Groups				
Surgical	181 (93.3)	13 (6.7)	b=3.306	0.481
Medical	78 (92.9)	6 (7.1)		
Paediatrics	33 (91.7)	3 (8.3)		
Oncology	28 (100.0)	0 (0.0)		
Obstetrics & Gynaecology	84 (96.6)	3 (3.4)		

a = Chi-Square b = Fisher's Exact Test * Statistically Significant

Analysis of socio-demographic variables revealed that length of stay was the only factor significantly associated with HAI status ($\chi^2 = 26.428$, $p < 0.001$). The HAI rate increased markedly with duration of hospitalisation: 1.6% among patients staying 2–7 days, 8.4% among those remaining for 8–14 days, and 17.4% among patients hospitalised beyond 14 days. No statistically significant association was observed between HAI and age group (p =

0.154), sex (p = 0.109), or ward assignment (p = 0.481). Whilst male patients had a higher crude HAI rate of 7.9% compared with 4.2% in females, this difference did not reach statistical significance. Notably, no HAI cases were recorded in the oncology ward during the study period.

Table 10: Physical characteristics and Hospital Acquired Infections (HAI)

Variables	HAI Status		Test statistics	p-value
	No (n=404) Freq (%)	Yes (n=25) Freq (%)		
BMI				
Underweight	72 (92.3)	6 (7.7)	b=1.250	0.699
Normal	276 (94.5)	16 (5.5)		
Overweight	44 (95.7)	2 (4.3)		
Obese	12 (92.3)	1 (7.7)		
MUAC	**(n=27)**	**(n=4)**		
SAM (<11.5)	1 (100.0)	0 (0.0)	b=1.700	0.525
MAM (11.5 – 13.4)	3 (75.0)	1 (25.0)		
Normal (≥13.5)	23 (88.5)	3 (11.5)		

b = Fisher's Exact Test

Neither BMI category nor MUAC status was significantly associated with the occurrence of HAI. Across BMI groups, HAI rates ranged from 4.3% in overweight patients to 7.7% in both underweight and obese patients, with normal-weight patients having a rate of 5.5%; these differences were not statistically significant (Fisher's Exact, p = 0.699). Among the 31 patients assessed for MUAC, all of whom were aged 6–59 months, one of the four patients with moderate acute malnutrition (25.0%) and three of the 26 with normal nutritional status (11.5%) developed HAI; the single patient with severe acute malnutrition had no HAI. The

overall MUAC analysis was not statistically significant (p = 0.525). It makes it impossible to draw any meaningful conclusion.

Table 11a: Comorbidities and Hospital Acquired Infections (HAI)

Variables	HAI Status		Test statistics	p-value
	No (n=404) Freq (%)	Yes (n=25) Freq (%)		
Hypertension				
No	303 (95.3)	15 (4.7)	a=2.762	0.097
Yes	101 (91.0)	10 (9.0)		
Diabetes Mellitus				
No	365 (94.1)	23 (5.9)	b=0.740	1.000
Yes	39 (95.1)	2 (4.9)		
Peptic Ulcer Disease				
No	376 (94.0)	24 (6.0)	b=0.321	1.000
Yes	28 (96.6)	1 (3.4)		
HIV/AIDS				
No	390 (94.0)	25 (6.0)	b=0.896	1.000
Yes	14 (100.0)	0 (0.0)		
Sickle Cell Disease				
No	399 (94.3)	24 (5.7)	b=1.303	0.304
Yes	5 (83.3)	1 (16.7)		
Heart Disease (HF, ASD etc.)				
No	394 (94.0)	25 (6.0)	b=0.634	1.000
Yes	10 (100.0)	0 (0.0)		
COPD				
No	402 (94.4)	24 (5.6)	b=4.165	0.165
Yes	2 (66.7)	1 (33.3)		

a = Chi-Square b = Fisher's Exact Test

Table 11b: Comorbidities and Hospital Acquired Infections (HAI)

Variables	HAI Status		Test statistics	p-value
	No (n=404) Freq (%)	Yes (n=25) Freq (%)		
Asthma				
No	401 (94.1)	25 (5.9)	b=0.187	1.000
Yes	3 (100.0)	0 (0.0)		
Chronic Kidney Disease				
No	399 (94.3)	24 (5.7)	b=1.303	0.304
Yes	5 (83.3)	1 (16.7)		
Immunosuppressive therapy				
No	398 (94.1)	25 (5.9)	b=0.377	1.000
Yes	6 (100.0)	0 (0.0)		
Malignancy				
No	394 (94.0)	25 (6.0)	b=0.634	1.000
Yes	10 (100.0)	0 (0.0)		
SLE				
No	402 (94.1)	25 (5.9)	b=0.124	1.000
Yes	2 (100.0)	0 (0.0)		
Arthritis				
No	403 (94.4)	24 (5.6)	b=7.144	0.113
Yes	1 (50.0)	1 (50.0)		
Epilepsy				
No	402 (94.4)	24 (5.6)	b=4.165	0.165
Yes	2 (66.7)	1 (33.3)		
Any Medical History				
No	240 (95.2)	12 (4.8)	a=1.264	0.261
Yes	164 (92.7)	13 (7.3)		

a = Chi-Square b = Fisher's Exact Test

Examination of individual comorbidities revealed no statistically significant associations with HAI status. Hypertension showed the closest approach to significance, with 10 (9.0%) hypertensive patients developing an HAI compared with 15 (4.7%) of those without the condition ($\chi^2 = 2.762$, $p = 0.097$). Patients with diabetes mellitus, peptic ulcer disease, sickle cell disease, and chronic kidney disease showed no significant difference in HAI rates relative to those without these conditions. Notably, no HAI cases were recorded among the 14 patients with HIV/AIDS or the 10 patients with heart disease, precluding statistical comparison for these variables.

Among the remaining comorbidities examined in Table 11b, none reached statistical significance. Arthritis showed the numerically largest difference, with one of two patients (50.0%) with the condition developing an HAI compared with 24 of 427 (5.6%) without it (Fisher's Exact, $p = 0.113$); however, this observation is based on only two patients and must be interpreted with extreme caution. Epilepsy and COPD similarly showed elevated but non-significant HAI rates of 33.3% each in small affected groups (n=3 for each). No HAI cases were recorded among patients receiving immunosuppressive therapy, those with malignancy, or those with SLE. Having any documented medical history was not significantly associated with overall HAI risk ($\chi^2 = 1.264$, $p = 0.261$).

Table 12: Presence of inserted devices and HAI status among respondents

Variables	HAI Status		Test statistics	p-value
	No (n=404) Freq (%)	Yes (n=25) Freq (%)		
Central IV Cannula				
Yes	6 (85.7)	1 (14.3)	b=0.928	0.345
No	398 (94.3)	24 (5.7)		
Urethral Catheter				
Yes	93 (86.1)	15 (13.9)	a=17.092	**<0.001***
No	311 (96.9)	10 (3.1)		
Endocervical Catheter				
Yes	6 (85.7)	1 (14.3)	b=0.928	0.345
No	398 (94.3)	24 (5.7)		
Nasogastric Tube				
Yes	11 (91.7)	1 (8.3)	b=0.141	0.518
No	393 (94.2)	24 (5.8)		
Surgical Drains				
Yes	25 (100.0)	0 (0.0)	b=1.643	0.385
No	379 (93.8)	25 (6.2)		
Peripheral IV Cannula				
Yes	362 (93.5)	25 (6.5)	b=2.881	0.155
No	42 (100.0)	0 (0.0)		
Any Inserted Devices				
Yes	377 (93.8)	25 (6.2)	b=1.783	0.390
No	27 (100.0)	0 (0.0)		

a = Chi-Square b = Fisher's Exact Test * Statistically Significant

The presence of a urethral catheter was the only inserted device significantly associated with HAI status ($\chi^2 = 17.092$, $p < 0.001$). Patients with a urethral catheter had an HAI rate of 13.9%, compared with 3.1% among those without, confirming the strong association between

catheterisation and healthcare-associated infection. No other individual device was significantly associated with HAI, including central intravenous cannulae (Fisher's Exact, p = 0.345), endocervical catheters (Fisher's Exact, p = 0.345), nasogastric tubes (Fisher's Exact, p = 0.518), and surgical drains (Fisher's Exact, p = 0.385). The peripheral intravenous cannula, whilst present in all 25 HAI patients, was also present in 93.5% of non-HAI patients, yielding a non-significant association (Fisher's Exact, p = 0.155). The aggregate variable of any inserted device was similarly non-significant (Fisher's Exact, p = 0.390).

Table 13: Clinical interventions, broad spectrum antibiotic use and HAI status among respondents

Clinical interventions	HAI Status		Test statistics	p-value
	No (n=164) Freq (%)	Yes (n=12) Freq (%)		
Clinical Interventions				
Surgical procedures	153 (92.7)	12 (7.3)	b=0.859	1.000
Non-surgical invasive procedures (dialysis, lumbar puncture etc.)	11 (100.0)	0 (0.0)		
Broad spectrum antibiotic use				
Yes	101 (95.3)	5 (4.7)	a=0.316	0.574
No	303 (93.8)	20 (6.2)		

a = Chi-Square b = Fisher's Exact Test

Among the 176 patients who underwent a clinical intervention, no statistically significant difference in HAI occurrence was observed between those who had surgical procedures (12; 7.3%) and those who underwent non-surgical invasive procedures such as dialysis or lumbar puncture (0; 0.0%) (Fisher's Exact, p = 1.000). The absence of HAI cases in the non-surgical group should be interpreted cautiously given the very small number of patients in that category (n = 11).

The use of broad-spectrum antibiotics was not significantly associated with HAI status (χ^2 = 0.316, p = 0.574). Among patients receiving broad-spectrum antibiotic therapy, five (4.7%) developed an HAI, compared with 20 (6.2%) among those who did not receive such treatment. The apparently lower HAI rate in the antibiotic-treated group is likely attributable to confounding, given that antibiotic use in this context largely reflects treatment of pre-existing or perioperative infections rather than prophylaxis against HAI.

Table 14a: Binary Logistic Regression Model for Predictors of HAI

Factors	B (Regression Coefficient)	Odds Ratio	95% CI for OR		p-value
			Lower	Upper	
Age (years)	0.002	1.002	0.974	1.031	0.877
Sex					
Male	-0.497	0.608	0.180	2.058	0.424
Female*		1.000			
Length of Stay (days)	0.065	1.067	1.026	1.110	**<0.001***
Ward Type					0.750
Medical	0.655	1.926	0.444	8.363	0.382
Paediatrics	1.214	3.366	0.421	26.911	0.253
Oncology†	-17.733	~0.000	~0.000	NC	0.998
Obstetrics & Gynaecology	-0.196	0.822	0.160	4.229	0.814
Surgical*		1.000			
Urethral Catheter					
Yes	1.830	6.233	2.206	17.615	**<0.001***
No*		1.000			

*Statistically significant (p < 0.05); *Reference category; OR = Odds Ratio; CI = Confidence Interval; B = Regression Coefficient; NC = Not Computable; R^2 = 11.3% – 31.5%

† Complete separation — no HAI cases recorded in the oncology ward; estimate is unreliable

Table 14b: Binary Logistic Regression Model for Predictors of HAI

Factors	B (Regression Coefficient)	Odds Ratio	95% CI for OR		p-value
			Lower	Upper	
Broad-Spectrum Antibiotics					
Yes	-0.528	0.590	0.175	1.993	0.395
No*		1.000			
Invasive Procedure					
Yes	0.515	1.674	0.560	5.004	0.356
No*		1.000			
Hypertension					
Yes	0.218	1.244	0.362	4.278	0.729
No*		1.000			
Diabetes Mellitus					
Yes	-0.539	0.583	0.102	3.319	0.543
No*		1.000			
COPD					
Yes	1.281	3.602	0.193	67.336	0.391
No*		1.000			
Epilepsy					
Yes	0.966	2.628	0.149	46.437	0.510
No*		1.000			
Arthritis					
Yes	2.802	16.478	0.333	815.500	0.159
No*		1.000			
BMI	0.067	1.069	0.917	1.247	0.393

*Statistically significant ($p < 0.05$); *Reference category; OR = Odds Ratio; CI = Confidence Interval; B = Regression Coefficient; NC = Not Computable; $R^2 = 11.3\% – 31.5\%$

† Complete separation — no HAI cases recorded in the oncology ward; estimate is unreliable

Binary logistic regression was conducted to identify independent predictors of HAI after simultaneously controlling for age, sex, length of stay, ward type, urethral catheterisation, broad-spectrum antibiotic use, invasive procedure, hypertension, diabetes mellitus, COPD, epilepsy, arthritis, and BMI. The model explained between 11.3% and 31.5% of the variance in HAI occurrence.

Length of stay and urethral catheterisation were the only statistically significant independent predictors of HAI. Each additional day of hospitalisation made patients 1.067 times more likely to develop HAI (OR = 1.067; 95% CI: 1.026 – 1.110; $p < 0.001$). Patients with a urethral catheter were 6.233 times more likely to develop HAI compared with those without one (OR = 6.233; 95% CI: 2.206 – 17.615; $p < 0.001$).

No significant independent association was observed between HAI and age ($p = 0.877$), sex ($p = 0.424$), ward type ($p = 0.750$), broad-spectrum antibiotic use ($p = 0.395$), invasive procedure ($p = 0.356$), hypertension ($p = 0.729$), diabetes mellitus ($p = 0.543$), COPD ($p = 0.391$), epilepsy ($p = 0.510$), arthritis ($p = 0.159$), or BMI ($p = 0.393$). The oncology ward estimate was not interpretable due to complete separation, as no HAI cases were recorded among the 28 oncology patients during the study period.

4.2 Qualitative Analysis - Data Presentation

The qualitative data were generated through seven (7) Key Informant Interviews (KIIs). The findings are organised thematically to ascertain the availability and usefulness of the systems currently in place for the reporting of hospital-acquired infections (HAIs) at the University of Benin Teaching Hospital. Verbatim quotations are presented in italics with informant codes and are used to illustrate key themes and enhance the credibility of the analysis. Two predefined themes guided the analysis:

Theme 1 — Availability: Examines whether HAI reporting structures, protocols, tools, and personnel exist and are operational at UBTH.

Theme 2 — Usefulness: Examines how informants perceive and evaluate the effectiveness, utility, and impact of HAI reporting systems on clinical practice and infection control.

Open codes are assigned to each meaningful unit, and sub-themes are grouped under the two predefined themes. Brief interpretations follow each quote cluster.

Theme 1: Availability of HAI Reporting Systems

This theme captures informant responses related to the structural existence, accessibility, awareness, resourcing, and functionality of HAI reporting systems at UBTH. Five (5) sub-themes were identified:

Sub-theme 1: Existence (or Absence) of Formal Reporting Structures

Responses across informants revealed a divergence in the degree of formalization of HAI reporting at UBTH.

"There is no system for reporting. There is no protocol, there is no process for reporting hospital acquired infections." (KII-05)

"When we find difficulty that we bring them in the medical microbiologists... they are the ones who will now tell us 'This is likely hospital-acquired infection'. To me, that's a kind of reporting — 'I am suspecting that I have a situation that is beyond ordinary, come and help investigate'." (KII-01)

"They are usually reported to the Infectious Disease Unit. Yes, for now. I know they take measures to identify the infection. They do microbiology swabs... and then they report it to the central... they notify the Community Health Department or so? There's a central committee it is escalated to." (KII-02)

"We usually just report back to the physician in charge of the patient, but there's no external body that we report to. ...We have an infection control unit in this hospital that is domiciled in the Public Health and Community Medicine department. And they do work with our lab to capture the HAIs that take place. Because sometimes, not all cases that we get a consult directly — the infection control nurses, they go on ward rounds and lab rounds to pick out those cases where you have infection." (KII-03)

"We do our statistics monthly, quarterly and yearly. So, at the end every day, every day we go out, we just do our normal observation, our normal work we come back. At the end of every month, we do our statistics. After writing it we submit to management, we submit to our chairman. ...Except when we see that we have a particular ward where something is occurring concurrently... we discuss verbally." (KII-04)

The most structured account came from the IPC nurse (KII-04), who described a defined reporting pathway from daily laboratory surveillance to monthly statistical submissions. This is similar to the account of the medical microbiologist and paediatrician (although with reduced clarity). By contrast, other clinicians reported no structured protocol whatsoever.

This pattern was confirmed by the two additional informants.

The general surgeon (KII-06), who had worked at UBTH for approximately 25 years, acknowledged the existence of an infection control committee but conceded that formal reporting to it was rarely practised:

"Normally there is a surgical society an infection committee within the IPC committee in the hospital... the normal routine is that when you have such cases of outbreak, you report to them. But usually there is no SOP, you know, for you to actually make those reports. Sometimes what we just do is we deal with them on our own without necessarily involving them as a protocol." (KII-06)

The internist (KII-07) similarly acknowledged the committee's existence while noting that dutiful reporting was the exception rather than the rule in clinical practice:

"There's a committee that has been set up in the hospital... But do we do this every time? I don't think so. A number of times, because we are internists, we just treat alongside. In terms of reporting—being dutiful in reporting such cases—I am not so sure that that is done appropriately." (KII-07)

Sub-theme 2: Awareness and Knowledge of HAI Reporting Systems

A notable pattern across informants was the stark contrast in awareness levels.

"I do not know that there is a specific protocol for such report." (KII-01)

"No. [Are you aware of any HAI reporting systems?] No, I've never heard of any. [How about SORMAS or Moni?] No, I've never heard of that." (KII-05)

"I know in the US they do report, so I think... I can't remember what it's called, but they in the US and the UK, they do have reporting systems where the HAI rates and HAI infections in

general are reported to their public health institutions... it's used as a benchmark for healthcare safety and quality in hospitals." (KII-03)

Awareness of HAI reporting system is limited or vague at the clinical level. Gaps were also evident among those that demonstrated more specific knowledge.

KII-06 acknowledged that while he knew an infection control unit existed and a newer antimicrobial stewardship committee had recently been constituted, he was unaware of any formal reporting mechanism beyond verbal notification:

"Just recently, very recently, I think there is a committee that was set up in the last administration... There is a newer committee also on these infection issues also in the hospital, on antimicrobial stewardship. But beyond what I am telling you now, I don't know of any other reporting mechanisms." (KII-06)

KII-07 confirmed that reporting to the committee was informal and limited to telephone contact, and that no written protocol existed:

"We don't write formal letters. It's through a phone call. It's usually the committee—the Community Health unit or department that handles that." (KII-07)

Sub-theme 3: Active Manual Surveillance by the IPC Unit

"What we do, we go to the lab to collect the positive results. Every result that is sent to the lab — urine, swab, blood sample — we go there to check any that are positive with microorganisms that can cause HAIs. We write the name of the patient; we write the ward... we now trace that patient to their various wards. On getting to the ward, we collect the case note of that patient, we analyse it. If a patient was admitted and a sample was collected after 48 hours — that's hospital acquired." (KII-04)

"These infection control nurses, they go on ward rounds and lab rounds to pick out those cases where you have infection, and then they now go to the wards to tie it up with the symptoms and signs of the patient's presentation to see if it fits an HAI. In that way, they are responsible for the data in the hospital." (KII-03)

Because doctors do not actively report HAIs, it falls entirely to the IPC nurses to find the data themselves. This is a dedicated, methodical process but it is entirely dependent on the effort of a small team doing everything by hand on paper. There is no computer system, no automatic flag, and no contribution from clinical staff. The microbiologist confirms that the IPC unit is essentially the sole custodian of HAI data at UBTH. The system is as good as the people running it, which makes it fragile and impossible to scale.

Sub-theme 4: Technological Infrastructure for Reporting

"Because even many a time I have written that they should give us a laptop in this our unit. Nothing. I have written several times. We use paper, paper. We don't have another reporting system." (KII-04)

"The current way that the documentation of HAIs takes place is where the nurse will first go to the lab, get information on all the infections... then they now have to go to the wards and go through each and every one of the patients. So, there's no linkage. But if we have a well-designed electronic medical record, these things become easier to determine because everything is digitalized and there's not much going back and forth." (KII-03)

"The first thing is to have a structured reporting system. A system that is easy to use, maybe electronic." (KII-05)

Lack of technology for adequate HAI reporting is observed in UBTH.

Sub-theme 5: Training and Capacity for HAI Reporting

"Many of us have one training or the other concerning infection prevention and control. Like myself I was sponsored to Ibadan for a course on IPC. I spent six weeks for the course. Then I have two other of my colleagues who went to Lagos for six months for IPC training. It's not frequent oh. When entering UBTH here we say they don't have money. It's not frequent. The last one we had was even our chairman that sponsored my nurse, that was last year." (KII-04)

"I think so. Doctor... yes, yes. She had a session on that. It's usually done within the departmental meeting. And I think I can't remember how long ago it was done. It's been a while. That's the only session I can remember." (KII-02)

"I have not received training in HAI reporting. I have received training in determining HAI prevalence. There are certain things you need to look out for... So that I have training on, but not specifically HAI reporting." (KII-03)

"No. None of my staff. [Have you ever received training in regards to HAI reporting?]"

(KII-05)

Participants feel training in HAI reporting is insufficient across all professional cadres at UBTH. The microbiologist makes a distinction worth highlighting: knowing how to diagnose an HAI (a clinical skill) is different from knowing how to report one (an administrative and systems skill). This gap is similarly shared among other clinical staff.

Both additional informants confirmed the absence of formal training in HAI reporting. KII-06 stated that while he had received background training in surgical asepsis and infection management through his clinical education and ongoing medical education, no formal hospital-directed training in HAI reporting had ever been provided:

"No, I have not received any formal training from infection management concern or from infection control committee, no. But you know those kind of basic training you get as a surgeon, in terms of your training, and of course continuous medical education... that is what you've gotten over and over again. But a formal training from the hospital committee, no." (KII-06)

KII-07 similarly reported no formal training in HAI reporting, recalling only a prior session on safe disposal of sharps and clinical waste:

"A part of reporting, a formal training... No, no formal training. However, we've had—I can't remember, that must have been when I was a senior registrar—we had a training on disposals, how to dispose injections, dangerous material. But for reporting system, I don't think there's any training for that." (KII-07)

Theme 2: Usefulness of HAI Reporting Systems

Despite varying awareness of and engagement with reporting systems, all five informants converged on the view that HAI reporting is valuable or would be valuable if properly implemented. Six sub-themes were identified under this theme:

Sub-theme 1: Benchmarking, Patient Safety Monitoring and Surveillance Data Generation

"It would be definitely very, very important because, like I said, it's a benchmark for determining patient quality of care and safety. If we were actually reporting, then we could say, 'oh, the HAI rate this month has increased or reduced.' If it's increased, we may be able to troubleshoot as to why." (KII-03)

"...there may be cases where HAIs are either missed or they're not completely diagnosed. If you ask me know what's the HAI rate in UBTH, I may not be able to tell you exactly what the HAI rate is because we are not really reporting." (KII-03)

"Before now, we have HAIs over sometimes 2 point something percent, 2 percent. But now we now have sometimes 1, 1 percent, even less than 1 percent at present. Before now it was on a very high side when I came new, but now I think it has actually reduced." (KII-04)

"It will be very useful. Like I said, it will give us an idea of the burden of the problem. We'll be able to know the common organisms and their sensitivity pattern. It will also help us to know if our infection control practices are working or not. So, it will be very, very useful." (KII-05)

HAI reporting is a foundational patient safety requirement that aids in actual HAI burden quantification and evaluation of infection control procedure effectiveness within the hospital.

The surgeon (KII-06) rated the usefulness of HAI reporting systems at the maximum possible level, offering an unambiguous endorsement:

"If it is a scale of 1 to 10, I will say 10. Oh, very, very useful. As a surgeon, very useful. I don't want to have any infection; the patients also don't want to have anyone." (KII-06)

The internist (KII-07) similarly affirmed its value, with emphasis on the need for the system to be formalised and widely understood across the institution:

"If it's well-documented and laid down, if it's something that every one of us or attending physicians or primary caregivers know about, it will be very useful. It will help in preventing to a large extent. It may not eradicate hospital-acquired infections, but to a large extent it will reduce the incidence." (KII-07)

Sub-theme 2: Linkage to Antimicrobial Stewardship

"HAI is also very closely linked with antimicrobial resistance because a lot of the healthcare-associated infections will be with multi-drug-resistant pathogens, because in the hospital environment, the use of antibiotics and antimicrobials is very high. So, you tend to have selection for multi-drug-resistant pathogens. And if the infection control practices are not optimal, then people get healthcare-associated infections, and these are difficult to treat because they are caused by multi-drug-resistant pathogens." (KII-03)

"Reducing hospital-acquired infection may extend to 'oh, don't use the high-ceiling antibiotics for what you can use a lower antibiotic for.' Use the appropriate antibiotic so that you do not start breeding resistance to infection." (KII-01)

Proper HAI reporting can help clinicians in selection of the appropriate antibiotics and improve treatment guidelines. Hospitals are places where antibiotics are used heavily, and this creates an environment where bacteria evolve to resist them. Poor infection control leads to HAIs, HAIs require stronger antibiotics, and stronger antibiotic use creates even more resistant bacteria continuing a dangerous cycle. KII-06 illustrated how this manifest in surgical practice, noting that patients with pre-existing infections often require escalation to broad-spectrum agents and emphasising the role of microbiological culture in guiding treatment rather than relying on empiric prescribing:

"The general principle is that you place some patients initially on broad-spectrum antibiotics, while you are awaiting the result of your MCS or tissue samples biopsies you taking for MCS as well. Then when the result comes you may need to make changes. But generally, for this type of infection you have to ensure you actually depend on the clinical signs of improvement." (KII-06)

Sub-theme 3: Improving Infection Control Practices and Lab-Clinician collaboration

"Knowing the rate of HAIs helps to trace lapses in infection control, and once those lapses are traced, then they can be checked. But if you don't even know that you have HAIs, you don't really know the rate, you don't know the numbers, it may be difficult to checkmate those lapses in infection control." (KII-03)

"If you're going to have a urinary tract infection that is hospital-acquired, it's likely associated with the use of things like catheters. So, could it be that there are lapses in the care of catheters? In other climes and even here to some extent, we have what we call 'bundles of care' — things that you are supposed to do to prevent a patient from having a catheter-associated urinary tract infection." (KII-03)

"It's supposed to be very, very useful — to make people make a change. Yes, when they are aware of what is happening, they will be able to make a change to the right thing to do, especially hand hygiene. If everybody in UBTH can actually focus on really washing our hands, I think HAI will be reduced in UBTH." (KII-04)

"...We went as a team — the lab scientists, the registrar among us, then we the nurses. We went to that SCBU to investigate. They took samples from everywhere... After the investigation, we now recommend what we want to be in place in SCBU." (KII-04)

HAI reporting provides data, the data shows where the problems are, prompting resolution and ultimately reducing infection rates. Without reporting, the hospital is working blindly and cannot identify cause of infections. The microbiologist recommends these groups need to collaborate formally, with a clear structure for sharing data and feeding it back to clinicians, avoiding duplication. The IPC nurse account of collaboration can be improved to be a normal routine for HAI management and not crisis or outbreak response.

Sub-theme 4: Perceived Role of Reporting in Reducing HAI Prevalence

All seven informants stated, with varying levels of conditionality, that HAI reporting would reduce HAI prevalence. The sufficiency of reporting alone was also considered.

"Yes, I would agree when we have the system — we, not just the obstetricians and gynaecologists now — when the system has now agreed that 'oh, this is hospital-acquired infection,' then reporting will help. Because we can hazard ideas on how hospital-acquired infections spread." (KII-01)

"Yes. If you report it and measures are taken to control the infection, of course the prevalence will reduce. So, these measures include, like I said, maintaining hand hygiene in the facility, prevent sharing of tools or gadgets and sterilization of... frequent sterilization of instruments." (KII-02)

"Definitely. Like I've already explained, reporting them would make the clinicians or people practicing at the first line, the healthcare workers that attend to the patient — it's important for them to know because there are risk factors for having these HAIs." (KII-03)

"It would have reduced if people keep to the corrective measures that were supposed to follow. If we report and people see that they are doing the wrong thing, if they decide to change and do the right thing, it will reduce it. But people don't change, so the thing continues to be as it is. When we correct something now, by the time you go back the next day you see that they are still doing the same way." (KII-04)

"Yes, it will. Because if you report and you know the burden, then you can put measures in place to reduce it. You can train staff, you can ensure that people wash their hands, you can

ensure that the environment is clean. So, reporting will definitely help to reduce the prevalence." (KII-05)

Every single informant agreed that reporting HAIs would lead to fewer occurrence of HAIs. However, the IPC nurse indicates staff behavioural change as an additional requirement. KII-06 emphasised that reporting must serve as a trigger for investigation and feedback, not merely documentation:

"Definitely. If it is reporting, it's not for documentation alone, it's for action. So, if you report now, it will help to, you know... find out contact tracing and do the lot they do behind the scenes. And their feedback to you can help to mitigate other risk factors or other predisposing factors to developing HAI. It will help in the long run, yes." (KII-06)

KII-07 added that the involvement of ancillary staff — nurses and cleaners — in infection control practices is equally critical to actualising the reduction:

"It will reduce, to a large extent. Especially when people do the right thing. A number of these hospital-acquired infections come from poor hygienic practices in the hospital. So, if the nurses, the cleaners, are made to do the right thing, I think to a large extent it will reduce the incidence of hospital-acquired infections." (KII-07)

Sub-theme 5: Confidence in Reporting

"I'm confident of what I'm doing now. I normally report whatever I see, I report as it is." (KII-04)

"If there was a formal system in place, definitely I would be confident because I can determine that this is a HAI. So, if I can now report, then definitely I'm confident in that." (KII-03)

"I've told you, once we suspect, we always report to the Infectious Disease Unit, the ones that are in charge." (KII-02)

The use of HAI reporting systems overtime translates individual diagnostic competence into institutional action. Both additional informants expressed conditional or structurally-driven confidence. KII-06 indicated that his confidence was not inhibited by clinical uncertainty, but rather by the absence of a standardised pathway — and that a simple, accessible form would be sufficient to prompt consistent reporting:

"If there is an hospital-acquired infection and you say okay, fill this form and the form should be available like we have like the form for pharmacovigilance that you have there everywhere in the hospital... you can simply fill it up, it's a structured infection, you drop it, somebody picks it up. That's the point I'm making." (KII-06)

KII-07 noted that confidence was high when the reporting method was accessible — specifically, the informality of a phone call — but that confidence in formal, written reporting was undermined by the absence of a defined protocol:

"It's very easy. Since we have one-on-one interaction with the head of the committee, we can easily reach out to them... But the formal written protocol for reporting, I'm not confident about that." (KII-07)

Sub-theme 6: Feedback Mechanisms from Reporting

"I think they send one maybe once or twice in a year that I'm aware of. But usually, they attempt to widely circulate it — it's reported in our morning reviews. But if one was not present on that particular morning review, then it may become a problem. ...A better way to inform the clinician would be to send that letter to every consultant. Not just getting to the

HOD and it's read out — it should be put in the pigeonhole of every consultant. That's a way the consultant has no choice but... he must see that document." (KII-01)

"One of the lapses or one of the problems we have is that we have infection control nurses who are trying to determine HAI rates, but the information is not being passed to all the stakeholders. If you ask the head of department, 'do you know the HAI rate and which HAIs are predominant in your department?', he may not be able to tell you." (KII-03)

Even when HAI surveillance data is generated, dissemination to frontline clinical staff, who most need it to modify their practice, is lacking. Without feedback, reporting may feel pointless. KII-06 articulated this concern with particular clarity, distinguishing between numerical feedback (rates and percentages) and actionable feedback that identifies sources and risk factors — the latter being what would genuinely improve clinical practice:

"The feedback I desire... is this feedback to say this is likely the source of this, this may likely be the risk factor for this kind of patient. That will improve practice. Not just giving figures, you know. That feedback that will improve practice... can say this thing occurred because of so and so thing, is likely from this so and so thing. That's the feedback I am talking about." (KII-06)

KII-07 similarly noted that while the IPC committee was known to conduct ward rounds, no formal report or presentation of their surveillance findings had ever been made to the clinical departments:

"Surveillance reports, they have not come to present anything to us. But I know the team comes into the wards to do their work. But a formal presentation on the work of the committee to different departments, I have not seen that." (KII-07)

Sub-theme 7: Suggestions for System Improvement

All seven informants offered recommendations for improving HAI reporting at UBTH. A consistent thread across responses was the need for a simple, standardised, widely visible reporting tool and for the IPC committee to increase its institutional presence. KII-06 called for a structured paper form — analogous to existing pharmacovigilance reporting slips — to be placed in every ward, with the primary clinician managing the patient responsible for completing it:

"It should be like a form to be filled by every patient that has wound infections in the hospital. The people managing, the core physician managing the patient should be the one to report it... Just let people know. If you probably put that as a standard operating procedure, and people come to trace what you are doing, your own work, it makes it better for everybody, so you can have proper documentation of it." (KII-06)

KII-07 focused on institutional visibility, recommending regular engagement activities by the committee to raise awareness among all staff, and noting that limited manpower within the committee appeared to constrain its outreach capacity:

"The committee should be obvious to everybody. Their work should be well known. There should be intermittent, what looks like an engagement with the people, so that the awareness as it were, will be obvious in the hospital. For now, I don't think that is what we are experiencing. Maybe due to shortage of manpower or so much engagement in other things, because these people also have their own primary assignment in the hospital apart from the committee work." (KII-07)

Together, these recommendations converge on a common institutional prescription: the IPC committee must be rendered visible and actionable across all clinical departments through standardised tools, clear reporting responsibilities, adequate staffing, and regular dissemination of findings to frontline staff.

Qualitative coding matrix

The coding matrix below presents the 12 sub-themes identified across the two predefined themes (Availability and Usefulness), with their definitions, illustrative evidence, analytical meanings, and linked objectives. This matrix is designed for use in Chapter 4 and as an analytical reference for Chapter 5.

Table 15: Coding Matrix — Availability and Usefulness of HAI Reporting at UBTH

Theme	Sub-theme	Definition	Illustrative Evidence (Verbatim)	Analytical Meaning	Linked Objective
AVAILABILITY	**1. Existence of Formal Reporting Structures**	Whether defined, documented protocols for HAI identification, documentation and escalation exist and are operational across clinical departments at UBTH.	"There is no system for reporting. There is no protocol, there is no process for reporting hospital acquired infections." (KII-05) "We do our statistics monthly, quarterly and yearly... we submit to management." (KII-04)	Formal reporting is confined to the IPC unit. At the clinical level, informal consultation substitutes for structured reporting. No hospital-wide protocol exists.	Obj 4

AVAILABILITY	**2. Awareness and Knowledge of Reporting Systems**	The degree to which healthcare workers across cadres are aware of, and informed about, any existing HAI reporting mechanism or protocol.	"I do not know that there is a specific protocol for such report." (KII-01) "No. I've never heard of any." (KII-05)	Critical awareness gap at clinical level. Knowledge is concentrated in the IPC unit and absent in high-risk areas (ICU). Cannot report what is not known.	Obj 4
AVAILABILITY	**3. Active IPC Manual Surveillance**	The IPC unit's daily active data collection process — physically visiting the laboratory and wards to identify and classify HAI cases against the 48-hour criterion.	"What we do, we go to the lab to collect the positive results... we now trace that patient to their various wards. On getting to the ward, we collect the case note of that patient, we analyse it." (KII-04)	IPC bears the full surveillance burden. System is methodical but person-dependent, paper-based, and fragile — cannot scale to hospital size without digital infrastructure.	Obj 4
AVAILABILITY	**4. Technological Infrastructure**	The availability of digital tools, electronic systems, hardware, and software that would enable accurate, timely, and scalable HAI reporting.	"Because even many a time I have written that they should give us a laptop in this our unit. Nothing... We use paper, paper." (KII-04) "there's no linkage." (KII-03)	Complete absence of electronic tools. Paper-based manual process limits completeness, speed, and analytical capacity of surveillance. Management unresponsive to requests.	Obj 4
AVAILABILITY	**5. Training and Capacity for Reporting**	Formal and informal training received by staff related to HAI identification, classification, documentation, and reporting processes — distinct from clinical diagnosis training.	"I have not received training in HAI reporting. I have received training in determining HAI prevalence... but not specifically HAI reporting." (KII-03) "No. None of my staff." (KII-05)	Critical distinction: diagnostic competence ≠ reporting competence. Training gap exists across all cadres. ICU — highest-risk setting — has received zero training.	Obj 4

USEFULNESS	**6. Benchmarking and Safety Monitoring**	The role of a reporting system in generating quantifiable HAI rate data, enabling trend tracking, quality benchmarking, and institutional performance assessment.	"it's a benchmark for determining patient quality of care and safety. If we were actually reporting, then we could say, 'oh, the HAI rate this month has increased or reduced.'" (KII-03) IPC rate trend: 2% → <1% (KII-04)	Where even basic recording exists (IPC unit), trend data is generated. Where it does not (microbiology), institutional HAI rate is unknown. Reporting has immediate informational value.	Obj 4
USEFULNESS	**7. Antimicrobial Stewardship Linkage**	The connection between HAI reporting and guiding evidence-based antibiotic prescribing, preventing resistance escalation, and informing stewardship programmes.	"HAI is also very closely linked with antimicrobial resistance because... you tend to have selection for multi-drug-resistant pathogens." (KII-03) Escalating antibiotic ladder to Meropenem/Imipenem (KII-01)	75.8% antibiotic use in quantitative data; clinicians empirically escalating to last-resort agents. Reporting system would enable organism profiling and stewardship targeting.	Obj 4
USEFULNESS	**8. Infection Control Practice Improvement**	The utility of reporting data in identifying specific infection control lapses (hand hygiene, catheter care bundles, sterilization failures) and driving corrective action.	"Knowing the rate of HAIs helps to trace lapses in infection control, and once those lapses are traced, then they can be checked." (KII-03) "when they are aware of what is happening, they will be able to make a change to the right thing to do." (KII-04)	Without reporting data, lapses cannot be located or corrected systematically. Catheter use is the quantitatively confirmed leading risk factor ($p<0.001$) — a directly modifiable target.	Obj 3 & 4
USEFULNESS	**9. Prevalence Reduction Potential**	Informants' assessments of whether and how a reporting system would contribute to reducing the occurrence of HAIs — including the conditions necessary for this effect.	"Yes. If you report it and measures are taken to control the infection, of course the prevalence will reduce." (KII-02) "It would have reduced if people keep to the corrective measures..." (KII-04)	Universal endorsement is conditional on compliance and accountability. Reporting alone is insufficient — a sustained corrective cycle is required. IPC nurse uniquely identifies persistent non-compliance as barrier.	Obj 1 & 4
USEFULNESS	**10. Confidence in**	Staff self-assessed ability	"I'm confident of what I'm doing now. I	Confidence is structurally, not	Obj 4

	Reporting	and willingness to report HAIs — whether confidence is structurally enabled or constrained by the absence of systems.	normally report whatever I see, I report as it is." (KII-04) "If there was a formal system in place, definitely I would be confident." (KII-03)	competency, determined. IPC nurse is embedded in a system. Clinicians lack the pathway. Building reporting infrastructure will build confidence automatically.	
USEFULNESS	**11. Feedback and Dissemination Mechanisms**	The flow of HAI surveillance data from IPC/microbiology back to clinical frontline staff — and whether this feedback loop currently functions to modify clinical practice.	"I think they send one maybe once or twice in a year... if one was not present on that particular morning review, then it may become a problem." (KII-01) "the information is not being passed to all the stakeholders." (KII-03)	Data is generated but not disseminated. Department heads cannot state their own HAI rates. Feedback failure breaks the surveillance-action loop. Without it, reporting cannot reduce prevalence.	Obj 4
USEFULNESS	**12. Suggestions for System Improvement**	Recommendations made by key informants for improving HAI reporting at UBTH — including structural tools (e.g. standardised reporting forms), clearer reporting responsibilities, increased IPC committee visibility, adequate staffing, and regular dissemination of findings to frontline clinical staff.	“It should be like a form to be filled by every patient that has wound infections in the hospital. The people managing, the core physician managing the patient should be the one to report it.” (KII-06) “The committee should be obvious to everybody. Their work should be well known. There should be intermittent... engagement with the people.” (KII-07)	All seven informants provided recommendations, converging on the same institutional prescription: standardised reporting tools, clearly assigned responsibilities, an institutionally visible IPC committee with adequate staffing, and regular feedback to frontline clinical departments. Improvements are actionable without digital infrastructure and align directly with the structural deficits identified across all other	Obj 4

sub-themes.

CHAPTER 5

DISCUSSION

The primary goal of this study was to assess the prevalence, risk factors, types, and reporting systems associated with hospital-acquired infections among in-patients at the University of Benin Teaching Hospital. In-patients were enrolled across surgical, medical, obstetrics and gynaecology, paediatrics, and oncology wards, and senior clinical and infection control personnel were purposively recruited for the qualitative component. The enrolled population was predominantly female, with the largest age group being younger working-age adults, and the surgical ward contributing the greatest share of patients. Most patients had been hospitalised for less than one week, and a considerable proportion carried at least one comorbidity, most commonly hypertension.

Hospital-acquired infections were confirmed in a small but clinically significant proportion of surveyed inpatients at UBTH, with CAUTIs being the most common type, followed by surgical site infections and hospital-acquired pneumonia. The true HAI burden is likely underestimated due to limited microbiological testing. Length of hospital stay and urethral catheter use were identified as the only significant independent risk factors, while demographic and comorbidity factors showed no significant association. Qualitative findings further revealed major weaknesses in the hospital's reporting and surveillance system, which remains largely manual, under-resourced, and lacking effective feedback mechanisms despite widespread recognition among staff of the importance of a functional HAI reporting structure.

The study found that a small fraction of the admitted patients developed HAIs. Patients above sixty years recorded the highest crude HAI rates among all age groups, followed by those in the middle-age bracket, while younger adults, who constituted the largest single age group, had the lowest crude rates. Although these age-based differences did not reach statistical significance, the direction of the trend is consistent with the well-established biology of

immunosenescence and accumulated comorbidity burden in older patients. Male patients had a somewhat higher crude HAI rate than females, though this difference similarly did not reach statistical significance, suggesting that sex-based biological differences were not a dominant driver of HAI occurrence in this population.

The surgical ward, which housed the largest share of enrolled patients by a substantial margin, contributed the greatest absolute number of confirmed HAI cases, reflecting the invasive-procedure burden associated with surgical admissions. Patients with the longest hospital stays faced the highest HAI rates, an observation that underscores the cumulative nature of HAI risk and the importance of discharge efficiency as an infection control lever.

The short median length of stay, is a highly plausible reason for the modest prevalence observed, as prolonged exposure to the hospital environment is a well-established prerequisite for the acquisition of many nosocomial pathogens.

Also, the observed prevalence is likely a conservative estimate. The majority of surveyed patients did not have microbiological cultures taken during their admission, which limits the sensitivity of a point-prevalence survey conducted under standard clinical and microbiological case definitions. In resource-limited settings such as UBTH, culture rates are constrained not only by laboratory capacity and reagent availability but also by clinician ordering practices. Infections meeting clinical criteria but lacking microbiological confirmation are therefore not classifiable as confirmed HAIs under ECDC and Global-PPS standards, leading to systematic undercounting.

The qualitative findings corroborate this structural inference. The medical microbiologist who participated in the study explicitly acknowledged being unable to state the institutional HAI rate despite being the member of staff most clinically equipped to do so, because formal reporting is not systematically practised at UBTH. The IPC nurse confirmed that all

surveillance is conducted manually by a small team, making full and consistent capture of HAI cases across a large and complex hospital practically impossible. These operational constraints are the most plausible explanation for why the observed prevalence appears lower than continental and national comparators.

The prevalence documented at UBTH falls within a range broadly consistent with findings from comparable African and Nigerian settings, though below the pooled estimate from the continent as a whole. The systematic review and meta-analysis by Abubakar et al. reported a pooled HAI prevalence across African studies substantially higher than what was recorded at UBTH, with the highest rates occurring in intensive care and neonatal units[52]. A point-prevalence survey conducted at Rivers State University Teaching Hospital, a similarly resourced tertiary institution in southern Nigeria, reported a HAI prevalence roughly double that observed at UBTH among a smaller sample[53]. A multi-centre point-prevalence study across acute care hospitals in northern Nigeria similarly recorded a prevalence considerably higher than the UBTH estimate.[61]

At the global level, the systematic review and meta-analysis by Raoofi et al. reported and pooled global HAI prevalence, which is considerably lower than the recorded prevalence at UBTH.[50]

Among the patients who contracted an infection, catheter-associated urinary tract infections were by far the most frequent, accounting for nearly half of all confirmed cases. Its dominance closely mirrors the high rate of urethral catheter use documented in the study population: urethral catheters were present in a substantial proportion of all enrolled patients at the time of the survey, and among catheterised patients, the HAI rate was substantially higher than among non-catheterised patients. Surgical site infections and hospital-acquired

pneumonia followed as the next most common types. HAP, though present in a small number of cases, is associated with very ill patients. Puerperal sepsis, while few, is specific to the obstetrics and gynaecology ward and has serious implications for maternal morbidity and mortality. The absence of any recorded HAI in the oncology ward during the survey period should be interpreted cautiously, given the limited number of oncology patients enrolled and the very low culture uptake across the broader study population.

The heavy burden of catheter-associated infections directly correlates with the high usage of urethral catheters observed among the patients, suggesting potential lapses in routine catheter care bundles or prolonged, unnecessary catheterization. Prolonged catheterisation increases cumulative exposure to pathogen colonisation and ascending urinary tract infection, particularly in the presence of suboptimal hand hygiene and catheter maintenance practices. The qualitative evidence is directly supportive of this inference: the medical microbiologist informant specifically identified catheter care bundles as an under-implemented prevention tool at UBTH, and the IPC nurse identified hand hygiene compliance as a persistent and incompletely resolved challenge on the wards.

The prominent presence of surgical site infections is clinically expected, given the large surgical proportion. These findings are well-supported by the literature; a systematic review of African tertiary hospitals similarly identified surgical site infections and urinary tract infections as the predominant healthcare-associated infections. Likewise, studies from Europe also highlighted respiratory tract infections, surgical site infections, and urinary tract infections as the most frequent complications among in-patients.

The HAI type profile at UBTH is broadly consistent with patterns reported across African and global tertiary hospital literature. The systematic review and meta-analysis by Bunduki et al. examining HAIs across African tertiary hospitals identified surgical site infections, urinary tract infections, and bloodstream infections as the most common types, a grouping that

overlaps with what was observed at UBTH[56]. A point-prevalence study conducted in a teaching hospital in Rome reported respiratory tract infections as the leading HAI type, followed by SSIs and UTIs, all three of which are represented among the UBTH HAI profile[54]. Another point-prevalence study conducted multiple centres in Lombardy reported bloodstream infections as the leading HAI type, followed by UTIs and respiratory infections. of which the latter two are represented among the UBTH HAI profile.[55] The predominance of CAUTI is therefore not anomalous; it is the expected consequence of high catheter utilisation in the absence of structured prevention programmes, as documented across multiple settings internationally.

The prominence of catheter-associated and surgical site infections contributes directly to the growing threat of antimicrobial resistance. When infections go under-reported, the unchecked spread of resistant pathogens within the facility can spill over into to household contacts, primary healthcare facilities, and the wider population. The public health implications of UBTH's HAI burden are therefore regional in scope, not merely institutional.

The duration of hospital stay and the presence of a urethral catheter were the only independent predictors significantly associated with the development of an infection. Socio-demographically, while the sample was diverse in age and medical history, these individual patient characteristics did not statistically predispose them to infections. Instead, hospital-related exposures were the primary drivers. Patients hospitalised for the longest periods faced by far the highest HAI rates, and the protective effect of shorter stays remained strong and statistically significant in the multivariate model after controlling for sex, age, comorbidities, and device use.

Urethral catheterisation was the only device variable to achieve statistical significance in both bivariate and multivariate analyses. Catheterised patients faced substantially higher odds of developing an HAI than non-catheterised patients, even after adjusting for the effect of prolonged hospitalisation and other covariates. No other device reached statistical significance. Neither age, sex, ward assignment, nutritional status, nor the presence of any individual comorbidity was significantly associated with HAI occurrence. The near-absence of HAI cases among patients with HIV/AIDS, malignancy, and immunosuppressive therapy (groups expected on biological grounds to be at elevated risk) most plausibly reflects the small absolute numbers in these subgroups rather than any genuine biological protection.

A highly probable reason, for this outcome is that increases a patient's cumulative exposure to nosocomial pathogens circulating in the ward environment, multiplies the number and duration of invasive interventions and devices the patient is subjected to, and may reflect the presence of more complex or severe underlying disease that itself predisposes to infection. The selective pressure of broad-spectrum antibiotic use — documented across the large majority of patients in this survey — progressively enriches the ward microbial environment with drug-resistant organisms over time, meaning that patients who remain in hospital longest are most likely to be exposed to the most treatment-resistant pathogens. Urethral catheters, specifically, bypass the body’s natural anatomical barriers, providing a direct channel for pathogens to enter the urinary tract. Biofilm formation on catheter surfaces renders colonising bacteria progressively resistant to both host immune responses and antimicrobial agents, particularly when catheters remain in place for extended periods without structured maintenance protocols. The qualitative evidence reinforces this mechanistic explanation: the medical microbiologist informant explicitly referenced catheter care bundles as under-implemented at UBTH and noted that catheter-associated UTI is a directly modifiable prevention target.

The risk factor profile identified at UBTH is directionally consistent with findings from several studies reviewed in Chapter Two, even where absolute magnitudes differ. The large Chinese meta-analysis by Liu et al. identified prolonged hospital stays and invasive device use as among the strongest hospital-related risk factors for HAI, alongside older age and the presence of chronic diseases[58]. The longitudinal Ethiopian study by Ali et al. similarly identified surgical procedures and underlying chronic illness as major risk factors in a setting that shares many structural characteristics with UBTH.[59] The paediatric prospective cohort study by Sahiledengle et al. identified length of stay exceeding six days as a significant independent risk factor with a considerable relative risk, closely paralleling this study's finding that stays beyond the shortest category confer progressively greater HAI risk at UBTH.[60]

The northern Nigerian multi-centre point-prevalence study by Abubakar found that duration of stay and gender were not significantly associated with HAI, a partial concordance with the UBTH findings regarding gender, though duration of stay did reach significance at UBTH. The absence of a significant comorbidity effect at UBTH, despite the biological plausibility of associations for conditions such as diabetes mellitus and HIV/AIDS, is consistent with the experience of studies with similar or smaller sample sizes in which small subgroup sizes preclude detection of statistically meaningful differences.[61]

At the clinical level, the identification of urethral catheter use and prolonged hospitalisation as the two independent predictors of HAI provides clinicians at UBTH with a clear, evidence-based framework for targeting preventive effort. Both risk factors are modifiable through clinical decision-making: catheter use can be governed by stricter indication criteria and supported by daily necessity reviews, while length of stay can be minimised through proactive discharge planning and timely clinical optimisation. These are not capital-intensive

interventions; they require changes in clinical culture, workflow, and accountability rather than new infrastructure.

The high antibiotic use rate, coupled with the low culture uptake, raises important clinical governance concerns. The widespread use of broad-spectrum antibiotics without culture-guided sensitivity data, a practice partly driven by the absence of reliable microbiological reporting, accelerates the development of resistance and increases the risk that subsequent infections will be caused by organisms with reduced antibiotic susceptibility. Strengthening culture-taking practices and linking culture results to prescribing decisions is therefore both a clinical quality imperative and an antimicrobial stewardship priority

The qualitative findings reveal a HAI reporting system at UBTH that is structurally absent at the hospital-wide level and operationally confined to the IPC unit. The key informants who participated in the study collectively represented many decades of clinical and administrative experience across the institution's most diverse and highest-risk departments. Despite this breadth of seniority and experience, awareness of any standardised HAI reporting mechanism was found to be extremely limited outside the IPC unit and medical microbiology department. The ICU coordinator, who oversees the hospital environment in which HAI risk is universally acknowledged to be greatest, was among those who explicitly reported having no awareness of any reporting system. Senior surgical, internal medicine, obstetrics, and gynaecology consultants similarly described their reporting behaviour as ad hoc and purely clinical in nature, limited to managing the identified infection without escalation to any formal institutional pathway.

The IPC nurse was the sole informant who could describe a structured, systematic HAI surveillance process. The entire system is paper-based and maintained by a small team that

has been denied access to even basic digital tools, notwithstanding formal written requests. This demographic asymmetry, in which a small, largely unsupported nursing cadre bears the full institutional burden of HAI surveillance while senior clinicians across the hospital operate without any reporting framework, constitutes the defining structural characteristic of UBTH's current HAI reporting landscape.

Several mutually reinforcing institutional and systemic factors explain the fragmented state of HAI reporting at UBTH. The most foundational is the absence of any written, standardised, hospital-wide HAI reporting protocol. Without a defined pathway, even clinicians who diagnose or strongly suspect an HAI have no institutional mechanism for escalating that diagnosis beyond the immediate clinical management of the patient. The default behaviour, treating the infection without recording or reporting it, is therefore not the product of clinical negligence but of a structural vacuum. The consultant general surgeon with the longest tenure at UBTH captured this precisely: the infection committee exists and is known to him, but there are no standard operating procedure compelling or guiding clinicians to report to it.

The complete absence of digital infrastructure compounds this structural deficit. A surveillance system that depends on a small team physically traversing the hospital each day, visiting the laboratory, locating patients on wards, and cross-referencing paper case notes, cannot realistically achieve the coverage, speed, or analytical capacity needed to function as a meaningful institutional alert system. A third contributing factor is the training gap across all clinical cadres. The medical microbiologist drew a critical distinction between training in how to diagnose an HAI, clinical knowledge that many staff possess, and training in how to report one within an institutional framework, an administrative and systems competency that no informant had received. Even the limited surveillance data generated by the IPC unit rarely reached the clinical frontlines in a timely, ward-specific, or actionable form removing the primary institutional incentive for reporting.

The structural deficits documented at UBTH are consistent with findings from comparable settings in Nigeria and across the African continent. The retrospective surveillance review by Iliyasu et al. from a tertiary hospital in north-western Nigeria[65] similarly described a high HAI burden captured through laboratory-based surveillance without any formalised reporting mechanism linking clinical departments to infection control structures, and called for prospective national-scale HAI surveillance, recommendations that remain equally applicable to UBTH. The South African observational study by Lowman demonstrated what becomes possible when active, unit-specific surveillance is instituted: significant, measurable reductions in ventilator-associated pneumonia and central line-associated bloodstream infection rates over a multi-year period[64]. This finding provides an African precedent for the clinical impact achievable through structured HAI reporting, contextualising the UBTH findings within a trajectory of improvement that is attainable rather than merely aspirational.

By contrast, the experience documented in large Chinese tertiary hospitals, where real-time electronic surveillance systems have been shown to improve the accuracy and timeliness of HAI case collection and guide clinicians in prevention, illustrates the upper boundary of what is achievable when surveillance is digitised and institutionally embedded[63]. The gap between UBTH's current system and these digital models is large, but the South African evidence demonstrates that meaningful progress does not require digital infrastructure as a prerequisite. It requires formalisation, resource commitment, and a functional feedback loop — all of which are achievable in UBTH's current environment.

The qualitative findings interact with the quantitative data in ways that are analytically important. The IPC nurse's observation that HAI rates recorded by the unit had been declining over her years of tenure provides a qualitative trend narrative that contextualises the quantitative prevalence figure. If even a rudimentary manual surveillance system — operating without computers and with minimal institutional backing — has been associated

with a declining HAI trend, the potential gains from a formalised, resourced, and digitally-enabled system are correspondingly greater. The dominance of CAUTI among HAI types in the quantitative component aligns precisely with the microbiologist informant's identification of catheter care bundles as under-implemented and the IPC nurse's description of hand hygiene as a persistent ward-level compliance failure. These correspondences between numerical patterns and qualitative institutional explanations strengthen the overall coherence and credibility of the study's conclusions.

The absolute reliance on paper-based, manual surveillance by a small team is unsustainable. The hospital faces an urgent imperative to modernize its infrastructure, as the current disjointed system limits the facility’s ability to benchmark its quality of care against national or global safety standards.

Furthermore, the absence of standardised HAI reporting means that UBTH cannot contribute to national HAI burden estimates or to the NCDC's epidemiological intelligence framework. The inability to quantify, characterise, and trend infections at a national level hampers evidence-based policymaking for healthcare quality, infection control resource allocation, and antimicrobial stewardship.

Taken together, the quantitative and qualitative findings of this study present a coherent and mutually reinforcing account of the HAI burden and surveillance landscape at UBTH. While the quantitative data points to a modestly low prevalence of hospital-acquired infections, primarily driven by modifiable hospital-related factors like catheter use and prolonged admission, the qualitative data revealed that no unified, hospital-wide HAI reporting protocol exists at UBTH, that clinical staff are largely unaware of any reporting mechanism, and that the only structured surveillance activity is the IPC unit’s daily manual laboratory and ward

review, conducted without electronic tools, institutional resource support or a functional feedback channel to the clinical departments where HAIs are identified and managed. Thus, the qualitative findings offer a direct institutional explanation for the quantitative outcome. With few patients having microbiological cultures taken, and with clinical staff in high-risk environments such as the ICU and O&G wards operating without any reporting system beyond the informal request for a specialist consult, a proportion of HAI cases will inevitably go unidentified, unrecorded, and therefore uncounted. The IPC nurse's confirmation that all surveillance data is paper-based and manually collated by a small team directly accounts for the limited reach of the system: it can only capture what its personnel can physically trace and document within a working day. The medical microbiologist's admission that she cannot state the current institutional HAI rate, despite being the most clinically equipped person to do so, is perhaps the clearest illustration of the surveillance gap that underlies the quantitative figure produced by this study.

Conversely, the quantitative data anchors and validates the qualitative analysis. The predominance of catheter-associated UTI in the HAI profile is directly consistent with the microbiologist informant's reference to catheter care bundles as an under implemented preventive tool, and with the high urethral catheter use rate documented in the survey. The absence of a structured reporting and feedback system, identified across all seven informants, is precisely the institutional condition under which catheter use goes unmonitored and care bundle compliance goes unverified. Furthermore, the IPC nurse's qualitative trend data, showing HAI rates declining from approximately to below over her tenure in the unit, demonstrates what is achievable when even a rudimentary surveillance system is consistently applied, and contextualises the potential for improvement if the system were to be formalised, digitised, and extended to the clinical level. The quantitative prevalence figure and the

qualitative picture of systemic under-surveillance are therefore not contradictory findings: they are two aspects of the same institutional reality.

This integration of quantitative and qualitative evidence reveals that the core challenge at UBTH is not a lack of clinical awareness of HAIs, all informants confirmed that infections occur and are clinically significant, but a structural absence of the institutional infrastructure needed to measure them accurately, report them systematically, and respond to them programmatically. The findings therefore call not only for clinical interventions targeting modifiable risk factors such as catheter use and length of stay, but also for the parallel development of a formalised, electronically enabled, feedback-driven HAI surveillance and reporting system as a prerequisite for sustained prevalence reduction.

5.1 Conclusion

This study establishes that while the recorded prevalence of hospital-acquired infections among in-patients is relatively low.

Catheter-associated urinary tract infections and surgical site infections were the most common HAIs observed.

The burden of HAIs is significantly driven by prolonged hospital stays and the use of urethral catheters. The lack of association with patient-specific comorbidities emphasizes that these infections are primarily a consequence of hospital-related exposures.

However, the integrity of this prevalence data is compromised by the absence of a formalized, hospital-wide reporting framework. The current reliance on a manual, and paper-based surveillance system, coupled with a lack of clinical awareness and absent feedback mechanisms, critically hinders the hospital's ability to accurately track, report, and ultimately reduce the incidence of these infections.

5.2 Recommendations

The following recommendations are presented according to the stakeholder group responsible for their implementation. Each recommendation has been formulated to be specific in action, measurable in outcome, achievable within UBTH's current resource context, relevant to the findings of this study, and time-bound to a defined implementation horizon.

For Hospital Management:

i. Develop and enforce a clear, standardized operating procedure for infection reporting that assigns specific documentation responsibilities to the primary managing physicians.
ii. Allocate specific funding to expand the capacity and technological resources of the Infection Prevention and Control unit.

For Clinicians and Frontline Healthcare Workers:

i. Strictly adhere to established “bundles of care” for the insertion and maintenance of invasive devices, particularly urethral catheters.
ii. Actively participate in antimicrobial stewardship programs to ensure that antibiotic prescriptions are driven by microbiological culture results rather than prolonged empirical therapy.

For the Infection Prevention and Control (IPC) Unit:

i. Design and distribute simple, standardized paper reporting forms to all wards as an interim measure while awaiting electronic infrastructure.
ii. Establish a mandatory, routine feedback mechanism where localized surveillance data and pathogen resistance profiles are formally presented to clinical departments during morning reviews or departmental meetings.

iii. Conduct regular, hospital-wide training and sensitization campaigns focused purely on the administrative and systemic processes of how to properly report a suspected infection.

iv. Develop and pilot a written CAUTI prevention bundle in all wards, incorporating catheter insertion indication criteria, an aseptic technique checklist, a daily catheter necessity review form, and a removal timeline.

Clinical Staff (Consultants, Registrars, and Ward Nurses)

i. Incorporate a documented daily assessment of urethral catheter necessity into every ward round, recording in the patient's case note both the specific clinical indication for continuation and the planned removal date; ward nurses should flag any catheter in situ beyond its documented removal date to the responsible clinician on the same day.

ii. Once HAI reporting forms have been distributed by the IPC committee, complete and submit a form within twenty-four hours of diagnosing or suspecting an HAI in any admitted patient, retaining a copy in the patient's case note; ward consultants are responsible for ensuring that this is done by any member of their team who makes such a diagnosis.

Training Bodies e.g. University of Benin Medicine & Surgery, and Nursing Science Departments, Postgraduate programs, UBTH College of Nursing

i. Develop and deliver a structured half-day training module on HAI identification, reporting procedures, and use of the UBTH reporting form.

ii. Establish a funded annual IPC training bursary that enables at least two IPC nurses per year to attend an accredited external infection prevention and control course.

Federal Ministry of Health and the Nigeria Centre for Disease Control (NCDC)

i. Establish a national HAI point-prevalence survey protocol, co-developed with federal teaching hospitals including UBTH, mandating standardised annual surveys using the ECDC Global-PPS tool across all federal tertiary institutions.

ii. Allocate a dedicated line item for HAI surveillance infrastructure, specifically electronic laboratory information system upgrades and IPC unit equipment, in the capital budgets of federal tertiary hospitals, with disbursement conditional on submission of a costed implementation plan verified by the hospital's IPC committee.

Future Researchers

i. A study enrolling a substantially larger sample at UBTH, powered to detect HAI risk in patients with HIV/AIDS, active malignancy, and immunosuppressive therapy should be designed and carried out.

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APPENDICES

APPENDIX A - QUESTIONNAIRE

PREVALENCE OF HOSPITAL-ACQUIRED INFECTIONS AMONG IN-PATIENTS AT UNIVERSITY OF BENIN TEACHING HOSPITAL (UBTH)

I am a 600 Level student of the University of Benin, Benin-City and this study aims at assessing the prevalence of hospital-acquired infections among in-patients at University of Benin Teaching Hospital (UBTH). All information given will be treated as confidential. Please mark and fill any areas as appropriate. Thank you.

Survey Date: _____ Ward/Unit:

_____

Hospital-acquired infections are infections that occur in patients while receiving care in hospitals, with the infections not being present or within incubation period at the time the patients are admitted.

SECTION A: Instructions for Data Collector

1. Use medical records, direct observation & dialogue with ward nurses to complete the form.
2. Complete one form per patient present on the ward.
3. Use consistent date format: DD-MM-YYYY.

SECTION B: Consent

4. ☐ Yes ☐ No If yes, date: _____Time:

   _____

SECTION C: Patient/Admission Details

5. Study ID No.: _____ Hospital ID No.: _____
6. Ward & Bed number: _____ Patient initials (optional): _____
7. Sex: ☐ Male ☐ Female Age: _____ years/months/days

8. Date of admission: _____ Time of admission: _____

9. Length of stay prior to survey (days/hours): _____

10. Admitting diagnosis: _____

11. Patient's weight: _____ Patient's height: _____

12. Comorbidities (tick all that apply): ☐ Diabetes mellitus ☐ Chronic kidney disease ☐ HIV/AIDS ☐ Malignancy ☐ COPD ☐ Heart disease ☐ Immunosuppressive therapy ☐ Obesity ☐ None ☐ Unknown ☐ Others, specify: _____

13. Recent surgery during current admission? ☐ Yes ☐ No

14. If yes: date of surgery: _____

15. Transfer from another healthcare facility for this admission? ☐ Yes ☐ No

16. If yes: type of facility: _____

17. Length of stay prior to transfer (days/hours): _____

SECTION D: Exposure & Device Use

18. Presence of indwelling urinary diversion device e.g. catheter (current): ☐ Yes ☐ No

19. If yes: Date inserted: _____ Indication: _____

20. Presence of peripheral IV line (current): ☐ Yes ☐ No

21. If yes: Date inserted: _____ Indication: _____

22. Presence of central venous catheter / central line (current): ☐ Yes ☐ No

23. If yes: Type: ☐ Tunneled ☐ Non-tunneled ☐ PICC ☐ Port ☐Other: _____

24. Date inserted: _____

25. Patient mechanically ventilated (current): ☐ Yes ☐ No

26. If yes: Date intubated: _____ Mode: _____

27. Presence of surgical wound/open drain/stoma (current): ☐ Yes ☐ No

28. If yes: site: _____ Date created: _____

29. Recent invasive procedure (within 7 days): ☐ Yes ☐ No

30. If yes, specify: _____

31. History of tobacco use: ☐ Yes ☐ No

32. History of gastric acid suppressing medications: ☐ Yes ☐ No

SECTION E: Antimicrobial Therapy and Labs

33. Currently on systemic antibiotics: ☐ Yes ☐ No

34. If yes: list antibiotics and start date(s): _____

35. Microbiology cultures taken during this admission? ☐ Yes ☐ No ☐ Unknown

36. If yes, specify specimen(s) and date(s):

37. Blood culture: ☐ Yes ☐ No Date _____

Result: ☐ Positive ☐ Negative ☐ Pending ☐ Unknown

38. Urine culture: ☐ Yes ☐ No Date _____

Result: ☐ Positive ☐ Negative ☐ Pending ☐ Unknown

39. Sputum/endotracheal aspirate: ☐ Yes ☐ No Date _____

Result: ☐ Positive ☐ Negative ☐ Pending ☐ Unknown

40. Wound swab: ☐ Yes ☐ No Date _____

Result: ☐ Positive ☐ Negative ☐ Pending ☐ Unknown

41. Organism isolated (if any) & antibiotic susceptibility (brief):

_____

_____

SECTION F: Current Infection Status

42. Does the patient meet criteria for a HAI at time of survey? ☐ Yes ☐ No ☐ Suspected

43. Onset of signs/symptoms relative to admission: ☐ Onset ≥48 h after admission (probable HAI) ☐ Onset <48 h (likely community-acquired or incubating) ☐ Uncertain

44. If Yes or Suspected to 41, record which HAI(s) (tick all that apply) and provide supporting details:

Code	HAI Type	Tick	Date of onset	Key findings
1	Surgical site infection (SSI)			e.g., wound purulence, redness, tenderness culture +
2	Catheter-associated urinary tract infection (CAUTI)			e.g., fever, dysuria, flank/suprapubic pain, culture + from catheter
3	Central line-associated bloodstream infection (CLABSI)			e.g., culture + from line, skin redness, tenderness, drainage from insertion site
4	Hospital-acquired pneumonia (non-ventilated)			e.g. fever, increased mucus production, ↑WBC (labs) + CXR
5	Others			e.g. fever, labs

45. Is the infection being managed as a HAI in chart/notes? ☐ Yes ☐ No ☐ Not documented

SECTION G: Data Collector Information

46. Initials: _____ Designation: _____

APPENDIX B – INTERVIEW SCRIPT

Good morning/afternoon, Sir/Ma.

I am Oyinduba Suowari, a 600L medical student carrying out a qualitative study on HAI and reporting systems. I would like to ask you some questions. Please can I go ahead?

Thank you for agreeing to participate in this interview. Could I record this conversation for ease of transcription?

Yes → Thank you. (Records)

No → Okay, I will just go ahead with the questions then.

Can you briefly describe your role and responsibilities in this hospital?

_____

_____

_____

_____

How long have you worked in UBTH and when did you assume this current role?

_____

_____

_____

_____

Can you tell me what you know about HAI?

_____

_____

How would you describe your experience with HAIs in your department?

If HAI cases are identified in your unit, how are they reported?

Are you aware of any HAI reporting systems in use? For example, is it electronic, online (e.g., SOMAS)? Are any in place currently?

To what extent can you or other staff make use of these systems? Challenges? Ease of use? Do these challenges affect your willingness or ability to report HAIs?

What training have you received regarding HAI reporting? Probe: Formal vs informal training, frequency of training

How confident are you in reporting HAIs? Probe: Challenges faced, Situations of uncertainty

How useful do you think HAI reporting systems are/will be in your practice?

In your opinion, do you feel that reporting HAIs reduces the prevalence of HAIs? (and in what way?)

_____

_____

_____

_____

Are HAI surveillance reports shared within your department? Could you briefly talk about how the data is used by management?

_____

_____

_____

_____

We have come to the end of the interview. Thank you very much for your time and valuable contributions. Your responses are greatly appreciated and will contribute meaningfully to this study.

APPENDIX C - INFORMED CONSENT FORM

TITLE OF RESEARCH: PREVALENCE OF HOSPITAL-ACQUIRED INFECTIONS AMONG IN-PATIENTS AT UNIVERSITY OF BENIN TEACHING HOSPITAL (UBTH)

NAME AND AFFILIATION OF INVESTIGATOR:

Oyinduba Gregory Suowari

Department of Public Health and Community Medicine,

University of Benin Teaching Hospital,

PMB 111 Ugbowo, Benin-Lagos Express Road,

Benin City, Edo State.

Email: oyinduba.suowari@med.uniben.edu

PURPOSE OF RESEARCH: To assess the prevalence, risk factors, and impact of hospital-acquired infections among patients at the University of Benin Teaching Hospital (UBTH).

PROCEDURES INVOLVED IN THE STUDY: In this study, questions will be asked regarding the prevalence, risk factors, and impact of hospital-acquired infections among patients at the University of Benin Teaching Hospital (UBTH).

CONFIDENTIALITY: All data collected will be treated with utmost confidentiality. Patients who volunteer to participate in this study will be given a unique study number, and data will be collected. Participants' information will be stored safely secured by codes in computers. All those handling data will not at any time reveal participants' identity.

FINANCIAL COMPENSATION: There shall be no monetary compensation for participation in this study.

VOLUNTARY PARTICIPATION: Your participation in this study is entirely voluntary. If you desire to withdraw from this study at any time, no punitive measures will be meted against you for your withdrawal. Your refusal to participate or withdraw from the study will not involve any negative consequences or loss of benefits to which you are otherwise entitled.

RISK: It is not expected that any harm will come to you because of your participation in this study. The study does not entail any activity that would harm you.

BENEFIT: The study will help assess the prevalence, risk factors, and impact of hospital-acquired infections among patients at the University of Benin Teaching Hospital (UBTH).

FINANCIAL SPONSORSHIP: This study will be sponsored by the principal investigator.

The under-listed may be contacted in case you have any clarifications to make:

Oyinduba Gregory Suowari

Department of Public Health and Community Medicine,

University of Benin Teaching Hospital,

PMB 111 Ugbowo, Benin-Lagos Express Road,

Benin City, Edo State.

Email: oyinduba.suowari@med.uniben.edu Cell: +234-811-883-4409

OR

Ethics and Research Committee,

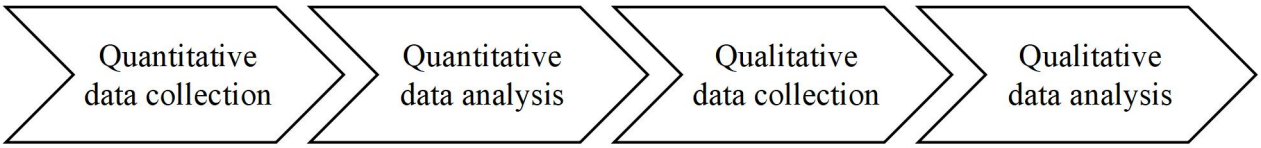
University of Benin Teaching Hospital,

Phone Number: +234-706-333-1337

APPENDIX D – WARD ALLOCATION TABLE

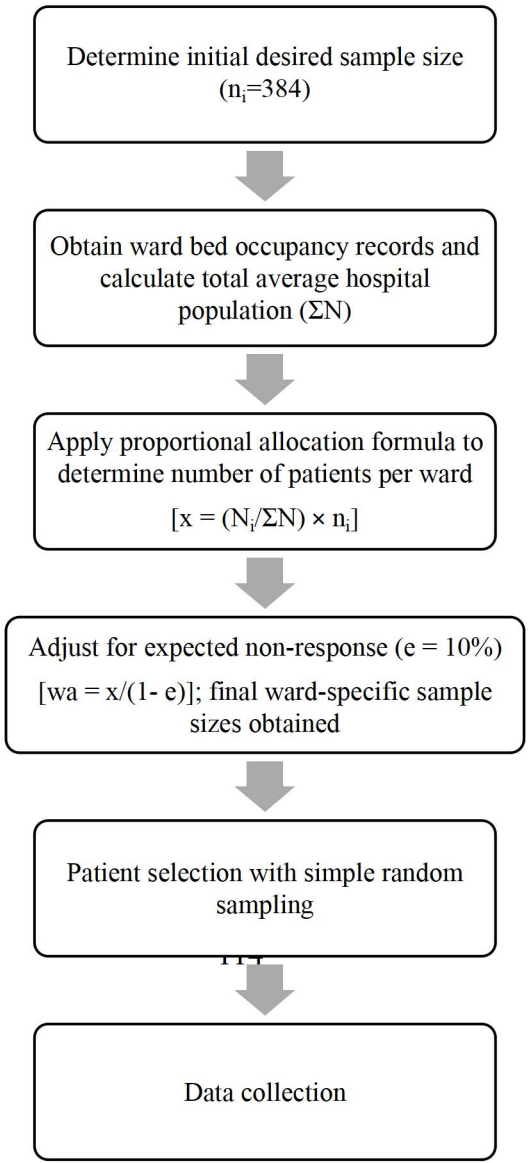
Ward	Ward bed number (N)	Proportion (N/ ΣN)	Ward allocation (x)	(wa)*
Surgical				
Female Surgical Ward (A4)	30	0.0577	22.1538	25
Male Surgical Ward 1 (B4)	30	0.0577	22.1538	25
Male Surgical Ward 2 (B2)	28	0.0538	20.6769	23
Paediatric Surgical Ward (B3)	25	0.0481	18.4615	21
Neurosurgery Ward (NSW1/2)	50	0.0962	36.9231	41
Female Orthopaedics Ward (FOW)**	34	0.0654	25.1077	28
Male Orthopaedics Ward (MOW)	27	0.0519	19.9385	22
Ophthalmology Ward (OPH)	11	0.0212	8.1231	9
Medical				
Female Medical Ward (A3)	30	0.0577	22.1538	25
Male Medical Ward (A1)	30	0.0577	22.1538	25
Geriatrics Ward (GW)	20	0.0385	14.7692	16
Stroke Ward (C1)	21	0.0404	15.5077	17
Paediatrics				
P Ward + P Extension (PW)	44	0.0846	32.4923	36
Oncology Ward (C2)	34	0.0654	25.1077	28
Obstetrics & Gynaecology				
Maternity Ward 1 (M1)	38	0.0731	28.0615	31
Maternity Ward 2 (M2)	38	0.0731	28.0615	31
Gynaecological Ward (A2)	30	0.0577	22.1538	25
Total	**520**		**384**	**429**

**To the nearest whole number* ***Paediatrics orthopaedics patients also included*



APPENDIX E – STUDY DESIGN FLOWCHART

PROPORTIONAL ALLOCATION PROCEDURE



APPENDIX F – UNIT PERMISSION LETTER

Clinical Student Hostel,

University of Benin.

_____.

Head of _____ Unit/Department,

Department of _____,

University of Benin Teaching Hospital.

Dear Sir/Madam,

REQUEST FOR PERMISSION TO COLLECT PATIENT DATA FOR RESEARCH PURPOSES

My name is Oyinduba Suowari, a final year medical student in the Department of Medicine & Surgery, under the supervision of Prof. Okojie and Dr. Mokogwu. I am currently undertaking a research project titled: **PREVALENCE OF HOSPITAL-ACQUIRED INFECTIONS AMONG IN-PATIENTS AT THE UNIVERSITY OF BENIN TEACHING HOSPITAL.**

The aim of this study is to determine the prevalence of hospital-acquired infections. The study will involve reviewing patient records and collecting relevant clinical data from patients admitted under the _____ Unit at University of Benin Teaching Hospital.

I hereby respectfully request your permission to collect relevant patient data from your ward for the purpose of this study. The data to be collected will include demographic details, diagnosis, operative findings, laboratory results, outcomes, etc., strictly limited to variables relevant to the study objectives. I wish to assure you and the entire unit that:

1. All patient information will be treated with strict confidentiality and no patient identifiers (names, hospital numbers, phone numbers, etc.) will be disclosed.
2. Ethical approval has been obtained from the Health Research Ethics Committee of University of Benin Teaching Hospital.
3. Data will be used solely for academic and research purposes.
4. The study will not interfere with patient care or ward activities.

I would also like to respectfully acknowledge the consultants in the unit — _____ — whose clinical work form the basis of this valuable data. Their support and guidance will be highly appreciated.

Kindly grant me approval to access the necessary records at your convenience. I am available to provide further clarification if required.

Thank you very much for your time and consideration.

Yours faithfully,

Oyinduba Suowari

MED1807497

0811 883 4409

oyinduba.suowari@med.uniben.edu

HEALTH RESEARCH ETHICS COMMITTEE (HREC)

UNIVERSITY OF BENIN TEACHING HOSPITAL

P.M.B. 1111 BENIN CITY NIGERIA Telephone: 052-600418 Website: ubth.org

CHIEF MEDICAL DIRECTOR Prof. (Mrs) I.N Ize-Iyamu

DIRECTOR OF ADMINISTRATION Jim Uwadie, Esq

CHAIRMAN Prof. (Mrs.) Antoinette N. Ofili

HREC OFFICE:
Committee email: ubthresearchethics@gmail.com
Registration Number:
NHREC-UBTH-HREC/24/12/2022B

PROTOCOL NUMBER: ADM/E 22/A/VOL. VII/1486549127264
PROPOSAL TITLE: "PREVALENCE OF HOSPITAL-ACQUIRED INFECTIONS AMONG IN-PATIENTS AT THE UNIVERSITY OF BENIN TEACHING HOSPITAL"

PRINCIPAL INVESTIGATOR(S): OYINDUBA GREGORY SUOWARI

DEPARTMENT/INSTITUTION: DEPARTMENT OF PUBLIC HEALTH AND COMMUNITY MEDICINE, SCHOOL OF MEDICINE, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA

DATE CONSIDERED: JANUARY 27TH, 2026

DECISION OF THE COMMITTEE: APPROVED

THIS APPROVAL DATES 27/01/2026 TO 26/01/2027. IF THERE IS DELAY IN STARTING THE RESEARCH, PLEASE INFORM THE HREC SO THAT THE DATES OF APPROVAL CAN BE ADJUSTED ACCORDINGLY
REMARK:

CHAIRMAN: PROF. (MRS) A.N. OFILI SIGNATURE & DATE AN.L 27/1/2026

Sign.....
Date.....

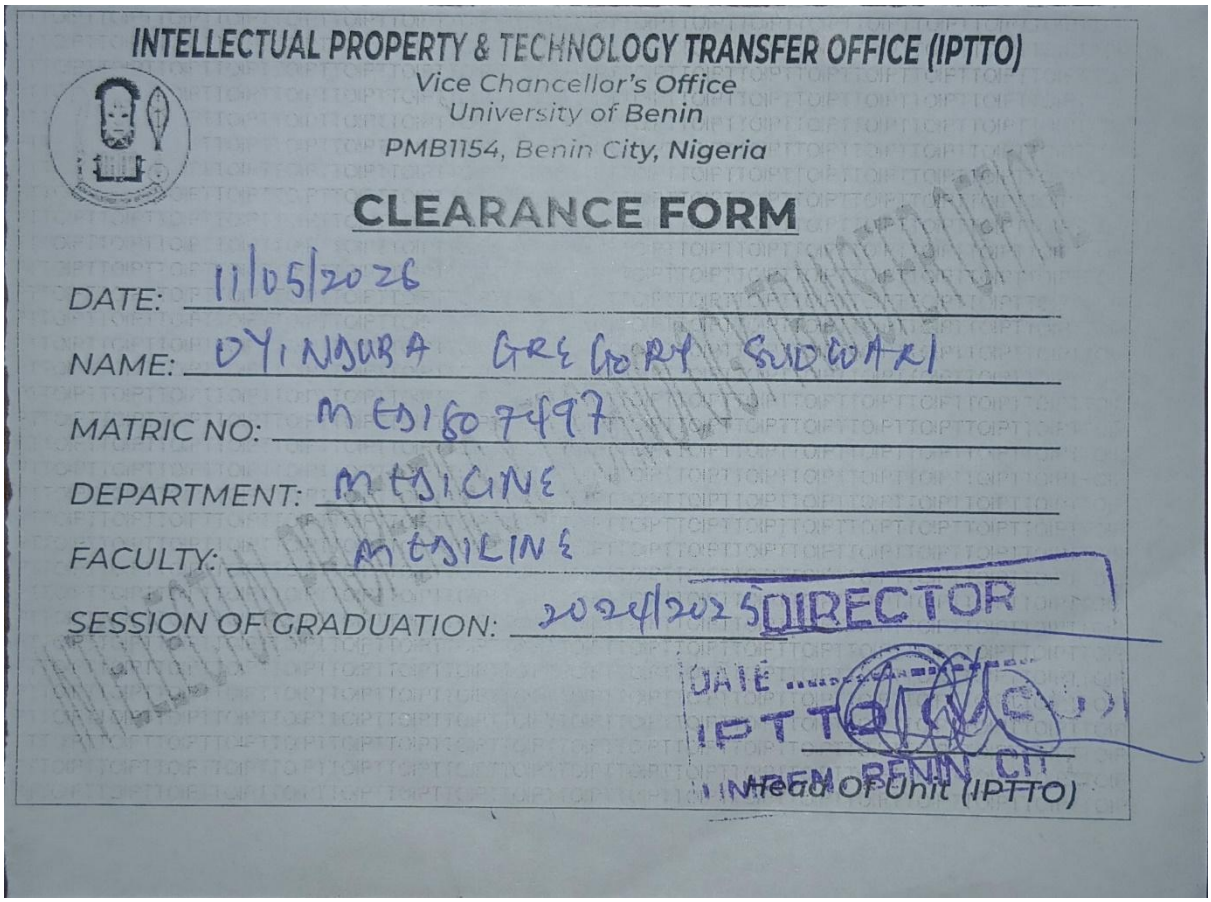
SUPERVISOR (S): PROF OBEHI OKOJIE, DR MOKOGWU NDUBUISI

DECLARATION BY INVESTIGATOR(S):
PROTOCOL NUMBER (please quote in all enquiries)
Note that no participant accrual or activity related to this research may be conducted outside of these dates and **you are to furnish the committee with the research activities at the completion of the study.** All informed consent forms used in this study must carry the HREC assigned number and duration of HREC approval of the study. In multiyear research, endeavor to submit your annual report to the HREC early in order to obtain renewal of your approval and avoid disruption of your research. No changes are permitted in the research without prior approval by the HREC except in circumstances outlined in the Code. The HREC reserves the right to conduct compliance visit your research site without previous notification.

Signature & Date..... 30/01/2026

APPENDIX G – ETHICAL CLEARANCE APPROVAL LETTER

APPENDIX H – PLAGIARISM CHECK RECEIPT



INTELLECTUAL PROPERTY & TECHNOLOGY TRANSFER OFFICE (IPTTO)

Vice Chancellor's Office
University of Benin
PMB1154, Benin City, Nigeria

CLEARANCE FORM

DATE: 11/05/2026

NAME: OYINJUBA GREGORY SUDOWARI

MATRIC NO: MED/16/7497

DEPARTMENT: MEDICINE

FACULTY: MEDICINE

SESSION OF GRADUATION: 2024/2025

DIRECTOR

DATE .....

IPTTO

UNIBEN BENIN CITY

Head Of Unit (IPTTO)